World malaria report 2022

World Health Organization

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Foreword

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Director-General
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Each year, the *World Malaria Report* spotlights progress and gaps in efforts to combat malaria across the globe. This year's report is organized around four themes: response, risks, resilience and research.

Malaria-affected countries continue to respond to a host of challenges, including disruptions arising from the COVID-19 pandemic. Although hard hit, most countries held the line and were able to maintain services to prevent, detect and treat malaria - a remarkable feat in the midst of a pandemic.

Nonetheless, more than 600 000 people still die of malaria every year – most of them children. Even with the heroic efforts to maintain services during the pandemic, malaria control efforts face many hurdles in addition to the already significant COVID-related disruptions and other health system challenges, including long-running humanitarian crises, limited donor funding, and the potential effect of climate change on the spread of the disease.

These challenges have been further compounded by declines in the effectiveness of our primary malaria-fighting tools. Rising resistance to insecticide-treated nets and to antimalarial drug regimens remain a major concern – particularly in Africa. In some areas, malaria parasites are escaping detection from the most widely used diagnostic tests. And the invasion of a mosquito that adapts easily to urban environments, *Anopheles stephensi*, poses a real risk.

To support the resilience of malaria programmes, WHO has published new guidance, including a new strategy to contain antimalarial drug resistance in Africa; a new framework, developed jointly by WHO and UN-Habitat, to guide city leaders in urban malaria control; and recommendations to stop the spread of *Anopheles stephensi* in urban environments. Countries are encouraged to adapt WHO guidance to local needs.

Malaria control is intimately tied to the overall health system. Investments in well-functioning, equitable and resilient health systems built on a foundation of primary health care are critical to a successful malaria response.

Research and development plays a critical role as well. As described in these pages, new types of vector control technologies are being developed, including a new generation of nets to combat mosquito resistance. New diagnostics and innovations in malaria medicines are also in the pipeline.

Another breakthrough is the RTS,S malaria vaccine, the first and only vaccine recommended to prevent malaria in children. More than 1.2 million children are protected by the vaccine in Ghana, Kenya and Malawi, and the vaccine will soon be expanded to several other countries. Other promising malaria tools are in development.

However, there continues to be a significant funding gap for basic research and product development. There is an urgent need to ramp up investment in new malaria tools, to address emerging threats such as urban malaria and the spread of antimalarial drug resistance.

We face many challenges, but there are many reasons for hope. By strengthening the response, understanding and mitigating the risks, building resilience and accelerating research, there is every reason to dream of a malaria-free future.

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Abbreviations and acronyms

ACT	artemisinin-based combination therapy
AIDS	acquired immunodeficiency syndrome
AIM	*Action and investment to defeat malaria 2016–2030*
AL	artemether-lumefantrine
AMP	Alliance for Malaria Prevention
ANC	antenatal care
ANC1	first ANC visit
app	application
AQ	amodiaquine
AS	artesunate
ATSB®	Attractive Targeted Sugar Bait
CDC	Centers for Disease Control and Prevention
CI	confidence interval
CoD	cause of death
COVID-19	coronavirus disease
CQ	chloroquine
CRS	creditor reporting system
DAC	Development Assistance Committee
DHA	dihydroartemisinin
dhfr	dihydrofolate reductase (gene)
dhps	dihydropteroate synthase (gene)
DHS	demographic and health surveys
DHIS2	District Health Information System 2
E-2020	malaria eliminating countries for 2020
E-2025	malaria eliminating countries for 2025
EHS	essential health services
EPI	Expanded Programme of Immunization
ERPd	Evidence Review Panel for diagnostics
FCDO	Foreign, Commonwealth and Development Office (United Kingdom)
FIF	financial intermediary fund
FIND	Foundation for Innovative New Diagnostics
G6PD	glucose-6-phosphate dehydrogenase
Gavi	Gavi, the Vaccine Alliance
GDP	gross domestic product
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
GMP	Global Malaria Programme
GMS	Greater Mekong subregion
GOHRD	Global Observatory on Health Research and Development
GTS	*Global technical strategy for malaria 2016–2030*
HBHI	high burden to high impact
HIV	human immunodeficiency virus
HMIS	Health Management Information System
HRP2	histidine-rich protein 2
HRP3	histidine-rich protein 3
iDES	integrated drug efficacy surveillance
IDSR	Integrated Disease Surveillance and Response
IMF	International Monetary Fund
IPTi	intermittent preventive treatment in infants
IPTp	intermittent preventive treatment of malaria in pregnancy
IPTp1	first dose of IPTp
IPTp2	second dose of IPTp
IPTp3	third dose of IPTp
IPTp4	fourth dose of IPTp
IPTsc	intermittent preventive treatment of malaria in school-aged children
IRM	insecticide resistance management
IRMMP	insecticide resistance monitoring and management plan
IRS	indoor residual spraying
IRST	indoor residual surface treatments

ITN	insecticide-treated mosquito net
IVB	Department of Immunization, Vaccines and Biologicals
IVCC	Innovative Vector Control Consortium
IVM	integrated vector management
LBW	low birthweight
LDH	lactate dehydrogenase
LLIN	long-lasting insecticidal net
LMIC	low- and middle-income countries
LMIS	Logistics Management Information System
LSHTM	London School of Hygiene & Tropical Medicine
mAbs	monoclonal antibodies
MAP	Malaria Atlas Project
MCEE	WHO Maternal and Child Health Epidemiology Estimation Group
MDA	mass drug administration
MECP	Malaria Control and Elimination Program
MEDB	Malaria Elimination Database
MEOC	Malaria Elimination Oversight Committee
MIS	malaria indicator surveys
MMV	Medicines for Malaria Venture
MPAG	Malaria Policy Advisory Group
MQ	mefloquine
MRP	mass relapse prevention
NCE	new chemical entity
NIH	National Institutes of Health
NMP	national malaria programme
OECD	Organisation for Economic Co-operation and Development
PBO	piperonyl butoxide
PCR	polymerase chain reaction
PDMC	post-discharge malaria chemoprevention
Pfhrp	*Plasmodium falciparum* histidine-rich protein (gene)
PfKelch13	*Plasmodium falciparum* Kelch13 (gene)
PMC	perennial malaria chemoprevention
PMI	President's Malaria Initiative
PPC	preferred product characteristic
PPQ	piperaquine
PPR	prevention, preparedness and response
PY	pyronaridine
R&D	research and development
RCT	randomized controlled trial
RD	resistance to damage
RDT	rapid diagnostic test
RTS,S	RTS,S/AS01
SDG	Sustainable Development Goal
SMC	seasonal malaria chemoprevention
SP	sulfadoxine-pyrimethamine
TB	tuberculosis
TES	therapeutic efficacy studies
TPP	target product profiles
UN	United Nations
UN-Habitat	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
United Kingdom	United Kingdom of Great Britain and Northern Ireland
US	United States
USA	United States of America
USAID	United States Agency for International Development
VCP	vector control product
WHO	World Health Organization
WHO-CHOICE	WHO-CHOosing Interventions that are Cost-Effective
WHOPES	WHO Pesticide Evaluation Scheme

This year's report at a glance

KEY EVENTS IN 2021–2022

The Seventh Replenishment of the Global Fund to Fight AIDS, Tuberculosis and Malaria

- In 2021, more than 40% of global malaria investment was channelled through the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund).
- In September 2022, via the Global Fund replenishment, a total of US$ 15.9 billion was raised through countries and partners, the largest replenishment in the history of the Global Fund.
- The replenishment fell short of the US$ 18 billion target at a time when the cost of health commodities is rising due to the coronavirus (COVID-19) pandemic, conflict and the global recession.
- The shortfall means that the current replenishment will be under considerable strain to maintain and expand levels of malaria intervention coverage.
- To optimize the impact of the limited resources, there will be an even greater need to maximize the efficient, effective and equitable use of malaria resources and other health system resources.
- Countries need to be able to identify the optimal mix of interventions suited to their local context and the best means of delivering them to all people in need, guided by local data.

New World Health Organization recommendations

- In June 2022, the World Health Organization (WHO) published guidance on new and updated recommendations. The guidelines encourage countries to tailor the recommendations to local disease settings for maximum impact.
- Updated guidelines provide recommendations on intermittent preventive treatment of malaria in pregnancy (IPTp), perennial malaria chemoprevention (PMC) and seasonal malaria chemoprevention (SMC), intermittent preventive treatment of malaria in school-aged children (IPTsc), post-discharge malaria chemoprevention (PDMC), mass drug administration (MDA) and elimination.
- The use of IPTp with sulfadoxine-pyrimethamine (SP) in areas of moderate to high *Plasmodium falciparum* malaria transmission continues to be strongly recommended.
- IPTp-SP is now recommended for all pregnant women, regardless of the number of pregnancies.
- An updated SMC and PMC recommendation supports the broader use of chemoprevention among young children at high risk of severe malaria in areas with both seasonal and year-round transmission.
- WHO has also issued a new recommendation on the use of IPTsc in settings with moderate to high perennial or seasonal malaria transmission. IPTsc should cover children aged 5–15 years, and its introduction should not compromise chemoprevention interventions for children aged under 5 years, who are at highest risk of severe malaria.

- PDMC is now recommended to prevent malaria among children with severe anaemia living in areas of moderate to high transmission after they are discharged from a hospital, when they are at high risk of re-admission or death.
- The new recommendations on malaria MDA provide guidance on rapidly reducing the malaria disease burden in emergency settings and in areas of moderate to high transmission. They also provide guidance on the use of MDA to reduce *P. falciparum* malaria in settings with very low to low transmission, and to reduce *P. vivax* transmission.
- Elimination recommendations include "mass" strategies applied to the entire population of a delimited geographical area, whether it be a village, township or district; "targeted" strategies applied to people at greater risk of infection than the general population; and "reactive" strategies triggered in response to individual cases.

New regional initiatives launched by WHO in collaboration with partners

Strategy to respond to antimalarial drug resistance in Africa

- The emergence of artemisinin partial resistance in the WHO African Region with the apparent rapid spread of mutations associated with artemisinin partial resistance is of great concern. This emergence has not spread from the Greater Mekong subregion (GMS) but has appeared *de novo* on the continent.
- Artemisinin-based combination therapies (ACTs) remain efficacious; resistance to the ACT partner drugs currently in use has not been confirmed, but there are some worrying signals that need to be investigated and action must be taken before ACTs start to fail.
- Given the heavy reliance on ACTs in Africa, the threat of artemisinin partial resistance and partner drug resistance must be monitored and addressed urgently.
- In November 2022, WHO launched the *Strategy to respond to antimalarial drug resistance in Africa*, which aims to provide guidance to key stakeholders in the malaria community.
- The strategy addresses the threat of antimalarial drug resistance in the WHO African Region through four pillars:
  - **Pillar I** – Strengthen surveillance of antimalarial drug efficacy and resistance.
  - **Pillar II** – Optimize and better regulate the use of diagnostics and therapeutics to limit drug pressure through pre-emptive measures.
  - **Pillar III** – React to resistance by limiting the spread of antimalarial drug-resistant parasites.
  - **Pillar IV** – Stimulate research and innovation to better leverage existing tools and develop new tools against resistance.
- Each pillar comprises a set of interventions that can be implemented at local, regional and global levels. Implementing countries need to tailor the interventions in the strategy to their local context.

Initiative to stop the spread of *Anopheles stephensi*

- *Anopheles stephensi*, native to south Asia and parts of the Arabian Peninsula, has been expanding its range over the past decade, with detections reported in Djibouti (2012), Ethiopia and the Sudan (2016), Somalia (2019) and Nigeria (2020).
- Where *An. stephensi* has been reported in the WHO African Region, it has been found to be resistant to many of the insecticides used in public health, posing an added challenge to its control.
- The invasion of *An. stephensi* in sub-Saharan Africa – where the burden of malaria is highest and over 40% of the population lives in urban environments – has raised concern, because it is thought to have driven the resurgence of malaria in Djibouti city and to be the source of at least one outbreak in Ethiopia.
- In September 2022, a new initiative was launched aimed at stopping the further spread of *An. stephensi* on the African continent and to determine whether it can be eliminated from areas that have already been invaded.

- The initiative calls for the national response to *An. stephensi* to be part of a comprehensive response to malaria vectors by enhancing collaboration, increasing surveillance, improving information exchange, developing guidance and prioritizing research.

The *Global framework for the response to malaria in urban areas*

- By 2050, almost seven in 10 people globally will live in cities and other urban settings. In malaria endemic countries, more people are likely to be in urban areas than in rural areas.
- In the 10 highest burden countries in the WHO African Region, over 40% of the population are already considered to live in urban areas.
- Urban areas and rural areas can differ in the dynamics of the transmission and the burden of malaria and other vector-borne diseases.
- Overall, urbanization will reduce malaria transmission. However, unplanned urbanization will lead to focal transmission, resulting in a disease burden that is disproportionately high among the urban poor.
- Invasion by vectors that are adapted to breeding in urban environments, such as the recent spread of *An. stephensi* in the WHO African Region, may be putting urban populations at increased risk.
- Approaches that work to reduce disease burden in rural areas may not work in urban settings, or may need to occur at a smaller, more targeted scale.
- The malaria response in urban areas requires data on the determinants that are unique to urban ecosystems, and that explain whether malaria transmission and disease burden are focal.
- Leadership from government departments, industry and finance, research, academia and other sectors tends to be concentrated in urban areas, providing a greater opportunity for integrated, multisectoral policies, strategies and actions.
- As urbanization rapidly increases, there is a greater focus on healthier cities, including the global political will to address the threats posed by climate change.
- In October 2022, WHO and the United Nations Human Settlements Programme (UN-Habitat) jointly launched the *Global framework for the response to malaria in urban areas*, which is targeted at policy-makers and relevant stakeholders.
- The framework is a response to malaria in towns and cities; it highlights the central role of city leadership and the need to ensure that the malaria response is part of the broader urban development and health agenda. It also emphasizes the need to implement a data-driven targeted response in the design of malaria interventions. If implemented, the framework is expected to help in improving health and well-being.

Rollout of the RTS,S/AS01 malaria vaccine in areas of moderate to high malaria transmission

- In October 2021, WHO recommended the RTS,S/AS01 malaria vaccine for the prevention of *P. falciparum* malaria in children living in regions with moderate to high transmission (as defined by WHO); in July 2022, WHO issued prequalification approval for the RTS,S vaccine.
- In December 2021, the board of Gavi, the Vaccine Alliance (Gavi) approved an initial investment of almost US$ 160 million (in 2022–2025) to support the broader rollout of the malaria vaccine in Gavi-eligible countries.
- Gavi has estimated that steady-state demand for the vaccine will exceed 80–100 million doses per year. In anticipation of a gap between supply and demand, WHO coordinated the development of a framework for allocating a limited malaria vaccine supply, to guide the fair and transparent allocation of limited doses, based on ethical principles and the best available evidence.
- In August 2022, the United Nations Children's Fund (UNICEF) announced that it had secured supply of the GSK-produced vaccine, for an available malaria vaccine supply of 18 million doses over the next 3 years (2023–2025).

- Since June 2022, WHO and Gavi have supported over 20 countries through multicountry workshops focusing on the development of applications to Gavi. A key part of this initiative has been the WHO-supported subnational tailoring of the malaria vaccine rollout, based on guidance from the framework for the allocation of the limited malaria vaccine supply.

Humanitarian and health emergencies

- Malaria endemic countries have been dealing with health and humanitarian emergencies unrelated to the COVID-19 pandemic. In 2021, an estimated 268 million people were dealing with humanitarian emergencies compared with 301 million in 2020.
- Conflicts, famine and flooding were the major contributors to these humanitarian emergencies, which were sometimes compounded by disease outbreaks.
- Countries with the highest need in 2021 in terms of affected people were Afghanistan, Colombia, the Democratic Republic of the Congo, Ethiopia, Mali, Myanmar, Nigeria, Somalia, South Sudan, the Sudan, Uganda and Yemen.

Malaria service disruptions during the COVID-19 pandemic

- Forty-six countries had insecticide-treated mosquito net (ITN) campaigns planned in 2020, to distribute about 272 million nets. By the end of 2020, 74% of all ITNs planned for distribution in 2020 had been distributed.
- In 2021, there were 43 countries that had ITN campaigns planned, including 14 countries that planned to distribute only ITNs carried over from 2020.
- A total of 171 million ITNs were planned for distribution in 2021; 70 million of these ITNs were carried over from 2020. In total, 128 million (75%) ITNs were distributed in 2021.
- Eight countries – Benin, Eritrea, Indonesia, Nigeria, Solomon Islands, Thailand, Uganda and Vanuatu – had distributed less than 60% of their ITNs. Seven countries – Botswana, the Central African Republic, Chad, Haiti, India, Pakistan and Sierra Leone – did not distribute any of the planned ITNs. India, Nigeria and Uganda – countries supported under the high burden high impact (HBHI) approach – had distributed 0%, 53% and 26%, respectively, of their ITNs planned for distribution in 2021.
- Results from Round 3 of the essential health services (EHS) pulse survey implemented in November to December 2021 suggest that, in the WHO African Region, disruptions in diagnosis and treatment had eased considerably in the latter part of 2021, with seven countries reporting disruptions, compared with 16 in 2020 and nine in the first quarter of 2021.

TRENDS IN THE BURDEN OF MALARIA

Malaria cases

- Globally, there were an estimated 247 million malaria cases in 2021 in 84 malaria endemic countries (including the territory of French Guiana), an increase from 245 million in 2020, with most of this increase coming from countries in the WHO African Region. In 2015, the baseline year of the *Global technical strategy for malaria 2016–2030* (GTS), there were an estimated 230 million malaria cases.
- Malaria case incidence (i.e. cases per 1000 population at risk) reduced from 82 in 2000 to 57 in 2019, before increasing to 59 in 2020. There was no change in case incidence between 2020 and 2021. The increase in 2020 was associated with disruption to services during the COVID-19 pandemic.

- Between 2019 and 2021, an estimated additional 13.4 million cases were attributed to disruptions during the COVID-19 pandemic.
- The proportion of cases due to *P. vivax* reduced from about 8% (20.5 million) in 2000 to 2% (4.9 million) in 2021.
- Twenty-nine countries accounted for 96% of malaria cases globally, and four countries – Nigeria (27%), the Democratic Republic of the Congo (12%), Uganda (5%) and Mozambique (4%) – accounted for almost half of all cases globally.
- The WHO African Region, with an estimated 234 million cases in 2021, accounted for about 95% of global cases.
- Between 2000 and 2019, case incidence in the WHO African Region reduced from 373 to 225 per 1000 population at risk, but increased to 234 in 2020, mainly because of disruptions to services during the COVID-19 pandemic. In 2021, case incidence declined to 229 per 1000 population.
- Cabo Verde reported zero indigenous cases for 3 consecutive years, ending the malaria epidemic.
- The WHO South-East Asia Region accounted for about 2% of the burden of malaria cases globally. Malaria cases reduced by 76%, from 23 million in 2000 to about 5 million in 2021. Malaria case incidence in this region reduced by 82%, from about 18 cases per 1000 population at risk in 2000 to about three cases per 1000 population at risk in 2021.
- India accounted for 79% of cases in the region. Sri Lanka was certified malaria free in 2016 and remains malaria free.
- Between 2020 and 2021, there was an increase of 400 000 cases in the region, with over half of these cases being in Myanmar.
- Malaria cases in the WHO Eastern Mediterranean Region reduced by 38%, from about 7 million cases in 2000 to about 4 million in 2015. Between 2016 and 2021, cases rose by 44% to 6.2 million.
- Over the period 2000–2020, malaria case incidence in the WHO Eastern Mediterranean Region declined from 20 to 12 cases per 1000 population at risk. The Sudan is the leading contributor to malaria in this region, accounting for about 54% of cases. In 2021, the Islamic Republic of Iran had no indigenous malaria cases for 4 consecutive years and Saudi Arabia reported zero indigenous cases for the first time.
- The WHO Western Pacific Region had an estimated 1.4 million cases in 2021, a decrease of 49% from the 3 million cases in 2000. Over the same period, malaria case incidence reduced from four to two cases per 1000 population at risk. Papua New Guinea accounted for nearly 87% of all cases in this region in 2021. China was certified malaria free in 2021 and Malaysia had no cases of non-zoonotic malaria for 4 consecutive years.
- In the WHO Region of the Americas, malaria cases reduced by 60% (from 1.5 million to 0.6 million) and case incidence by 70% (from 14 to 4) between 2000 and 2021. The region's progress in recent years has suffered from the major increase in malaria in the Bolivarian Republic of Venezuela, which had about 35 500 cases in 2000 and more than 482 000 cases by 2017. In 2020, cases reduced by more than half compared with 2019, to 223 000, and further in 2021 to 205 000 cases. This decrease was due to restrictions on movement during the COVID-19 pandemic and a shortage of fuel that affected the mining industry, which was the main contributor to the recent increase in malaria in the country. These restrictions may also have affected access to care, leading to a reduction in the number of cases reported from health facilities.
- Estimated cases more than doubled in Honduras and Panama in 2021 compared with 2019. Over the same period substantial reductions in cases were seen in the Bolivarian Republic of Venezuela (–263 000), Brazil (–17 000), Colombia (–17 000) and Peru (–22 000).
- The Bolivarian Republic of Venezuela, Brazil and Colombia accounted for more than 79% of all cases in this region.
- Argentina, El Salvador and Paraguay were certified malaria free in 2019, 2021 and 2018, respectively. Belize reported zero indigenous malaria cases for the third consecutive year, ending the malaria epidemic.
- Since 2015, the WHO European Region has been free of malaria.

Malaria deaths

- Globally, malaria deaths reduced steadily over the period 2000–2019, from 897 000 in 2000 to 577 000 in 2015 and to 568 000 in 2019. In 2020, malaria deaths increased by 10% compared with 2019, to an estimated 625 000. Estimated deaths declined slightly in 2021 to 619 000. Between 2019 and 2021, there were 63 000 deaths that were due to disruptions to essential malaria services during the COVID-19 pandemic.
- The percentage of total malaria deaths in children aged under 5 years reduced from 87% in 2000 to 76% in 2015. Since then there has been no change.
- Globally, the malaria mortality rate (i.e. deaths per 100 000 population at risk) halved from about 30 in 2000 to 15 in 2015; it then continued to decrease but at a slower rate, falling to 14 in 2019. In 2020, the mortality rate increased again, to 15.1, before decreasing slightly to 14.8 in 2021.
- About 96% of malaria deaths globally were in 29 countries. Four countries accounted for just over half of all malaria deaths globally in 2021: Nigeria (31%), the Democratic Republic of the Congo (13%), the Niger (4%) and the United Republic of Tanzania (4%).
- Malaria deaths in the WHO African Region decreased from 841 000 in 2000 to 541 000 in 2018, before increasing to 599 000 in 2020. Estimated deaths decreased again to 593 000 in 2021. The malaria mortality rate reduced by 62% between 2000 and 2019, from 148 to 56 per 100 000 population at risk, before rising to 60 in 2020 and decreasing again to 58 in 2021.
- Cabo Verde has reported zero malaria deaths since 2018.
- In the WHO South-East Asia Region, malaria deaths reduced by 74%, from about 35 000 in 2000 to 9000 in 2019. The number of deaths has remained the same over the past 3 years.
- India accounted for about 83% of all malaria deaths in the WHO South-East Asia Region.
- In the WHO Eastern Mediterranean Region, malaria deaths reduced by 45%, from about 13 600 in 2000 to 7500 in 2014, and then increased by 79% between 2014 and 2021, to 13 400 deaths. Most of the increase was observed in the Sudan, where more than 90% of cases are due to *P. falciparum*, which is associated with a higher case fatality rate than *P. vivax* cases.
- In the WHO Eastern Mediterranean Region, the malaria mortality rate reduced by 60% between 2000 and 2009; however, since 2016, mortality rates have remained largely unchanged with a slight increase of 28% from 2.0 to 2.5 deaths per 100 000 population at risk.
- In the WHO Western Pacific Region, malaria deaths reduced by 58%, from about 6200 cases in 2000 to 2600 in 2021; the mortality rate reduced by 67% over the same period, from 0.9 to 0.3 malaria deaths per 100 000 population at risk. Papua New Guinea accounted for more than 94% of malaria deaths in 2021.
- In the WHO Region of the Americas, malaria deaths reduced by 64% (from 919 to 334) and the mortality rate by 73% (from 0.8 to 0.2). Most of the deaths in this region were in adults (78%).

Malaria cases and deaths averted

- Globally, an estimated 2 billion malaria cases and 11.7 million malaria deaths were averted in the period 2000–2021.
- Most of the cases (82%) and deaths (95%) averted were in the WHO African Region, followed by the WHO South-East Asia Region (cases 10% and deaths 3%).

Burden of malaria in pregnancy

- In 2021, in 38 moderate and high transmission countries in the WHO African Region, there were an estimated 40 million pregnancies, of which 13.3 million (32%) were exposed to malaria infection during pregnancy.
- By WHO subregion, west Africa had the highest prevalence of exposure to malaria during pregnancy (40.7%), closely followed by central Africa (39.8%), while prevalence was 20% in east and southern Africa.

- It is estimated that, without a pregnancy-specific intervention, malaria infection during pregnancy in these 38 countries would have resulted in 961 000 children with low birthweight. In the 33 countries in which IPTp was implemented, an estimated 457 000 of these low birthweights were averted.
- If all of the pregnant women visiting antenatal care (ANC) clinics at least once received a single dose of IPTp – assuming they were all eligible and that second and third doses of IPTp (IPTp2 and IPTp3) remained at current levels – an additional 55 000 low birthweights would have been averted in 33 countries with information on IPTp.
- If IPTp3 coverage was raised to the same levels as that of ANC first visit coverage, and if subsequent ANC visits were just as high, then an additional 162 000 low birthweights would be averted.
- If IPTp3 coverage was optimized to 90% of all pregnant women, an additional 265 000 low birthweights would be averted.
- Given that low birthweight is a strong risk factor for neonatal and childhood mortality, averting a substantial number of low birthweights will save many lives.

MALARIA ELIMINATION AND PREVENTION OF RE-ESTABLISHMENT

- Progress towards malaria elimination is increasing; in 2021, there were 84 malaria endemic countries compared with 108 in 2000.
- The number of countries that were malaria endemic in 2000 and that reported fewer than 100 malaria cases increased from 6 in 2000 to 27 in 2021, remaining unchanged in 2021 when compared with 2020.
- Between 2000 and 2021, the number of countries with fewer than 10 indigenous cases increased from four to 25.
- In the period 2010–2021, total malaria cases in the E-2025 countries (malaria eliminating countries for 2025) reduced by 82.8%; however, when compared with 2020, these countries and territories experienced a 30.4% increase in 2021.
- In the WHO South-East Asia Region, there has been a notable rise in the number of humans infected with *P. knowlesi* in some countries, especially in Malaysia. No indigenous human malaria cases or deaths have been reported in Malaysia for the past 4 years; however, since 2017, a total of 17 125 *P. knowlesi* cases and 48 deaths have been reported in this country.
- In 2021 alone, 3575 *P. knowlesi* cases were reported that resulted in 13 deaths. Over the same period, an additional 435 *P. knowlesi* cases were reported in the WHO South-East Asia Region, in Indonesia, the Philippines and Thailand.
- Belize and Cabo Verde reported zero malaria cases for the third consecutive year, with Iran (Islamic Republic of) and Malaysia reporting zero indigenous cases for the fourth consecutive year. In 2021, Timor-Leste, following an outbreak in the previous year, reported zero indigenous malaria cases, and Saudi Arabia reported zero indigenous cases for the first time.
- Five countries – Azerbaijan, Belize, Cabo Verde, Iran (Islamic Republic of) and Tajikistan – have submitted an official request for malaria free certification.
- Despite disruptions during the COVID-19 pandemic, 61.5% of E-2025 countries reporting cases continued making progress towards elimination and reduction of the malaria burden. Countries that continued to show reduction in cases in 2021 when compared with 2020 were Bhutan (59.1%), Botswana (20.5%), the Dominican Republic (65.6%), Mexico (32.0%), Nepal (56.2%), the Republic of Korea (23%), Saudi Arabia (100%), South Africa (33.7%), Suriname (85.9%), Thailand (22.3%), Timor-Leste (100%) and Vanuatu (36.7%).

- When compared with 2020, the following countries (and one territory) saw an increase in cases in 2021: the Comoros (56.9%), Costa Rica (52.4%), the Democratic People's Republic of Korea (22.8%), Ecuador (11.1%), Eswatini (53.9%), French Guiana (2.1%), Guatemala (16.9%), Honduras (47.4%), Panama (55.3%) and Sao Tome and Principe (28.9%). Ecuador, for the second consecutive year, reported increases in the number of indigenous cases.
- Despite the setbacks, many countries continue to make immense progress – between 2011 and 2021, the classification rates within the E-2025 countries increased from 7.6% to 90.8%, demonstrating continued efforts by countries in pursuit of their elimination goals.
- Between 2000 and 2021, the six countries of the GMS – Cambodia, China (Yunnan Province), the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam – together reported a 76.5% decrease in indigenous malaria cases and a 94.1% decline in indigenous *P. falciparum* malaria cases. The rate of decline has been the fastest since 2012, when the Mekong Malaria Elimination (MME) programme was launched. Between 2012 and 2021, the region saw a staggering decrease in indigenous malaria cases (86.4%) and in indigenous *P. falciparum* malaria cases (95.7%). In 2021, a total of 90 082 indigenous cases and 16 484 indigenous *P. falciparum* cases were reported – a 17.3% increase in indigenous malaria cases and a 12.2% decline in indigenous *P. falciparum* cases when compared with 2020.
- In 2021, Myanmar saw an increase in numbers of both *P. falciparum* and *P. vivax* cases because of the continued political instability in the area. In 2021, Myanmar continued to account for most of the indigenous malaria cases (87.7%) and indigenous *P. falciparum* malaria cases (80.9%).
- As *P. falciparum* cases continue to decline, *P. vivax* has emerged as the dominant species within the subregion. In 2021, Cambodia reported relapses for the first time; the country reported a total of 1978 relapse cases, making up 48% of the country's total indigenous cases.
- Countries in the GMS are leveraging the subnational verification exercise to strengthen their programmes to prevent re-establishment and to prepare for their country's certification by WHO.
- Between 2000 and 2021, no country that was certified malaria free has been found to have malaria transmission re-established.

HBHI APPROACH

- Since November 2018, all 11 HBHI countries have implemented HBHI-related activities across the four response elements.
- In 2020 and 2021, WHO and the RBM Partnership to End Malaria supported countries to implement rapid self-evaluations on progress in the HBHI objectives across the four response elements.
- In 2021, with the ongoing increase in malaria cases, HBHI countries accounted for 68% of all cases and 70% of deaths globally.
- Between 2020 and 2021, malaria cases in HBHI countries increased from 163 million to 168 million, while there was a reduction in deaths from 444 600 to 427 854.
- With the ongoing increases in 2021, the following countries accounted for most of the malaria cases: Nigeria (39.0%), the Democratic Republic of the Congo (18.2%), Uganda (7.8%) and Mozambique (6.1%).
- Five of the 11 HBHI countries – the Democratic Republic of the Congo, Ghana, India, the Niger and the United Republic of Tanzania – showed a decline in deaths, although their contributions to the malaria burden within HBHI countries is still substantial.

SURVEILLANCE

- Over 40 countries are using malaria surveillance packages designed for the District Health Information System 2 (DHIS2), and 34 countries have adopted the aggregate malaria module.
- Standard modules specific for entomology and vector control have also been developed to support countries to improve the collection and use of entomological and vector control intervention data.
- A suite of tools has been developed or enhanced to support malaria elimination surveillance using the DHIS2 web platform and DHIS2 capture application (app) for Android. These tools can be used for case notification, investigation and response, and for focus investigation and response.
- A total of 12 countries have started establishing malaria repositories, which are data warehouses for all malaria-related data.
- WHO has launched the malaria surveillance assessment toolkit, which provides a systematic and standardized way of assessing the performance of surveillance systems.
- Four countries – Burkina Faso (2020), Cameroon (2021), the Democratic Republic of the Congo (2021) and Ghana (2021) – have undertaken a surveillance system assessment using the toolkit. The assessments from three of these countries that are available for publication (excluding Cameroon) showed that completeness and timeliness of reporting was good, but concordance of core variables between registers and aggregate reports was poor.

INVESTMENTS IN MALARIA PROGRAMMES AND RESEARCH

- The GTS sets out estimates of the funding required to achieve milestones for 2025 and 2030. Total annual resources needed were estimated at US$ 6.8 billion in 2020, rising to US$ 9.3 billion in 2025 and US$ 10.3 billion by 2030. An additional US$ 0.85 billion is estimated to be required annually for global malaria research and development (R&D) during the period 2021–2030.
- Total funding for malaria control and elimination in 2021 was estimated at US$ 3.5 billion, compared with US$ 3.3 billion in 2020 and US$ 3.0 billion in 2019. The amount invested in 2021 fell short of the US$ 7.3 billion estimated to be required globally to stay on track towards the GTS milestones.
- The funding gap between the amount invested and the resources needed has continued to widen dramatically over recent years, increasing from US$ 2.6 billion in 2019 to US$ 3.5 billion in 2020 and US$ 3.8 billion in 2021.
- Over the period 2010–2021, 67% of the total funding for malaria control and elimination, almost US$ 2.4 billion, stemmed from international sources. The United States of America (USA) contributed over US$ 1.3 billion through planned bilateral funding and malaria-adjusted share of multilateral contributions agencies. This was followed by bilateral and multilateral disbursements from the United Kingdom of Great Britain and Northern Ireland (United Kingdom) and Germany of about US$ 0.2 billion; contributions of about US$ 0.1 billion from Canada, France and Japan; and a combined US$ 0.4 billion from other countries that are members of the Development Assistance Committee and from private-sector contributors.
- Governments of malaria endemic countries contributed more than a third of total funding in 2021, with investments of over US$ 1.1 billion, of which over US$ 0.3 billion was spent on malaria case management in the public sector and US$ 0.8 billion on other malaria control activities, a US$ 0.1 billion increase from 2020.
- Of the US$ 3.5 billion invested in 2020, over US$ 1.5 billion (44%) was channelled through the Global Fund. Compared with previous years, the Global Fund's disbursements to malaria endemic countries increased by about US$ 0.1 billion since 2020 and US$ 0.3 billion since 2019.
- The World Bank's classifications by income group vary from year to year. In 2021, the 27 low-income group countries accounted for 47% of total funding, experiencing an increase in funding of more

than 50% since 2010 and representing over 90% of global malaria cases and deaths. The 39 low- and middle-income countries (LMIC) accounted for 41% of total funding in 2021, whereas the remaining countries and unspecified regions where no geographical information on recipients was available accounted for 12% of malaria funding.

- The assessment of malaria funding per person at risk highlights the variation in domestic and international funding across WHO regions, and has shown sizeable changes over the past decade. Most WHO regions have experienced funding per person at risk falling to levels below that of 2010, apart from the WHO African Region, in which funding doubled in 2021 compared with 2010.
- Of the US$ 3.5 billion invested in 2021, over three quarters (78%) went to the WHO African Region, 5% each went to the South-East Asia Region and the Eastern Mediterranean Region, 4% to the Region of the Americas and 3% to the Western Pacific Region. The remaining 5% of total funding in 2021 was allocated to unspecified regions.
- Many countries have experienced changes in their real gross domestic product (GDP) due to the COVID-19 pandemic and other crises; in turn, this has affected the global economy, which expanded by 5.5% in 2021 after a contraction of 3.4% in 2020. In 2021, there was significant growth among the lower income countries and LMIC, with only 11% of such countries experiencing a negative shock to their real GDP growth compared with 70% in 2020. Despite the continued increase in funding for malaria, the actual impact of the COVID-19 pandemic, the associated economic crisis, other global factors and the increase in population at risk will continue to unfold in the coming years.
- Total R&D funding in malaria was US$ 626 million in 2021.
- This is the third consecutive year of funding decline since its 2018 peak, with malaria R&D funding declining across almost all product categories. In particular, the Bill & Melinda Gates Foundation reduced its investment; however, it remained the third largest overall funder of malaria vaccine R&D, behind only the US National Institutes of Health (NIH) and industry.
- Basic research appeared to experience the largest absolute decline in funding in 2021 (–12%) and vector control production saw a decrease of just under 20% since 2020. Diagnostics funding received 2.5% of total malaria funding in 2021, its lowest share since 2013. Only R&D for therapeutics bucked the overall downward trend, with drug R&D rising by 2.3% and biologics by 7.0%.
- The US NIH remained the top funder for malaria R&D in 2021, with funding remaining stable at US$ 189 million, followed by industry and the Bill & Melinda Gates Foundation.

DISTRIBUTION AND COVERAGE OF MALARIA PREVENTION

- Manufacturers' delivery data for 2004–2021 show that almost 2.5 billion ITNs were supplied globally in that period, of which 2.2 billion (87%) were supplied to sub-Saharan Africa.
- Manufacturers delivered about 220 million ITNs to malaria endemic countries in 2021. Of these, 46% were pyrethroid–piperonyl butoxide (PBO) nets and 9% were dual active ingredient ITNs.
- By 2021, 68% of households in sub-Saharan Africa had at least one ITN, an increase from about 5% in 2000. The percentage of households owning at least one ITN for every two people increased from 1% in 2000 to 38% in 2021. In the same period, the percentage of the population with access to an ITN within their household increased from 3% to 54%.
- The percentage of the population sleeping under an ITN also increased considerably between 2000 and 2021, for the whole population (from 2% to 47%), for children aged under 5 years (from 3% to 53%) and for pregnant women (from 3% to 53%).
- Overall, access to and use of ITNs remains below the levels observed in 2017.
- Globally, the percentage of the population at risk protected by indoor residual spraying (IRS) in malaria endemic countries declined from 5.5% in 2010 to 2.4% in 2021. The percentage of the population protected by IRS has remained stable since 2016, with less than 6% of the population protected in each WHO region.

- The number of people protected by IRS globally fell from 153 million in 2010 to 112 million in 2015, and further declined to 80 million in 2021.
- The average number of children treated per cycle of SMC increased from about 0.2 million in 2012 to almost 45 million in 2021.
- The total number of treatment doses delivered in the 15 countries implementing SMC in 2021 was about 180 million.
- Using data from 33 countries in the WHO African Region, the percentage of IPTp use by dose was computed. In 2021, 72% of pregnant women used ANC services at least once during their pregnancy. About 55% of pregnant women received one dose of IPTp, 45% received two doses and 35% received three doses.

DISTRIBUTION AND COVERAGE OF MALARIA DIAGNOSIS AND TREATMENT

- Globally, 3.5 billion rapid diagnostic tests (RDTs) for malaria were sold by manufacturers in 2010-2021, with almost 82% of these sales being in sub-Saharan African countries. In the same period, national malaria programmes (NMPs) distributed 2.4 billion RDTs – 88% in sub-Saharan Africa.
- In 2021, 413 million RDTs were sold by manufacturers and 262 million were distributed by NMPs.
- Almost 3.8 billion treatment courses of ACT were delivered globally by manufacturers in 2010–2021. About 2.6 billion of these deliveries were to the public sector in malaria endemic countries; the rest were either public-sector or private-sector Affordable Medicines Facility–malaria (AMFm) or Global Fund co-payment mechanisms, or reflect deliveries to the private sector outside the Global Fund co-payment mechanism for the relevant years.
- National data reported by NMPs in 2010–2021 show that 2.4 billion ACTs were delivered to health service providers to treat malaria patients in the public health sector.
- In 2021, some 225 million ACTs were delivered by manufacturers to the public health sector; in that same year, 242 million ACTs were distributed to this sector by NMPs, of which 97% were in sub-Saharan Africa.
- Aggregated data from household surveys conducted in sub-Saharan Africa between 2005 and 2021 in 20 countries with at least two surveys (baseline 2005–2011, and most recent 2015–2021) were used to analyse coverage of treatment seeking, diagnosis and use of ACTs in children aged under 5 years.
- Comparing the baseline and latest surveys, there was little change in prevalence of fever within the 2 weeks preceding the surveys (median 25% versus 20%) or in treatment seeking for fever (median 65% versus 67%).
- Comparisons of the source of treatment between the baseline and more recent surveys show that the proportion who received care from public health facilities increased from a median of 58% to 69%, the proportion who received care from the private sector decreased from a median of 40% to 28%, and the use of community health workers remained low, with medians of 2% and 1%, respectively.
- The rate of diagnosis among children aged under 5 years with fever and for whom care was sought increased considerably, from a median of 30% at baseline to 57% in the latest household surveys.
- Use of ACTs among those for whom care was sought also increased, from 14% at baseline to 24% in the latest surveys.
- Among those for whom care was sought and who received a finger or heel prick, use of ACTs was 29% in the most recent survey, compared with 21% at baseline.

PROGRESS TOWARDS THE GTS MILESTONES OF 2020

- The GTS aims for a reduction in malaria case incidence and mortality rate of at least 75% by 2025 and 90% by 2030 from a 2015 baseline. In 2020, the GTS target was a reduction of 40% by 2020.
- The number of countries that achieved the GTS targets for 2021 was derived from official burden estimates, rather than from projections (as was done in the *World malaria report 2020*).
- In 2020 and 2021, the estimates included the effect of disruptions of malaria services during the pandemic and were based on a new method for quantifying the malaria cause of death (CoD) fraction.
- Despite the considerable progress made since 2000, the GTS 2020 milestones for morbidity and mortality were not achieved globally. If the current trends continue, the GTS 2025 targets will not be achieved globally.
- The malaria case incidence of 59 cases per 1000 population at risk in 2021 instead of the expected 31 cases per 1000 if the world were on track for the 2021 GTS morbidity milestone means that, globally, we are off track by 48%.
- Although relative progress in the mortality rate is greater than that of case incidence, the GTS target of 7.8 malaria deaths per 100 000 population at risk in 2021 was 48% lower than the mortality rate of 14.8 observed in the same year.
- Of the 93 countries that were malaria endemic (including the territory of French Guiana) globally in 2015, 39 (42%) met the GTS morbidity milestone for 2021, having achieved a reduction of 40% or more in case incidence or having reported zero malaria cases.
- Nineteen countries (20%) had made progress in reducing malaria case incidence but by less than the expected target.
- Twenty-seven countries (29%) had increased case incidence and 14 countries (15%) had an increase of 40% or more in malaria case incidence in 2021 compared with 2015.
- In eight countries (8.6%), malaria case incidence in 2021 was similar to that of 2015.
- Forty-three countries (46%) that were malaria endemic in 2015 achieved the GTS mortality milestone for 2021, with 28 of them reporting zero malaria deaths.
- Twenty-two countries (24%) achieved reductions in malaria mortality rates but of less than the 40% target.
- Malaria mortality rates remained at the same level in 2021 as they were in 2015 in nine countries (9.7%), whereas mortality rates increased in 19 countries (20%), 11 of which had increases of 40% or more.
- The WHO South-East Asia Region met the GTS 2020 milestones for both mortality and morbidity. All countries in the region except Indonesia reduced case incidence and mortality by 40% or more.

BIOLOGICAL AND OTHER THREATS TO MALARIA INTERVENTION TOOLS

Parasite deletions of *Pfhrp2/3* genes

- Parasites that cannot express histidine-rich protein 2 (HRP2) may not be detectable by RDTs based on HRP2, and those that no longer express both HRP2 and histidine-rich protein 3 (HRP3) are completely undetectable by such RDTs.
- WHO has recommended that countries with reports of *Pfhrp2/3* deletions, and their neighbouring countries, should conduct representative baseline surveys among suspected malaria cases, to determine whether the prevalence of *Pfhrp2/3* deletions causing false negative RDT results has reached a threshold that requires a change in RDT (>5% *Pfhrp2* deletions causing false negative RDT results).

- Alternative RDT options (e.g. based on detection of the parasite's lactate dehydrogenase) are limited; in particular, there are currently no WHO-prequalified non-HRP2 combination tests that can detect and distinguish between *P. falciparum* and *P. vivax*.
- WHO is tracking published reports of *Pfhrp2/3* deletions using the Malaria Threats Map application and is encouraging a harmonized approach to mapping and reporting of *Pfhrp2/3* deletions through publicly available survey protocols.
- In 2022, several countries in the WHO African Region began planning or implementing representative surveys for *Pfhrp2/3* deletions; results are expected in 2022 and 2023.
- WHO has launched a dashboard for tracking surveillance activities globally to inform priorities and resource allocation and RDT forecasting, and to avoid duplication of efforts. The dashboard features key characteristics of surveillance activities as well as timelines.
- Between September 2021 and September 2022, investigations of *Pfhrp2/3* deletions were reported in 17 publications from 17 countries: Benin, Brazil, Cameroon, the Democratic Republic of the Congo, Djibouti, Ecuador, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, India, Kenya, Madagascar, Rwanda, Sierra Leone and the United Republic of Tanzania. Of these, only Equatorial Guinea, Kenya and Rwanda did not identify any *Pfhrp2* deletions, although deletions in these three countries have been reported in previous publications.
- Based on data from publications included in the Malaria Threats Map, some form of investigation has been conducted in 47 countries, with the presence of deletions being confirmed in 40 of these countries.
- The WHO Global Response Plan for *Pfhrp2/3* deletions outlines several areas for action beyond scaling up of surveillance. These other areas for action include identifying new biomarkers, improving the performance of non-HRP2 RDTs, undertaking market forecasting and strengthening laboratory networks to support the demand for using molecular characterization to determine the presence or absence of these gene deletions.

Parasite resistance to antimalarial drugs

- Antimalarial drug efficacy is monitored through therapeutic efficacy studies (TES), which track clinical and parasitological outcomes among patients receiving antimalarial treatment. TES are considered the gold standard by which countries can best determine their national treatment policies.
- Antimalarial drug resistance can be assessed using several tools. For some drugs, genetic changes associated with reduced drug sensitivity have been identified. Artemisinin partial resistance is monitored using an established list of validated and candidate *PfKelch13* markers associated with delayed clearance after a treatment containing artemisinin.
- WHO collates results of studies on antimalarial drug efficacy and resistance, and makes them available in the Malaria Threats Map.
- **WHO African Region:** A total of 266 *P. falciparum* TES were conducted in the WHO African Region according to the WHO standard protocol between 2015 and 2021 enrolling at least 20 patients. Among these TES, six studies have demonstrated a greater than 10% failure rate: four studies with artemether-lumefantrine (AL) in Burkina Faso and in Uganda, and two studies with dihydroartemisinin-piperaquine (DHA-PPQ) in Burkina Faso. A further five studies with AL and two studies with DHA-PPQ using a methodology to distinguish between reinfection and recrudescence that differs from the WHO-recommended methodology reported treatment failure rates greater than 10%; these include studies in Angola, the Democratic Republic of the Congo and Uganda. *PfKelch13* mutations have emerged in Eritrea, Rwanda and Uganda. Treatment failure rates remain below 10%, because the partner drug is still effective. Further studies are needed to determine the extent of the spread of the *PfKelch13* mutations and to investigate any changes to parasite clearance time and in vitro resistance.
- **WHO Region of the Americas:** Limited TES data are available from the WHO Region of the Americas. TES of AL conducted between 2015 and 2021 in Brazil and Colombia demonstrated high

efficacy. In Guyana, the *PfKelch13* C580Y mutation associated with artemisinin partial resistance was sporadically observed between 2010 and 2017 but has not been found in any of the more recent samples, indicating that the mutation has probably disappeared.

- **WHO Eastern Mediterranean Region:** Of 36 *P. falciparum* TES conducted in the WHO Eastern Mediterranean Region enrolling at least 20 patients, two studies with artesunate plus SP (AS+SP) in Somalia and the Sudan demonstrated a greater than 10% failure rate. In these countries, the first-line treatment was subsequently changed to AL.
- **WHO South-East Asia Region:** Of 67 *P. falciparum* TES conducted in the WHO South-East Asia Region enrolling at least 20 patients, no TES reported a greater than 10% treatment failure rate. However, the presence of mutations associated with resistance to SP in central India could be an early warning sign before failure of AS+SP. In Thailand, where drug efficacy is assessed with integrated drug efficacy surveillance, treatment failure rates with DHA-PPQ plus primaquine were found to be high in Sisaket province. This led the province to change its first-line therapy to artesunate-pyronaridine (AS-PY) in 2020. In the GMS, *PfKelch13* mutations associated with artemisinin partial resistance are at a high prevalence in Myanmar and Thailand.
- **WHO Western Pacific Region:** Of 63 *P. falciparum* TES conducted in the WHO Western Pacific Region enrolling at least 20 patients, 14 studies demonstrated a greater than 10% failure rate. One study with AL in the Lao People's Democratic Republic in 2017 found high failure rates (17.2%) but this study had only 29 patients and later studies found high AL efficacy. Two studies in Cambodia found high failure rates with artesunate-amodiaquine (AS-AQ), indicating the presence of AQ resistance in Cambodia. High rates of treatment failure were detected with DHA-PPQ in Cambodia, the Lao People's Democratic Republic and Viet Nam, prompting changes from the use of this drug as first-line treatment. In the GMS, *PfKelch13* mutations associated with artemisinin partial resistance are at a high prevalence in Cambodia, the Lao People's Democratic Republic and Viet Nam. Additionally, in Papua New Guinea, the *PfKelch13* C580Y mutation has emerged and appears to be spreading.

Vector resistance to insecticides

- From 2010 to 2020, 88 countries reported data to WHO on standard insecticide resistance monitoring, including 38 on the intensity of resistance to pyrethroids, and 32 on the ability of PBO to restore susceptibility to pyrethroids.
- In 2020, new discriminating concentrations and procedures for monitoring resistance in malaria vectors against chlorfenapyr, clothianidin, transfluthrin, flupyradifurone and pyriproxyfen became available, and discriminating concentrations for pirimiphos-methyl and alpha-cypermethrin were revised. Countries should adjust their monitoring of insecticide resistance in malaria vectors to align with these new procedures. WHO has not received any vector resistance monitoring data for transfluthrin, flupyradifurone and pyriproxyfen. Although WHO has received some resistance monitoring data for chlorfenapyr and clothianidin, these data are insufficient to assess the potential presence of resistance to either of these two insecticides.
- Of the 88 malaria endemic countries that provided data for 2010–2020, 78 have detected resistance to at least one insecticide class in at least one malaria vector and one collection site; 29 have already detected resistance to pyrethroids, organochlorines, carbamates and organophosphates across different sites; and 19 have confirmed resistance to all these four classes in at least one site and at least one local vector.
- Globally, resistance to pyrethroids – the primary insecticide class currently used in ITNs – is widespread, having been detected in at least one malaria vector in 68% of the sites for which data were available. Resistance to organochlorines was reported in 64% of the sites. Resistance to carbamates and organophosphates was less prevalent, being detected in 34% and 28% of the sites that reported monitoring data, respectively.
- Of the 38 countries that reported data on the intensity of pyrethroid resistance, high intensity resistance was detected in 27 countries and 293 sites.

- Since 2010, PBO has been observed to fully restore susceptibility in 283 sites across 29 countries.
- To guide resistance management, countries should develop and implement national insecticide resistance monitoring and management plans, drawing on the WHO *Framework for a national plan for monitoring and management of insecticide resistance in malaria vectors*. The number of countries that reported having such a plan increased from 53 in 2019 to 67 in 2020.
- Technical and funding support is required to support countries to monitor and manage insecticide resistance.
- Standard insecticide resistance data reported to WHO are included in the WHO global database on insecticide resistance in malaria vectors and can be explored via the Malaria Threats Map.

Effectiveness of ITNs

- ITNs are considered the main drivers of the declines in malaria transmission and burden in the period 2005–2015, especially in settings with moderate to high transmission. Long-lasting insecticidal nets (LLINs) remain effective and WHO encourages their continued use to prevent malaria.
- Given that LLINs are the main vector control tool, the factors that impair their effectiveness in malaria prevention are important in progress against malaria. These factors include the physical durability of the net (i.e. fabric integrity) and its chemical durability (i.e. bioefficacy, which is the availability of the active ingredient on the surface of the net over time), operational and behavioural constraints (i.e. delivery, access, coverage and acceptability, use, maintenance and retention), and vector dynamics (species biting and resting behaviours).
- The emergence and wide geographical spread of pyrethroid resistance is the most recognized threat to the effectiveness of long-lasting pyrethroid-based ITNs.
- A multicountry trial study commissioned by WHO and published in 2018 showed that ITNs remained highly protective against malaria, even in the presence of high pyrethroid resistance.
- In contrast, data from several experimental hut studies suggest that, as vector susceptibility to pyrethroids falls, the repellent and mortality effects on mosquitoes are greatly reduced.
- Modelling analysis further suggests that the epidemiological impact of ITNs is reduced at high levels of pyrethroid resistance.
- The greater efficacy seen in randomized controlled trials of some of the newer generation of ITNs (compared with pyrethroid-only ITNs) suggests that insecticide resistance is having an effect on epidemiological outcomes.
- In sub-Saharan Africa, where most ITNs are distributed, about 590 million ITNs were delivered to communities in the period 2019–2021. However, in 2021, the estimated percentage of the population with access to an ITN within their household and the percentage of the population sleeping under an ITN was 54% and 47%, respectively, owing to several factors.
- Factors affecting universal ITN ownership and use include allocation efficiency, retention and use. Equitable allocation of ITNs is supported by identifying coverage gaps at the local level and expanding distribution to these areas. Retention of ITNs is determined by the household's attitudes towards their nets, net handling behaviours and other hazards, and durability of the net fabric and construction. The median lifespan of current ITNs, while variable by setting, is about 1.9 years. Finally, even when nets are available to household members, they are not used 100% of the time; variation in usage is affected by age, season, gender and malaria risk.
- An illustrative modelling analysis was undertaken. The analysis started with an "ideal" LLIN (i.e. one that is perfectly allocated, never discarded, always used, highly insecticidal and highly durable), and explored scenarios in which each of the constraints listed above was re-introduced sequentially.
- The analysis showed that the main factors in reducing net effectiveness are the waning of insecticide efficacy and physical durability. When combined with barriers to ITN access, use rate and retention, the impact of an ITN campaign wanes dramatically by the end of the third year.

- Solutions are needed to improve the physical and chemical durability of LLINs, their allocation efficiency, and their maintenance and use by household members. In addition, dual active ingredient nets or fully non-pyrethroid LLINs are essential to mitigate the impact of widespread insecticide resistance.

Effectiveness of IRS

- IRS is the second most widely implemented vector control intervention by NMPs. There is, however, limited trial evidence of the efficacy of IRS.
- From observation data, when IRS is carried out correctly it is a powerful intervention to reduce adult mosquito vector density and longevity, and thus to reduce malaria transmission.
- Some of the factors that influence IRS effectiveness are similar to those that affect ITNs. For example, most of the vector population feeds and rests indoors, people mainly sleep indoors at night and there are high levels of acceptance in the community. Factors specific to IRS include the timing of spraying and the level of training of spray operators (which affects the quality of spraying).
- Implementation of IRS at the required quality is logistically more challenging and considerably more expensive than distribution of ITNs.
- A recent review showed that, compared with ITNs, IRS was about five times more expensive per person protected per year, meaning that IRS is considerably less cost effective.
- A study in Ethiopia suggests that community-based delivery of IRS (in which spray operators and materials are closer to the households and engagement of community health workers) may reduce costs, improve performance efficiencies and increase coverage without reducing performance.
- Even where community-based delivery is used, overall costs remain, and when added to the cost for the maintenance of equipment and the sustained supervision of sprayers, it is clear that widespread scale-up of IRS requires a large budget.
- Costs are likely to increase further as resistance to the insecticides used in IRS emerges and more expensive chemicals are needed.

Beyond the reach of ITNs and IRS: addressing residual transmission

- Beyond the genetic adaptation of mosquitoes to insecticides (i.e. insecticide resistance), an understanding of the behavioural adaptation of the mosquito – in terms of changes to biting, feeding and resting behaviour – is equally important.
- There is increasing evidence of the vector's attempts to reduce contact with insecticides (i.e. biting earlier before people go to bed, spending more time resting outdoors or feeding on livestock instead of humans).
- Vectors with this behavioural plasticity become more dominant than those with limited behavioural changes. Behavioural adaptation on the part of the vector will require investment in R&D of interventions that target outdoor transmission.

MALARIA R&D AND PRODUCTS IN THE PIPELINE

Preferred product characteristics and target product profiles

- The WHO Global Malaria Programme (WHO/GMP) has been involved in the development of preferred product characteristics (PPCs) and target product profiles (TPPs), as key tools to incentivize and guide the development of products with high public health impact and suitability for use in LMIC.

- WHO is coordinating the development of TPPs for glucose-6-phosphate dehydrogenase (G6PD) point-of-care tests to meet the needs for *P. vivax* control.
- Building on the RTS,S malaria vaccine experience, WHO published updated malaria vaccine PPCs in 2022. The PPCs include an expanded set of strategic goals for malaria vaccine R&D for the prevention of blood-stage infection, reduction of morbidity and mortality, and reduction of community-level transmission.
- WHO has also developed several PPCs for vector control including those for ITNs for malaria transmission control in insecticide-resistant mosquito populations (published in 2021), for vector control interventions to control malaria in complex humanitarian emergencies and in response to natural disasters (published in 2021), for endectocide and ectocide products for malaria transmission control (published in 2022) and for indoor residual surface treatment for malaria transmission control in areas with insecticide-resistant mosquitoes (published in 2022).
- For chemoprevention, WHO has developed PPCs for malaria chemoprevention drugs aimed at addressing several use-cases: chemoprevention in children (SMC, PMC [previously known as intermittent preventive treatment in infants, or IPTi], IPTsc and PDMC), during pregnancy (IPTp) and in nonimmune travellers.
- In November 2021, WHO/GMP and the WHO Department of Immunization, Vaccines and Biologicals (IVB) convened a scientific development group to develop PPCs and address clinical development considerations for monoclonal antibodies (mAbs) for malaria prevention. The most immediate public health priority is the reduction of morbidity and mortality in infants and children due to *P. falciparum*.
- WHO has also worked in close coordination with product development partners such as the Foundation for Innovative New Diagnostics (FIND), the Medicines for Malaria Venture (MMV) and the Innovative Vector Control Consortium (IVCC) to assemble a database of malaria products in the R&D pipeline.

Diagnostic tests and antimalarial medicines

- On malaria diagnostic tests, the spread of *P. falciparum* parasites with *Pfhrp2/3* gene deletions presents a major threat to reliable diagnosis; a diversified diagnostic landscape is needed to address this liability. Key R&D challenges are the inadequate sensitivity of tools for non-*P. falciparum* species and a broader range of diagnostic use-cases (e.g. highly sensitive noninvasive screening for the prevention of re-introduction).
- The current R&D pipeline includes products to address these gaps through efforts to improve existing point-of-care platforms (specifically, microscopy and the RDTs lateral-flow immune-chromatographic antigen-detection tests) and develop alternatives that use a range of sample types and technologies.
- The current focus of the malaria medicine R&D is on the development of next-generation life-saving medicines for adults, particularly pregnant women, and children who are at elevated risk from the consequences of malarial infection. Another high priority is delivering a non-ACT treatment option, to simplify therapy or as a contingency against the intensification of either artemisinin or the partner drug resistance.
- Under MMV coordination, the R&D in malaria medicines has focused on two main areas: innovations with existing antimalarial treatments and next-generation antimalarial treatments. In relation to existing treatments, work is ongoing on triple ACT, ACT plus single low-dose primaquine for transmission blocking and artemether-lumefantrine for neonates.
- There are several next-generation medicines at different trial phases: ganaplacide-lumefantrine, M5717-pyronaridine, ZY19489-ferroquine and cipargamin. In addition, there are seven next-generation molecules under investigation.

Vector control

- The WHO Global Observatory on Health Research and Development (GOHRD) currently lists 28 vector control products in the R&D pipeline. Eleven (39%) of these products are ITNs and seven (25%) are indoor residual wall treatments. Thirteen products (46%) are in the data-generation stage to support assessment of safety, quality and entomological efficacy. Seven products (25%) are undergoing epidemiological trials, six (21%) are being assessed by WHO to inform prequalification listing or WHO policy recommendation and two (7%) are at the prototype development stage.
- IVCC provided an overview of the current and previous malaria intervention products pipeline that lists several novel and repurposed insecticides with different modes of action, for use in ITNs and IRS, to support best practice insecticide resistance management.
- Among the products that IVCC has helped bring to market for IRS are pirimiphos-methyl (listed by the WHO Pesticide Evaluation Scheme [WHOPES] in January 2013), clothianidin (prequalified by WHO in 2017) and clothianidin plus deltamethrin (prequalified by WHO in 2018).
- In addition, chlorfenapyr and broflanilide are under review and are expected to be listed for prequalification in the near future.
- Interceptor® G2, a new ITN, combines a pyrethroid with a repurposed insecticide, chlorfenapyr, which has a different mode of action. The mixture of these two active ingredients is a step forward in insecticide resistance. Three further active ingredients are either in late-stage research or have progressed to full development and are expected to obtain a prequalification listing between 2026 and 2030.
- An expanded vector control toolbox is under development that includes larviciding, lethal house lures (eave tubes) and Attractive Targeted Sugar Bait. These tools are integral to managing insecticide resistance and reducing outdoor biting.

Vaccines

- The malaria vaccines currently in clinical development target the pre-erythrocytic phase of the parasite; that is, they target the sporozoite or liver stage of the parasite, the parasite blood stage, the gametocytes or the parasite development in the mosquito.
- Detailed information can be found in the vaccine dashboard of the GOHRD. In brief, of the vaccine candidates under development, six target the parasite at the pre-erythrocytic stage (*P. falciparum*), three target the blood stage (*P. falciparum*), and six target the sexual stage or block transmission (of these, four target *P. vivax* and two target *P. falciparum* malaria in pregnancy).

Avant-propos

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Directeur général
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Chaque année, le *Rapport sur le paludisme dans le monde* met en lumière les progrès et les lacunes des efforts antipaludiques déployés au niveau mondial. Le rapport de cette année s'articule autour de quatre thèmes : riposte, risques, résilience et recherche.

Les pays touchés par le paludisme continuent de relever une multitude de défis, notamment les perturbations liées à la pandémie de COVID 19. Bien que durement touchés, la plupart des pays ont tenu bon et ont pu maintenir les services de prévention, de détection et de traitement du paludisme, un exploit remarquable en pleine pandémie.

Néanmoins, plus de 600 000 personnes meurent encore chaque année du paludisme, et la grande majorité sont des enfants. Malgré les efforts héroïques déployés pour maintenir les services pendant la pandémie, la lutte contre le paludisme se heurte à de nombreux obstacles qui viennent s'ajouter aux perturbations déjà importantes liées à la COVID et aux autres problèmes des systèmes de santé, notamment des crises humanitaires interminables, des financements limités de la part des bailleurs de fonds et l'effet potentiel du changement climatique sur la propagation de la maladie.

Toutes ces difficultés ont été aggravées par la baisse d'efficacité de nos principaux outils antipaludiques. La résistance croissante aux moustiquaires imprégnées d'insecticide et aux médicaments antipaludiques reste très préoccupante, surtout en Afrique. Dans certaines zones, les parasites du paludisme échappent à la détection des tests les plus couramment utilisés. En outre, l'invasion d'un moustique qui s'adapte facilement aux environnements urbains, *Anopheles stephensi*, présente un risque réel.

Pour soutenir la résilience des programmes de lutte contre le paludisme, l'OMS a publié de nouvelles orientations, notamment une nouvelle stratégie pour contenir la résistance aux médicaments antipaludiques en Afrique, un nouveau cadre développé conjointement par l'OMS et ONU Habitat pour guider les responsables municipaux dans leur lutte contre le paludisme en milieu urbain, ainsi que des recommandations pour stopper la propagation d'*Anopheles stephensi* en milieu urbain. Les pays sont encouragés à adapter les orientations de l'OMS aux conditions locales.

La lutte contre le paludisme est intimement liée à l'ensemble du système de santé. Pour que la lutte contre le paludisme soit efficace, il est essentiel d'investir dans des systèmes de santé qui fonctionnement bien, qui sont équitables et résilients, et qui reposent sur des soins de santé primaires.

La recherche et le développement jouent également un rôle essentiel. Comme décrit dans ce rapport, de nouveaux types de technologies de lutte antivectorielle sont en cours de développement, notamment une nouvelle génération de moustiquaires pour combattre la résistance des moustiques. De nouveaux diagnostics et des innovations dans les médicaments antipaludiques sont également en préparation.

Une autre avancée majeure est le vaccin antipaludique RTS,S, le premier et le seul vaccin recommandé pour prévenir le paludisme chez les enfants. Plus d'1,2 million d'enfants sont protégés par ce vaccin au Ghana, au Kenya et au Malawi, et le vaccin sera bientôt étendu à plusieurs autres pays. D'autres outils antipaludiques prometteurs sont en cours de développement.

Toutefois, la recherche fondamentale et le développement de produits continuent de souffrir d'un important déficit de financement. Il est urgent d'accélérer les investissements dans de nouveaux outils antipaludiques, afin de faire face aux menaces émergentes telles que le paludisme en milieu urbain et la propagation de la résistance aux médicaments antipaludiques.

De nombreux défis nous attendent, mais les raisons d'espérer ne manquent pas. En renforçant la réponse, en comprenant et en atténuant les risques, en développant la résilience et en accélérant la recherche, nous avons toutes les raisons de rêver à un avenir sans paludisme.

Le rapport de cette année en un clin d'œil

ÉVÉNEMENTS CLÉS EN 2021-2022

Septième reconstitution des ressources du Fonds mondial de lutte contre le sida, la tuberculose et le paludisme

- En 2021, plus de 40 % des investissements mondiaux dans la lutte contre le paludisme ont transité par le Fonds mondial de lutte contre le sida, la tuberculose et le paludisme (Fonds mondial).
- Au total, US$ 15,9 milliards ont été réunis en septembre 2022 par les différents pays et partenaires dans le cadre de la reconstitution des ressources du Fonds mondial, le montant le plus important dans l'histoire du Fonds mondial.
- Cette collecte de fonds reste néanmoins en deçà de l'objectif de US$ 18 milliards, dans un contexte d'augmentation du prix des produits de santé du fait de la pandémie de coronavirus (COVID-19), des conflits et de la récession mondiale.
- À cause de ce déficit, une pression considérable va peser sur les ressources reconstituées en vue de maintenir, voire d'élever les niveaux de couverture des interventions antipaludiques.
- Pour optimiser l'impact de ressources financières limitées, il va donc falloir utiliser les fonds pour la lutte contre le paludisme et les systèmes de santé de manière plus efficace, efficiente et équitable.
- Les pays doivent être en mesure d'identifier la meilleure combinaison d'interventions adaptées au contexte local et le meilleur moyen de les fournir à ceux qui en ont besoin, tout en tenant compte des données locales.

Nouvelles recommandations de l'Organisation mondiale de la Santé

- En juin 2022, l'Organisation mondiale de la Santé (OMS) a publié des lignes directrices concernant ses recommandations nouvelles ou mises à jour. Ces lignes directrices encouragent les pays à adapter les recommandations au contexte local pour un impact maximal.
- Les lignes directrices misent à jour incluent des recommandations sur le traitement préventif intermittent du paludisme pendant la grossesse (TPIp), la chimioprévention du paludisme pérenne (CPP) et la chimioprévention du paludisme saisonnier (CPS), le traitement préventif intermittent chez les enfants d'âge scolaire (TPIsc), la chimioprévention du paludisme après la sortie de l'établissement de soins (PDMC), l'administration de masse de médicaments (AMD) et l'élimination du paludisme.
- L'utilisation du TPIp par sulfadoxine-pyriméthamine (SP) dans les zones de transmission modérée à élevée du paludisme à *Plasmodium falciparum* reste fortement recommandée.
- L'utilisation du TPIp par SP est désormais recommandée pour toutes les femmes enceintes, indifféremment du nombre de grossesses qu'elles ont menées.
- L'actualisation de la recommandation concernant la CPP et la CPS plaide pour un usage plus large de la chimioprévention chez les jeunes enfants présentant un risque élevé de paludisme grave dans les zones de transmission saisonnière ou pérenne.
- L'OMS a également énoncé une nouvelle recommandation sur l'utilisation du TPIsc dans les zones de transmission modérée à élevée, qu'elle soit pérenne ou saisonnière. Le TPIsc est censé couvrir les enfants âgés de 5 à 15 ans. Son introduction ne doit pas compromettre les interventions de chimioprévention auprès des enfants de moins de 5 ans, qui présentent le risque le plus élevé de paludisme grave.

- La PDMC est aujourd'hui recommandée en prévention du paludisme chez les enfants souffrant d'anémie grave et qui vivent dans des zones de transmission modérée à élevée, suite à leur sortie de l'hôpital, lorsqu'ils présentent un risque important de réadmission ou de décès.
- Les nouvelles recommandations concernant l'administration de masse de médicaments antipaludiques portent sur la réduction rapide du poids du paludisme dans les situations d'urgence et dans les zones de transmission modérée à élevée. Elles donnent également des orientations sur l'utilisation de l'AMD pour réduire le paludisme à *P. falciparum* dans les zones de transmission très faible à faible, ainsi que pour réduire la transmission du paludisme à *P. vivax*.
- Les recommandations concernant l'élimination intègrent des stratégies « de masse » appliquées à l'ensemble de la population d'une zone géographique définie (qu'il s'agisse d'un village, d'un canton ou d'un district), des stratégies « ciblées » appliquées aux personnes présentant un plus grand risque d'infection que le reste de la population, ainsi que des stratégies « réactives » déclenchées en réponse à des cas individuels.

Nouvelles initiatives régionales lancées par l'OMS en collaboration avec des partenaires

Stratégie de riposte face à la résistance aux médicaments antipaludiques en Afrique

- L'émergence d'une résistance partielle à l'artémisinine dans la région Afrique de l'OMS et la propagation manifestement rapide des mutations associées à cette résistance partielle sont inquiétantes. Cette émergence ne s'est pas répandue depuis la sous-région du Grand Mékong, mais est apparue *de novo* sur le continent.
- Les combinaisons thérapeutiques à base d'artémisinine (ACT) demeurent efficaces. Même si la résistance aux médicaments partenaires des ACT actuellement utilisés n'a pas été confirmée, il va s'avérer nécessaire de se pencher sur certains signaux préoccupants et prendre des mesures avant que l'effet des ACT ne commence à s'estomper.
- Compte tenu de la forte dépendance aux ACT en Afrique, la menace d'une résistance partielle à l'artémisinine et d'une résistance aux médicaments partenaires doit être surveillée et traitée d'urgence.
- En novembre 2022, l'OMS a lancé la *Stratégie de riposte face à la résistance aux médicaments antipaludiques en Afrique* dans le but de définir des orientations pour les principaux intervenants de la communauté antipaludique.
- Cette stratégie apporte une réponse à la menace que représente la résistance aux médicaments antipaludiques dans la région Afrique de l'OMS et s'articule autour de quatre piliers :
  - **Pilier I** – Renforcer la surveillance de l'efficacité des médicaments antipaludiques et de la résistance à ces médicaments.
  - **Pilier II** – Optimiser et mieux réglementer, par l'intermédiaire de mesures préventives, l'utilisation des produits de diagnostic et des traitements pour limiter la pression médicamenteuse.
  - **Pilier III** – Faire face à la résistance en limitant la propagation de parasites résistants aux médicaments antipaludiques.
  - **Pilier IV** – Stimuler la recherche et l'innovation afin de mieux tirer parti des outils existants et de mettre au point de nouveaux outils contre la résistance aux médicaments antipaludiques.
- Chaque pilier correspond à un ensemble d'interventions, qui peuvent être mises en œuvre séparément à l'échelle locale, régionale et mondiale. Les pays adoptant cette stratégie doivent adapter les interventions à leur contexte local.

Initiative pour stopper la propagation du moustique *Anopheles stephensi*

- Originaire d'Asie du Sud et de certaines zones de la péninsule arabique, le moustique *Anopheles stephensi* n'a cessé d'étendre son territoire ces dix dernières années. Il a été détecté à Djibouti (2012), en Éthiopie et au Soudan (2016), en Somalie (2019) et au Nigéria (2020).
- Au moment où le moustique *An. stephensi* a été signalé dans la région Afrique de l'OMS, il s'est avéré résistant à plusieurs des insecticides utilisés dans les établissements de santé publics, ce qui a ajouté une difficulté supplémentaire à son contrôle.
- L'invasion de l'Afrique subsaharienne par *An. stephensi*, région la plus lourdement touchée par le paludisme et où plus de 40 % de la population vit en milieu urbain, soulève l'inquiétude, car il semble qu'il ait provoqué la résurgence du paludisme dans la ville de Djibouti et qu'il ait été à l'origine d'au moins une flambée épidémique en Éthiopie.

- En septembre 2022, une nouvelle initiative a été lancée dans le but d'enrayer la propagation d'*An. stephensi* sur le continent africain et de déterminer s'il peut être éliminé de certaines régions qu'il a déjà envahies.
- Cette initiative plaide pour que la riposte nationale face à An. stephensi fasse partie d'une réponse plus vaste aux vecteurs du paludisme grâce à l'amélioration de la collaboration, l'augmentation de la surveillance, l'optimisation des échanges d'informations, le développement d'orientations et la priorisation de la recherche.

Cadre mondial pour répondre au paludisme en milieu urbain

- D'ici 2050, près de sept personnes sur dix dans le monde vivront dans les villes et autres zones urbaines. Dans les pays d'endémie palustre, il est même probable que plus de gens vivent en zones urbaines qu'en zones rurales.
- D'ailleurs, dans les 10 pays où le paludisme sévit le plus au sein de la région Afrique de l'OMS, on considère que plus de 40 % de la population vit déjà en milieu urbain.
- La dynamique de la transmission et le poids du paludisme, ainsi que d'autres maladies vectorielles, peuvent ne pas être identiques dans les zones urbaines et rurales.
- D'une manière générale, l'urbanisation va réduire la transmission du paludisme. Toutefois, une urbanisation sauvage entraînera une transmission focale, qui se traduira par un poids du paludisme démesuré parmi les populations pauvres en milieu urbain.
- L'invasion par des vecteurs adaptés à se reproduire en environnement urbain, comme la propagation récente du moustique *An. stephensi* dans la région Afrique de l'OMS, peut faire courir un plus grand risque aux populations des villes.
- Il se peut que les approches visant à réduire le poids du paludisme dans les zones rurales ne fonctionnent pas en milieu urbain ou qu'elles nécessitent une application ciblée à plus petite échelle.
- La riposte face au paludisme dans les zones urbaines requiert des données sur les déterminants qui sont propres aux écosystèmes urbains et qui expliquent si la transmission et le poids du paludisme sont focalisés.
- Le leadership des ministères, de l'industrie et de la finance, de la recherche, des milieux universitaires et d'autres secteurs a tendance à se concentrer dans les zones urbaines, offrant davantage de chances aux politiques, stratégies et actions multisectorielles intégrées.
- Avec l'accélération de l'urbanisation, l'accès est mis sur des villes plus saines, en intégrant la volonté politique, au niveau mondial, de contrer les menaces que représente le changement climatique.
- En octobre 2022, l'OMS et le Programme des Nations unies pour les établissements humains (ONU-Habitat) ont lancé conjointement le *Cadre mondial pour répondre au paludisme en milieu urbain*, qui s'adresse aux décideurs politiques et aux intervenants concernés.
- Ce cadre conceptuel est une réponse au paludisme dans les villes. Il souligne le rôle central des autorités municipales et la nécessite de veiller à ce que la riposte face au paludisme s'inscrive dans le cadre plus large du développement urbain et du programme de santé. Il insiste également sur le besoin de mettre en œuvre une riposte ciblée, basée sur des données, dans le cadre de la conception des interventions antipaludiques. S'il est appliqué, ce cadre devrait présenter de nombreux avantages pour améliorer la santé et le bien être.

Déploiement du vaccin antipaludique RTS,S/AS01 dans les zones de transmission modérée à élevée

- En octobre 2021, l'OMS a recommandé l'utilisation du vaccin RTS,S/AS01 pour la prévention du paludisme à *P. falciparum* chez les enfants vivant dans des zones de transmission modérée à élevée, telles que définies par l'OMS. En juillet 2022, l'OMS a délivré son approbation pour la préqualification du vaccin RTS,S.
- En décembre 2021, le Conseil d'administration de Gavi, l'Alliance du Vaccin, a approuvé un investissement initial de près de US$ 160 millions (sur la période 2022-2025) pour étendre le déploiement du vaccin contre le paludisme dans les pays éligibles au soutien de Gavi.
- Gavi a estimé que la demande régulière de vaccins devrait dépasser 80 à 100 millions de doses par an. Pour anticiper un écart entre l'offre et la demande, l'OMS a coordonné le développement d'un cadre pour la répartition des approvisionnements limités en vaccins antipaludiques, afin de déterminer où le nombre limité de doses devra être alloué de manière transparente et équitable, sur la base de principes éthiques et des meilleures données disponibles.

- En août 2022, le Fonds des Nations Unies pour l'enfance (UNICEF) a annoncé qu'il avait assuré l'approvisionnement en vaccins produits par GSK, à savoir la fourniture de 18 millions de doses de vaccin antipaludique sur les trois prochaines années (2023-2025).
- Depuis juin 2022, l'OMS et Gavi ont soutenu plus de 20 pays au travers d'ateliers multinationaux dédiés à la préparation de dossiers de demande de subventions à Gavi. Appuyée par l'OMS, l'adaptation au niveau sous-national du déploiement du vaccin antipaludique, sur la base des orientations du Cadre pour la répartition des approvisionnements limités en vaccins antipaludiques, représente une part essentielle de cette initiative.

Urgences sanitaires et humanitaires

- Les pays d'endémie palustre ont été confrontés à diverses urgences sanitaires et humanitaires sans rapport avec la pandémie de COVID-19. En 2021, on estime que 268 millions de personnes ont dû faire face à des urgences humanitaires, contre 301 millions en 2020.
- Les conflits, la famine et les inondations ont été les principales causes d'urgences humanitaires, parfois aggravées par des épidémies.
- En 2021, les pays les plus touchés (en nombre de personnes affectées) par les crises sanitaires et humanitaires ont été l'Afghanistan, la Colombie, l'Éthiopie, le Mali, le Myanmar, le Nigéria, l'Ouganda, la République démocratique du Congo, la Somalie, le Soudan, le Soudan du Sud et le Yémen.

Perturbation des services antipaludiques durant la pandémie de COVID-19

- Quarante-six pays avaient des campagnes de distribution de moustiquaires imprégnées d'insecticide (MII) prévues sur 2020, pour un total de 272 millions de moustiquaires à distribuer. Fin 2020, 74 % de toutes les MII dont la distribution était prévue sur l'année avaient effectivement été distribuées.
- Quarante trois pays avaient prévu des campagnes de distribution de MII sur 2021 et quatorze de ces pays ne prévoyaient de distribuer que les moustiquaires prévues pour 2020.
- Globalement, il était donc prévu de distribuer 171 millions de MII en 2021 dont 70 millions étaient initialement programmées pour 2020. Au total, 128 millions de MII (soit 75 %) ont été distribuées en 2021.
- Huit pays (Bénin, Érythrée, Îles Salomon, Indonésie, Nigéria, Ouganda, Thaïlande et Vanuatu) ont distribué moins de 60 % de leurs MII en 2021. Sept pays (Botswana, Haïti, Inde, Pakistan, République centrafricaine, Sierra Leone et Tchad) n'ont distribué aucune des moustiquaires prévues pour 2021. L'Inde, le Nigéria et l'Ouganda, trois pays soutenus dans le cadre de l'approche « high burden to high impact » (HBHI), ont distribué respectivement 0 %, 53 % et 26 % des moustiquaires prévues pour 2021.
- Les résultats de la 3e série d'enquêtes indicatives sur les services de santé essentiels, menée de novembre à décembre 2021, suggèrent que les perturbations dans l'accès au diagnostic et au traitement du paludisme dans la région Afrique de l'OMS se sont largement dissipées au cours des derniers mois de 2021, avec sept pays signalant des perturbations, contre 16 en 2020 et neuf au premier trimestre 2021.

ÉVOLUTION DU NOMBRE DE CAS ET DE DÉCÈS

Cas de paludisme

- Au niveau mondial, le nombre de cas de paludisme est estimé à 247 millions en 2021 dans 84 pays d'endémie palustre (y compris le territoire de la Guyane française), soit une hausse par rapport aux 245 millions de 2020. La plupart des cas supplémentaires sont estimés dans la région Afrique de l'OMS. En 2015, l'année de référence de la Stratégie technique mondiale de lutte contre le paludisme 2016-2030 ([le] GTS), le nombre de cas de paludisme était estimé à 230 millions.
- L'incidence du paludisme (i. e. nombre de cas pour 1 000 habitants exposés au risque de paludisme) a reculé au niveau mondial, passant de 82 en 2000 à 57 en 2019, avant d'augmenter à nouveau pour atteindre 59 en 2020. Ce nombre n'a pas évolué de 2020 à 2021. L'augmentation de 2020 est associée à la perturbation des services durant la pandémie de COVID-19.

- Entre 2019 et 2021, 13,4 millions de cas supplémentaires ont été attribués aux perturbations dues à la pandémie de COVID-19, selon les estimations.
- Le pourcentage des infections à *P. vivax* a diminué, passant de 8 % (20,5 millions) en 2000 à 2 % (4,9 millions) en 2021.
- Vingt-neuf pays ont concentré 96 % du nombre total de cas de paludisme dans le monde. Quatre d'entre eux ont enregistré, à eux seuls, près de la moitié des cas : le Nigéria (27 %), la République démocratique du Congo (12 %), l'Ouganda (5 %) et le Mozambique (4 %).
- En 2021, la région Afrique de l'OMS représentait environ 95 % (234 millions) des cas estimés dans le monde.
- Dans la région Afrique de l'OMS, l'incidence du paludisme a baissé de 373 à 225 cas pour 1 000 habitants exposés au risque de paludisme sur la période 2000-2019 avant de remonter à 234 en 2020, principalement en raison de la perturbation des services pendant la pandémie de COVID-19. En 2021, l'incidence du paludisme a reculé pour atteindre 229 cas pour 1 000 habitants.
- Le Cabo Verde a rapporté zéro cas de paludisme indigène pour la troisième année consécutive, mettant fin à l'épidémie de paludisme.
- La région Asie du Sud-Est de l'OMS a concentré près de 2 % des cas de paludisme dans le monde. Le nombre de cas y a chuté de 76 %, passant de 23 millions en 2000 à près de 5 millions en 2021. De même, l'incidence du paludisme dans cette région a diminué de 82 %, avec quelque 18 cas pour 1 000 habitants exposés au risque de paludisme en 2000, contre 3 en 2021.
- L'Inde a représenté à elle seule 79 % des cas de paludisme dans la région. Le Sri Lanka a été certifié exempt de paludisme en 2016 et reste sans paludisme.
- Entre 2020 et 2021, 400 000 cas supplémentaires ont été dénombrés dans la région, dont la moitié au Myanmar.
- Le nombre de cas de paludisme dans la région Méditerranée orientale de l'OMS a réduit de 38 %, passant de près de 7 millions de cas en 2000 à 4 millions environ en 2015. Entre 2016 et 2021, il a augmenté de 44 % pour atteindre 6,2 millions.
- Sur la période 2000-2020, l'incidence du paludisme dans la région Méditerranée orientale de l'OMS a diminué de 20 à 12 cas pour 1 000 habitants exposés au risque de paludisme. Avec quelque 54 % des cas, le Soudan est le pays le plus touché dans cette région. En 2021 et pour la quatrième année consécutive, la République islamique d'Iran a rapporté zéro cas de paludisme indigène. Quant à l'Arabie saoudite, elle n'a signalé, en 2021 et pour la première fois, aucun cas de paludisme indigène.
- Dans la région Pacifique occidental de l'OMS, 1,4 million de cas ont été estimés en 2021, soit une baisse de 49 % par rapport aux 3 millions de 2000. Sur la même période, l'incidence du paludisme est passée de quatre à deux cas pour 1 000 habitants exposés au risque de paludisme. La Papouasie-Nouvelle-Guinée a enregistré près de 87 % des cas dans cette région en 2021. En 2021, la Chine a été certifiée exempte de paludisme par l'OMS et, pour la quatrième année de suite, la Malaisie n'a rapporté aucun cas de paludisme humain en 2021.
- Dans la région Amériques de l'OMS, le nombre de cas de paludisme a diminué de 60 % (passant de 1,5 million à 0,6 million) et l'incidence du paludisme de 70 % (de 14 à 4) entre 2000 et 2021. Les progrès réalisés dans cette région ces dernières années ont souffert de la forte hausse du paludisme en République bolivarienne du Venezuela, qui avait recensé près de 35 500 cas en 2000 contre plus de 482 000 en 2017. En 2020, le nombre de cas y a été réduit de plus de 50 % (223 000) par rapport à 2019, avant de continuer à décroître (205 000) en 2021. Ce recul s'explique par la limitation des déplacements due à la pandémie de COVID-19 et la pénurie de carburant ayant affecté l'industrie minière, qui contribue grandement à l'augmentation récente du paludisme dans le pays. Cette limitation des déplacements peut aussi avoir freiné l'accès aux soins, réduisant ainsi le nombre de cas de paludisme rapportés par les établissements de santé.
- En 2021, les cas estimés ont plus que doublé au Honduras et au Panama par rapport à 2019. Sur la même période, des baisses significatives des cas de paludisme ont été enregistrées en République bolivarienne du Venezuela (-263 000), au Brésil (-17 000), en Colombie (-17 000) et au Pérou (-22 000).
- Le Brésil, la Colombie et la République bolivarienne du Venezuela ont concentré plus de 79 % des cas dans cette région.
- L'Argentine, El Salvador et le Paraguay ont été certifiés exempts de paludisme en 2019, 2021 et 2018, respectivement. Le Belize n'a signalé aucun cas de paludisme indigène pour la troisième année consécutive, mettant fin à l'épidémie de paludisme.
- Depuis 2015, la région Europe de l'OMS est exempte de paludisme.

Mortalité associée

- Au niveau mondial, le nombre de décès dus au paludisme a baissé de façon régulière sur la période 2000-2019, passant de 897 000 en 2000 à 577 000 en 2015, puis à 568 000 en 2019. En 2020, le nombre de décès dus au paludisme a augmenté de 10 % par rapport à 2019, atteignant 625 000 selon les estimations. En revanche, les estimations concernant le nombre de décès en 2021 ont légèrement diminué pour s'élever à 619 000. Entre 2019 et 2021, 63 000 décès ont été provoqués par les perturbations des services antipaludiques essentiels pendant la pandémie de COVID-19.
- Les enfants de moins de 5 ans représentaient 87 % des décès associés au paludisme en 2000, contre 76 % en 2015. Aucune évolution n'est à noter depuis lors.
- La mortalité associée au paludisme (i. e. nombre de décès pour 100 000 habitants exposés au risque de paludisme) a diminué de moitié au niveau mondial, passant de 30 en 2000 à 15 en 2015. La baisse s'est ensuite poursuivie à un rythme plus modeste pour atteindre 14 en 2019. En 2020, le taux de mortalité est remonté à 15,1, avant de légèrement diminuer à 14,8 en 2021.
- Au niveau mondial, près de 96 % des décès dus au paludisme ont été enregistrés dans 29 pays. Quatre pays ont concentré un peu plus de la moitié des décès dus au paludisme dans le monde en 2021 : le Nigéria (31 %), la République démocratique du Congo (13 %), le Niger (4 %) et la République Unie de Tanzanie (4 %).
- Dans la région Afrique de l'OMS, le nombre de décès dus au paludisme a diminué, passant de 841 000 en 2000 à 541 000 en 2018, avant de remonter à 599 000 en 2020. Selon les estimations, le nombre de décès a de nouveau baissé en 2021 pour atteindre 593 000. Sur la période 2000-2019, la mortalité associée a baissé de 62 %, chutant de 148 à 56 décès pour 100 000 habitants exposés au risque de paludisme, avant de remonter à 60 en 2020 pour finalement retomber à 58 en 2021.
- Depuis 2018, le Cabo Verde n'a signalé aucun décès dû au paludisme.
- Dans la région Asie du Sud-Est de l'OMS, le nombre de décès dus au paludisme a diminué de 74 %, avec 35 000 décès en 2000 contre 9 000 en 2019. Ce nombre est resté inchangé depuis trois ans.
- L'Inde a concentré environ 83 % des décès dus au paludisme dans la région Asie du Sud-Est de l'OMS.
- Dans la région Méditerranée orientale de l'OMS, le nombre de décès dus au paludisme a diminué de 45 %, passant de 13 600 en 2000 à 7 500 en 2014. Il a ensuite augmenté de 79 % entre 2014 et 2021 pour atteindre 13 400. La plus grande partie de cette augmentation a été observée au Soudan, où plus de 90 % des cas sont des infections à *P. falciparum*, dont le taux de létalité est supérieur aux infections à *P. vivax*.
- Dans la région Méditerranée orientale de l'OMS, la mortalité liée au paludisme a baissé de 60 % entre 2000 et 2009. Toutefois, elle est restée pratiquement inchangée depuis 2016, affichant une légère augmentation de 28 % pour passer de 2 à 2,5 décès pour 100 000 habitants à risque.
- Dans la région Pacifique occidental de l'OMS, le nombre de décès dus au paludisme a diminué de 58 %, passant de 6 200 en 2000 à 2 600 en 2021. Sur la même période, la mortalité associée a baissé de 67 %, chutant de 0,9 à 0,3 décès pour 100 000 habitants exposés au risque de paludisme. Dans cette région, la Papouasie-Nouvelle-Guinée a enregistré près de 94 % des décès dus au paludisme en 2021.
- Dans la région Amériques de l'OMS, le nombre de décès dus au paludisme a diminué de 64 % (919 contre 334) et la mortalité associée de 73 % (0,8 contre 0,2). La plupart des décès (78 %) dans cette région ont été enregistrés parmi les adultes.

Nombre de cas de paludisme et de décès évités

- Selon les estimations, 2 milliards de cas de paludisme et 11,7 millions de décès associés ont été évités dans le monde entre 2000 et 2021.
- La plupart des cas (82 %) et des décès (95 %) évités l'auraient été dans la région Afrique de l'OMS, suivie par la région Asie du Sud-Est (10 % des cas et 3 % des décès).

Poids du paludisme pendant la grossesse

- En 2021, sur les 40 millions de femmes enceintes vivant dans 38 pays de la région Afrique de l'OMS où la transmission est modérée à élevée, 13,3 millions (32 %) ont été exposées à une infection palustre durant leur grossesse.

- En détaillant les sous-régions de l'OMS, l'Afrique de l'Ouest a affiché la plus forte prévalence d'exposition au paludisme durant la grossesse (40,7 %), suivie de près par l'Afrique centrale (39,8 %), alors que la prévalence était de 20 % en Afrique de l'Est et en Afrique australe.
- Sans prévention du paludisme pendant la grossesse, il est estimé que 961 000 enfants auraient présenté un faible poids à la naissance dans ces 38 pays. Dans les 33 pays ayant mis en œuvre le TPIp, 457 000 cas estimés de faible poids à la naissance ont été évités.
- Si toutes les femmes enceintes se rendant au moins une fois à une consultation prénatale recevaient une seule dose de TPIp, en supposant qu'elles soient toutes éligibles et que le taux de couverture en TPIp par deux et trois doses restait aux niveaux actuels, 55 000 cas supplémentaires de faible poids à la naissance auraient été évités dans ces 33 pays qui fournissent des données sur ce traitement.
- Si la couverture en TPIp par trois doses atteignait le taux de couverture des soins prénataux (une visite), et si ce taux de couverture était maintenu pour les consultations prénatales suivantes, 162 000 enfants supplémentaires ne présenteraient pas un faible poids à la naissance.
- Si 90 % des femmes enceintes recevaient trois doses de TPIp, 265 000 enfants supplémentaires ne présenteraient pas un faible poids à la naissance.
- Éviter l'insuffisance pondérale à la naissance, qui représente un risque important de mortalité néonatale et infantile, permettrait de sauver de nombreuses vies.

ÉLIMINATION DU PALUDISME ET PRÉVENTION DE SA RÉAPPARITION

- Les progrès vers l'élimination du paludisme s'accélèrent : les pays endémiques n'étaient que 84 en 2021 contre 108 en 2000.
- Le nombre de pays où le paludisme était endémique en 2000 et qui ont rapporté moins de 100 cas a augmenté, passant de 6 en 2000 à 27 en 2020 comme en 2021.
- Entre 2000 et 2021, les pays comptant moins de 10 cas de paludisme indigène sont passés de 4 à 25.
- Sur la période 2010-2021, le nombre total de cas de paludisme dans les pays « visant l'élimination du paludisme d'ici 2025 » (initiative E-2025) a diminué de 82,8 %. Cependant, ces pays et territoires ont enregistré une hausse des cas de 30,4 % entre 2020 et 2021.
- Dans la région Asie du Sud-Est de l'OMS, le nombre d'infections par *P. knowlesi* chez l'homme a considérablement augmenté dans certains pays, notamment la Malaisie. Aucun cas de paludisme indigène chez l'homme ou décès associé n'a été signalé en Malaisie ces quatre dernières années. Néanmoins, 17 125 cas d'infections par *P. knowlesi* et 48 décès ont été rapportés au total dans ce pays.
- Au cours de la seule année 2021, 3 575 infections par *P. knowlesi* ont été signalées, entraînant 13 décès. Sur la même période, 435 infections supplémentaires par *P. knowlesi* ont été signalées dans la région Asie du Sud-Est de l'OMS, à savoir en Indonésie, aux Philippines et en Thaïlande.
- Le Belize et le Cabo Verde n'ont signalé aucun cas de paludisme pour la troisième année consécutive, alors que la République islamique d'Iran et la Malaisie ont rapporté zéro cas de paludisme indigène pour la quatrième année de suite. En 2021, le Timor-Leste, suite à la flambée épidémique de l'année précédente, a rapporté zéro cas de paludisme indigène. Quant à l'Arabie saoudite, elle n'a signalé, en 2021 et pour la première fois, aucun cas de paludisme indigène.
- Cinq pays (Azerbaïdjan, Belize, Cabo Verde, République islamique d'Iran et Tadjikistan) ont déposé une demande formelle de certification.
- Malgré les perturbations dues à a pandémie de COVID-19, 61,5 % des pays E-2025 signalant des cas de paludisme ont continué à enregistrer des progrès vers la réduction du poids de la maladie et son élimination. En 2021, plusieurs pays ont affiché des baisses de cas par rapport à 2020 : Afrique du Sud (33,7 %), Arabie saoudite (100 %), Bhoutan (59,1 %), Botswana (20,5 %), Mexique (32 %), Népal (56,2 %), République dominicaine (65,6 %), République de Corée (23 %), Suriname (85,9 %), Thaïlande (22,3 %), Timor-Leste (100 %) et Vanuatu (36,7 %).
- En revanche, les pays (et un territoire) suivants ont affiché des hausses en 2021 par rapport à 2020 : Comores (56,9 %), Costa Rica (52,4 %), Équateur (11,1 %), Eswatini (53,9 %), Guatemala (16.9 %), Guyane française (2,1 %), Honduras (47,4 %), Panama (55,3 %), République populaire démocratique de Corée (22,8 %) et Sao Tomé-et-Principe (28.9 %). Pour la deuxième année consécutive, le nombre de cas de paludisme indigène a augmenté en Équateur.

- En dépit des obstacles, de nombreux pays réalisent d'immenses progrès : entre 2011 et 2021, le taux de classification des cas au sein des pays E-2025 a augmenté de 7,6 % à 90,8 %, prouvant les efforts soutenus de ces pays dans la poursuite des objectifs d'élimination.
- Dans les six pays de la sous-région du Grand Mékong (Cambodge, Chine [province du Yunnan], Myanmar, République démocratique populaire lao, Thaïlande et Viet Nam), le nombre total de cas de paludisme indigène a globalement chuté de 76,5 %, alors que le nombre de cas de paludisme indigène à *P. falciparum* a diminué de 94,1 % entre 2000 et 2021. Ce recul a connu une accélération plus rapide depuis 2012, date à laquelle le programme « Mekong Malaria Elimination » (MME) a été lancé. Entre 2012 et 2021, la région a enregistré une baisse impressionnante du nombre de cas de paludisme indigène (86,4 %) et du nombre de cas de paludisme indigène à *P. falciparum* (95,7 %). En 2021, 90 082 cas de paludisme indigène et 16 484 cas de paludisme indigène à *P. falciparum* ont été signalés, soit une hausse de 17,3 % des cas de paludisme indigène et une diminution de 12,2 % des cas de paludisme indigène à *P. falciparum* par rapport à 2020.
- Les cas de paludisme à *P. falciparum* et *P. vivax* ont augmenté au Myanmar en 2021 du fait de l'instabilité politique persistante dans la zone. En 2021, le Myanmar a d'ailleurs continué à cumuler la majeure partie des cas de paludisme indigène (87,7 %) et des cas de paludisme indigène à *P. falciparum* (80,9 %).
- Les cas à *P. falciparum* ne cessant de diminuer, *P. vivax* apparaît comme l'espèce dominante dans la sous-région. En 2021, le Cambodge a signalé des rechutes pour la toute première fois : le pays a enregistré 1 978 cas de rechute au total, ce qui représente 48 % de tous les cas de paludisme indigène au niveau national.
- Les pays de la sous-région du Grand Mékong tirent parti de l'exercice de vérification au niveau sous-national pour renforcer leurs programmes de prévention de la réapparition du paludisme et préparer leur certification par l'OMS.
- De 2000 à 2021, la transmission du paludisme n'est réapparue dans aucun des pays préalablement certifiés exempts du paludisme.

APPROCHE « HIGH BURDEN TO HIGH IMPACT »

- Depuis novembre 2018, les 11 pays de l'approche « high burden to high impact » (HBHI) ont mis en œuvre des activités en rapport avec les quatre éléments de riposte définis.
- En 2020 et 2021, l'OMS et le Partenariat RBM pour en finir avec le paludisme ont apporté leur soutien à ces pays afin qu'ils réalisent des auto-évaluations rapides sur les progrès accomplis dans l'atteinte des objectifs HBHI relatifs aux quatre éléments de riposte.
- En 2021, avec l'augmentation continue des cas de paludisme, les pays HBHI représentaient 68 % des cas de paludisme et 70 % des décès associés.
- Entre 2020 et 2021, le nombre de cas de paludisme dans les pays HBHI est passé de 163 millions à 168 millions, alors que le nombre de décès a diminué de 444 600 à 427 854.
- En 2021, avec l'augmentation continue des cas de paludisme, les pays suivants ont recensé la majeure partie des cas de paludisme : Nigéria (39 %), République démocratique du Congo (18,2 %), Ouganda (7,8 %) et Mozambique (6,1 %).
- Cinq des 11 pays HBHI (Ghana, Inde, Niger, République démocratique du Congo et République Unie de Tanzanie) ont enregistré une baisse du nombre de décès dus au paludisme, même si la maladie y sévit encore lourdement par rapport à l'ensemble des pays HBHI.

SURVEILLANCE

- Plus de 40 pays utilisent à l'heure actuelle les kits de surveillance du paludisme conçus pour le système d'information sur la santé au niveau du district (DHIS2) et 34 pays ont adopté le module sur le paludisme.

- Des modules standardisés dédiés à l'entomologie et à la lutte antivectorielle ont également été développés pour aider les pays à améliorer la collecte et l'utilisation des données sur les interventions entomologiques et de lutte antivectorielle.
- Une série d'outils a été développée ou améliorée pour aider à la surveillance de l'élimination du paludisme par la plate-forme web DHIS2 et de l'application de saisie des données DHIS2 pour Android. Ces outils peuvent être utilisés pour la notification et l'investigation des cas, pour l'investigation des foyers et, de manière générale, pour la définition des éléments de réponse.
- Au total, 12 pays ont commencé à établir des référentiels sur le paludisme, qui constituent des entrepôts réunissant toutes les données sur le paludisme.
- L'OMS a lancé la Boîte à outils d'évaluation de la surveillance du paludisme, qui offre une méthode standardisée et systématique pour évaluer la performance des systèmes de surveillance.
- Le Burkina Faso (2020), le Cameroun (2021), le Ghana (2021) et la République démocratique du Congo (2021) ont entrepris une évaluation de leur système de surveillance à l'aide de cette boîte à outils. Les évaluations de ces pays (sauf celle du Cameroun) sont prêtes à être publiées et mettent en lumière le bon niveau d'exhaustivité et d'actualité du reporting, mais un manque de correspondance entre les variables de base des registres et des rapports agrégés.

INVESTISSEMENTS DANS LES PROGRAMMES ET LA RECHERCHE ANTIPALUDIQUES

- Le GTS donne une estimation des fonds requis pour atteindre les objectifs intermédiaires de 2025 et 2030. Au total, les ressources annuelles nécessaires ont été estimées à US$ 6,8 milliards en 2020, avec une hausse à US$ 9,3 milliards en 2025 et US$ 10,3 milliards d'ici 2030. Toujours selon les estimations, US$ 850 000 millions supplémentaires seront requis chaque année pour la recherche et le développement (R&D) sur le paludisme au niveau mondial durant la période 2021-2030.
- En 2021, US$ 3,5 milliards ont été investis au total pour le contrôle et l'élimination du paludisme, contre US$ 3,3 milliards en 2020 et US$ 3,0 milliards en 2019. Les investissements de 2021 ont été bien inférieurs aux US$ 7,3 milliards estimés nécessaires au niveau mondial pour rester sur la voie des objectifs du GTS.
- L'écart entre investissements et ressources nécessaires a augmenté de façon spectaculaire au cours de ces dernières années, passant de US$ 2,6 milliards en 2019 à US$ 3,5 milliards en 2020, puis à US$ 3,8 milliards en 2021.
- Sur la période 2010-2021, 67 % des fonds dédiés à la lutte contre le paludisme et à son élimination, soit près de US$ 2,4 milliards, provenaient de sources internationales. La contribution des États-Unis s'est élevée à plus de US$ 1,3 milliard au travers de financements bilatéraux planifiés et de la part, ajustée au paludisme, provenant des agences de contributions multilatérales. Sont venues s'y ajouter, par ordre d'importance, les contributions de partenaires bilatéraux et multilatéraux : le Royaume Uni de Grande-Bretagne et d'Irlande du Nord (Royaume Uni) et l'Allemagne (environ US$ 200 millions), le Canada, la France et le Japon (environ US$ 100 millions), ainsi que d'autres pays membres du Comité d'aide au développement et bailleurs de fonds du secteur privé pour des contributions totales à hauteur de US$ 400 millions.
- En 2021, les gouvernements des pays d'endémie ont contribué à hauteur de plus d'un tiers du financement total, soit plus de US$ 1,1 milliard. Sur ce montant, US$ 300 millions ont été investis dans la prise en charge des cas de paludisme dans le secteur public et US$ 800 millions dans d'autres activités antipaludiques, ce qui correspond à une augmentation de US$ 100 millions par rapport à 2020.
- Sur les US$ 3,5 milliards investis en 2020, plus de US$ 1,5 milliard (44 %) ont transité par le Fonds mondial. Par rapport aux années précédentes, les décaissements du Fonds mondial en faveur des pays d'endémie ont augmenté de près de US$ 100 millions depuis 2020 et de US$ 300 millions depuis 2019.
- Les classifications de la Banque mondiale par groupes de revenus varient d'une année sur l'autre. En 2021, les 27 pays du groupe à faible revenu ont représenté 47 % du financement total. Leur financement a augmenté de plus de 50 % depuis 2010 et ils recensent plus de 90 % des cas de paludisme et décès associés au niveau mondial. Les 39 pays à revenu faible et intermédiaire ont représenté 41 % du financement total en 2021. Les autres pays et certaines régions non précisées, qui n'avaient fourni

aucune donnée géographique sur les destinataires, ont représenté 12 % du financement de la lutte contre le paludisme.

- L'évaluation du financement de la lutte contre le paludisme par personne à risque révèle des écarts entre les financements nationaux et internationaux au sein des régions de l'OMS, et montre des changements importants au cours des dix dernières années. La plupart des régions de l'OMS ont vu le financement par personne à risque chuter à des niveaux inférieurs à 2010, hormis la région Afrique de l'OMS, où le financement a doublé en 2021 par rapport à 2010.
- Sur les US$ 3,5 milliards investis en 2021, plus des trois quarts (78 %) ont été dirigés vers la région Afrique de l'OMS, suivie par les régions Asie du Sud-Est et Méditerranée orientale (5 % chacune), Amériques (4 %) et Pacifique occidental (3 %). Les 5 % restants ont été alloués à des régions non précisées.
- De nombreux pays ont vu leur produit intérieur brut (PIB) réel fluctuer du fait de la pandémie de COVID-19 et d'autres crises. Ces fluctuations ont affecté l'économie mondiale, qui a progressé de 5,5 % en 2021 après une contraction de 3,4 % en 2020. En 2021, les pays à plus faible revenu ainsi qu'à revenu faible et intermédiaire ont affiché une croissance significative. En effet, seuls 11 % de ces pays ont subi un contrecoup négatif sur leur PIB réel alors qu'ils étaient 70 % en 2020. Bien que le financement de la lutte contre le paludisme n'ait cessé d'augmenter, l'impact réel de la pandémie de COVID-19, la crise économique qui en a découlé, divers autres facteurs internationaux et l'accroissement de la population à risque vont continuer de peser dans les années à venir.
- Les fonds dédiés à la recherche et au développement (R&D) ont atteint US$ 626 millions en 2021.
- Depuis le pic de 2018, ce financement diminue pour la troisième année de suite et ce, dans presque toutes les catégories de produits antipaludiques. La Fondation Bill & Melinda Gates a notamment réduit le montant de ses investissements. Elle reste pourtant le troisième plus important bailleur de fonds engagé dans la recherche et le développement du vaccin antipaludique, après les Instituts nationaux de santé américains (NIH) et les acteurs du secteur en général.
- La recherche fondamentale a connu la plus forte diminution en valeur absolue de son financement en 2021 (–12 %), alors que les fonds pour la production de produits de lutte antivectorielle ont décliné d'un peu moins de 20 % depuis 2020. En 2021, le financement de R&D concernant les outils de diagnostic s'est élevé à 2,5 % du financement total de la lutte contre le paludisme, son niveau le plus bas depuis 2013. Seuls la recherche et le développement de traitements ont évolué à contre-courant de la tendance générale à la baisse, avec une hausse de 2,3 % pour les médicaments et de 7,0 % pour les produits biologiques.
- En matière de R&D et avec un financement stable d'environ US$ 189 millions, les Instituts nationaux de santé américains demeurent le principal bailleur de fonds en 2021, suivis par les acteurs du secteur et la Fondation Bill & Melinda Gates.

DISTRIBUTION ET COUVERTURE DES OUTILS DE PRÉVENTION DU PALUDISME

- Les fabricants de MII ont indiqué en avoir livré près de 2,5 milliards dans le monde entre 2004 et 2021, dont 2,2 milliards (87 %) en Afrique subsaharienne.
- En 2021, ces fabricants ont livré près de 220 millions de MII à des pays d'endémie. Sur ces 220 millions, 46 % étaient des moustiquaires imprégnées de butoxyde de pipéronyle (PBO) et 9 % des MII à double substance active.
- En 2021, 68 % des ménages vivant en Afrique subsaharienne disposaient d'au moins une MII, contre 5 % environ en 2000. Le pourcentage des ménages disposant d'au moins une MII pour deux membres du foyer est passé de 1 % en 2000 à 38 % en 2021. Durant la même période, le pourcentage de la population ayant accès à une MII dans son foyer a augmenté de 3 % à 54 %.
- Le pourcentage de la population dormant sous une MII a aussi considérablement augmenté entre 2000 et 2021, qu'il s'agisse de la population dans son ensemble (de 2 % à 47 %), des enfants âgés de moins de 5 ans (de 3 % à 53 %) ou des femmes enceintes (de 3 % à 53 %).
- Cependant, depuis 2017, les indicateurs sur l'accès aux MII et sur leur utilisation sont en baisse.
- Au niveau mondial, le pourcentage de la population à risque protégée par pulvérisation intradomiciliaire d'insecticides à effet rémanent (PID) dans les pays d'endémie a reculé, passant de

5,5 % en 2010 à 2,4 % en 2021. Le pourcentage de la population protégée par PID est stable depuis 2016, avec moins de 6 % dans chacune des régions de l'OMS.

- Au niveau mondial, le nombre de personnes protégées par PID a chuté de 153 millions en 2010 à 112 millions en 2015, puis à 80 millions en 2021.
- Le nombre moyen d'enfants traités par cycle de CPS n'a cessé d'augmenter, passant de quelque 0,2 million en 2012 à près de 45 millions en 2021.
- Dans les 15 pays ayant mis en œuvre la CPS, près de 180 millions de doses ont été livrées en 2021.
- Le pourcentage d'utilisation (par nombre de doses) du TPIp a été calculé sur la base des données provenant de 33 pays de la région Afrique de l'OMS. En 2021, 72 % des femmes enceintes ont reçu des soins prénataux au moins une fois durant leur grossesse. Environ 55 % des femmes enceintes ont reçu une dose de TPIp, alors que 45 % ont reçu deux doses, et 35 % trois doses.

DISTRIBUTION ET COUVERTURE DES OUTILS DE DIAGNOSTIC ET DE TRAITEMENT DU PALUDISME

- De 2010 à 2021, 3,5 milliards de tests de diagnostic rapide (TDR) du paludisme ont été vendus dans le monde, dont 82 % à destination des pays d'Afrique subsaharienne. Durant la même période, 2,4 milliards de TDR ont été distribués par les programmes nationaux de lutte contre le paludisme (PNLP), dont 88 % en Afrique subsaharienne.
- En 2021, 413 millions de TDR ont été vendus par les fabricants et 262 millions distribués par les PNLP.
- Entre 2010 et 2021, près de 3,8 milliards de traitements par ACT ont été vendus dans le monde. Sur ces ventes, environ 2,6 milliards ont été livrés au secteur public des pays d'endémie. Le reste correspond à des mécanismes de co paiement public ou privé du Fonds pour des médicaments antipaludéens à des prix abordables (AMFm) ou du Fonds mondial, voire à des livraisons au secteur privé en dehors du mécanisme de co paiement du Fonds mondial pour chacune de ces deux années.
- Les données nationales rapportées par les PNLP montrent que, de 2010 à 2021, 2,4 milliards de traitements par ACT ont été livrés à des prestataires de santé pour le traitement des patients au sein d'un établissement public.
- En 2021, quelque 225 millions de traitements par ACT ont été livrés par les fabricants au secteur public. Cette même année, les PNLP ont distribué 242 millions de traitements par ACT dans ce secteur, dont 97 % en Afrique subsaharienne.
- Les données compilées à partir d'enquêtes réalisées auprès des ménages entre 2005 et 2021 dans 20 pays d'Afrique subsaharienne (ayant mené au moins deux enquêtes : l'une entre 2005-2011 pour servir de référence et l'autre entre 2015-2021 pour la plus récente) ont permis d'analyser le taux de sollicitation de traitement, la couverture en diagnostic et l'utilisation des ACT chez les enfants de moins de 5 ans.
- En comparant enquêtes de référence et enquêtes plus récentes, peu de différences sont apparues concernant la prévalence de la fièvre dans les 2 semaines précédant les enquêtes (médiane de 25 % contre 20 %) ou la sollicitation de traitement en cas de fièvre (médiane de 65 % contre 67 %).
- Les comparaisons de la source du traitement entre enquêtes de référence et enquêtes plus récentes indiquent une médiane de 58 % contre 69 % pour les soins reçus dans des établissements de santé publics, et une médiane de 40 % contre 28 % pour les soins administrés dans le secteur privé. Le recours aux agents de santé communautaires est resté faible sur ces deux périodes, avec une médiane de 2 % (enquêtes de référence) et 1 % (enquêtes plus récentes).
- Le taux de couverture en diagnostic chez les enfants de moins de 5 ans avec de la fièvre et pour lesquels des soins ont été sollicités a largement progressé, d'une médiane de 30 % au départ à 57 % dans les dernières enquêtes.
- L'utilisation des ACT parmi les enfants fiévreux pour lesquels des soins ont été sollicités a également augmenté, passant de 14 % à 24 % dans les dernières enquêtes.
- Parmi les enfants fiévreux ayant subi un prélèvement sanguin au doigt ou au talon, le recours aux ACT a atteint 29 % dans les dernières enquêtes, alors qu'il correspondait à 21 % dans les enquêtes de référence.

PROGRÈS VERS L'ATTEINTE DES OBJECTIFS DU GTS POUR 2020

- Le GTS vise à réduire l'incidence du paludisme et la mortalité associée d'au moins 75 % d'ici 2025 et 90 % d'ici 2030 en se basant sur les données de référence de 2015. En 2020, le GTS avait pour objectif d'atteindre une réduction de 40 %.
- Le nombre de pays ayant atteint les objectifs du GTS pour 2021 a été extrapolé à partir des estimations officielles du poids du paludisme plutôt qu'à partir de projections (selon la méthode déjà utilisée dans le *Rapport sur le paludisme dans le monde 2020*).
- En 2020 et 2021, les estimations tiennent compte de l'effet des perturbations des services antipaludiques durant la pandémie et sont basées sur une nouvelle méthode de quantification de la part des décès attribuables au paludisme.
- En dépit des progrès considérables accomplis depuis 2000, les objectifs intermédiaires du GTS pour 2020 relatifs à la morbidité et la mortalité n'ont pas été atteints au niveau mondial. Si la tendance actuelle se confirme, l'ensemble des objectifs du GTS pour 2025 ne seront également pas atteints au niveau mondial.
- En 2021, l'incidence du paludisme s'est établie à 59 cas pour 1 000 habitants à risque, au lieu des 31 cas représentés par l'objectif intermédiaire de morbidité fixé dans le GTS. En d'autres termes, nous sommes à 48 % en deçà de notre objectif.
- Même si la baisse de la mortalité est plus nette, relativement, que la baisse de l'incidence, l'objectif intermédiaire du GTS pour 2021 défini à 7,8 décès pour 100 000 habitants exposés au risque de paludisme était 48 % en deçà de la mortalité réellement établie au niveau mondial à 14,8 pour 100 000 en 2021.
- Sur les 93 pays où le paludisme était endémique en 2015 (y compris le territoire de la Guyane française), 39 (42 %) ont atteint l'objectif intermédiaire pour 2021 en matière de morbidité. En effet, ils ont réduit leur incidence de 40 % ou plus, ou ont rapporté zéro cas de paludisme.
- Dix-neuf pays (20 %) ont réussi à faire baisser l'incidence du paludisme, mais pas suffisamment pour atteindre l'objectif fixé.
- Vingt-sept pays (29 %) ont enregistré une hausse de l'incidence, et dans 14 pays (15 %) elle était en hausse de 40 % ou plus en 2021 par rapport à 2015.
- Dans huit pays (8,6 %), l'incidence du paludisme en 2021 a été estimée à un niveau équivalent à celui de 2015.
- Quarante-trois pays (46 %) où le paludisme était endémique en 2015 ont atteint l'objectif intermédiaire du GTS pour 2021 en matière de mortalité, et 28 d'entre eux ont rapporté zéro décès lié au paludisme.
- Vingt-deux pays (24 %) ont réduit la mortalité due au paludisme, mais leurs progrès sont restés en deçà de l'objectif de 40 %.
- En 2021, la mortalité due au paludisme est restée au même niveau qu'en 2015 dans neuf pays (9,7 %) ; elle a augmenté dans 19 pays (20 %), et de 40 % ou plus dans 11 d'entre eux.
- La région Asie du Sud-Est de l'OMS a atteint les objectifs intermédiaires du GTS pour 2020 à la fois en matière de morbidité et de mortalité. Tous les pays de la région, à l'exception de l'Indonésie, ont réduit l'incidence et la mortalité de 40 % ou plus.

MENACES BIOLOGIQUES ET AUTRES PESANT SUR LES OUTILS D'INTERVENTION

Suppression des gènes *pfhrp2/3* du parasite

- Les parasites incapables d'exprimer la protéine riche en histidine 2 (HRP2) présentent le risque de ne pas être détectés par les TDR basés sur HRP2. Quant aux parasites qui n'expriment plus HRP2 ni la protéine riche en histidine 3 (HRP3), ils sont complètement indétectables au moyen de ce type de TDR.
- L'OMS a recommandé aux pays rapportant des suppressions des gènes *pfhrp2/3* et à leurs pays voisins de mener des études de référence représentatives sur les cas suspectés de paludisme, afin de déterminer si la prévalence des suppressions *pfhrp2/3* causant des « faux » résultats de TDR négatifs avait atteint un seuil qui nécessite un changement de TDR (suppressions du gène pfhrp2 > 5 % causant des faux résultats de TDR négatifs).

- Les alternatives aux TDR (par exemple, basées sur la détection du lactate déshydrogénase du parasite [pLDH]) sont limitées. Il n'existe à l'heure actuelle aucune combinaison de tests non HRP2 préqualifiée par l'OMS, capable de faire la distinction entre *P. falciparum* et *P. vivax*.
- L'OMS effectue un suivi des rapports publiés sur les suppressions des gènes *pfhrp2/3* par le biais de l'outil de cartographie Carte des menaces du paludisme, et encourage une approche harmonisée de cartographie et de signalement des suppressions des gènes *pfhrp2/3* grâce à des protocoles d'enquête accessibles au public.
- En 2022, plusieurs pays de la région Afrique de l'OMS ont initié la planification et la conduite d'études représentatives sur les suppressions des gènes *pfhrp2/3*. Les résultats sont attendus en 2022 et 2023.
- L'OMS a introduit un tableau de bord dans le but d'effectuer le suivi des activités de surveillance dans le monde et de fournir ainsi des renseignements sur les priorités, l'affectation des ressources et les prévisions concernant les TDR, ainsi que d'éviter la duplication des efforts. Ce tableau de bord comprend les principales caractéristiques des activités de surveillance et le calendrier correspondant.
- Entre septembre 2021 et septembre 2022, des enquêtes sur la suppression des gènes *pfhrp2/3* ont été rapportées dans 17 publications émanant de 17 pays : Bénin, Brésil, Cameroun, Djibouti, Équateur, Érythrée, Éthiopie, Gabon, Ghana, Guinée équatoriale, Inde, Kenya, Madagascar, République démocratique du Congo, République Unie de Tanzanie, Rwanda et Sierra Leone. Parmi ces pays, seuls la Guinée équatoriale, le Kenya et le Rwanda n'ont pas détecté de suppressions du gène *pfhrp2*, bien que ces trois pays aient signalé des suppressions dans des publications précédentes.
- En se basant sur les données de ces publications, y compris la Carte des menaces du paludisme, une forme d'enquête a été menée dans 47 pays, et la présence de suppressions est confirmée dans 40 d'entre eux.
- Dans son plan de réponse mondiale aux délétions *pfhrp2/3*, l'OMS expose plusieurs domaines d'action allant au-delà de l'intensification de la surveillance. Ces autres domaines d'action incluent l'identification de nouveaux biomarqueurs, l'amélioration des performances des TDR non HRP2, la réalisation de prévisions de marché et le renforcement des réseaux de laboratoires pour soutenir la demande concernant l'utilisation de la caractérisation moléculaire pour déterminer la présence ou l'absence de ces suppressions de gènes.

Résistance des parasites aux antipaludiques

- L'efficacité des médicaments antipaludiques fait l'objet d'une surveillance par le biais d'études relatives à l'efficacité thérapeutique, qui suivent les résultats cliniques et parasitologiques parmi les patients recevant des médicaments antipaludiques. Ces études relatives à l'efficacité thérapeutique sont considérées comme la norme de référence grâce à laquelle les pays peuvent établir au mieux leurs politiques de traitement.
- Plusieurs outils permettent d'évaluer la résistance aux médicaments antipaludiques. Dans certains cas, des mutations génétiques associées à une sensibilité réduite à des médicaments antipaludiques ont été identifiées. La résistance partielle à l'artémisinine est surveillée grâce à une liste établie de marqueurs *PfKelch13* candidats et validés, associés à une élimination retardée suite à un traitement contenant de l'artémisinine.
- L'OMS compile les résultats des études menées sur l'efficacité des médicaments antipaludiques et sur la résistance à ces médicaments, avant de les mettre à disposition via la Carte des menaces du paludisme.
- **Région Afrique de l'OMS:** entre 2015 et 2021, 266 études relatives à l'efficacité thérapeutique contre les infections à *P. falciparum* ont été menées au total dans la région Afrique de l'OMS en suivant le protocole normalisé de l'OMS, avec la participation d'au moins 20 patients. Parmi toutes ces études, six ont constaté un taux d'échec supérieur à 10 % : quatre avec l'artéméther-luméfantrine (AL) au Burkina Faso et en Ouganda, et deux avec la dihydroartémisinine-pipéraquine (DHA-PPQ) au Burkina Faso. Cinq autres études avec l'AL et deux avec la DHA-PPQ basées sur une méthodologie sans rapport avec les recommandations de l'OMS, mais opérant une distinction entre réinfection et recrudescence, ont rapporté des taux d'échec au traitement supérieurs à 10 %. Ces études ont été menées en Angola, en République démocratique du Congo et en Ouganda. Des mutations du gène *PfKelch13* sont apparues en Érythrée, au Rwanda et en Ouganda. Les taux d'échec au traitement y restent inférieurs à 10 %, car le médicament partenaire demeure efficace. D'autres études sont nécessaires pour déterminer l'étendue de la propagation des mutations du gène *PfKelch13*, ainsi que pour étudier tout changement de durée de clairance parasitaire et de résistance in vitro.

- **Région Amériques de l'OMS:** les données tirées d'études relatives à l'efficacité thérapeutique fournies par la région Amériques de l'OMS sont limitées. Les études relatives à l'efficacité thérapeutique de l'AL conduites entre 2015 et 2021 au Brésil et en Colombie ont démontré une efficacité élevée. Au Guyana, la mutation *PfKelch13* C580Y associée à la résistance à l'artémisinine a été observée sporadiquement entre 2010 et 2017, mais n'a pas été détectée parmi les échantillons plus récents, ce qui indique que cette mutation a probablement disparu.
- **Région Méditerranée orientale de l'OMS:** sur les 36 études relatives à l'efficacité thérapeutique contre les infections à *P. falciparum* menées dans la région Méditerranée orientale de l'OMS avec la participation d'au moins 20 patients, deux études avec l'artésunate-sulfadoxine-pyriméthamine (AS + SP) en Somalie et au Soudan ont constaté un taux d'échec supérieur à 10 %. Dans ces pays, les traitements de première intention sont désormais à base d'AL.
- **Région Asie du Sud-Est de l'OMS:** sur les 67 études relatives à l'efficacité thérapeutique contre les infections à *P. falciparum* menées dans la région Asie du Sud-Est de l'OMS avec la participation d'au moins 20 patients, aucune n'a signalé un taux d'échec supérieur à 10 %. Toutefois, la présence de mutations associées à la résistance à la SP en Inde centrale pourrait être un signe avant coureur de l'échec au traitement par AS + SP. En Thaïlande, où l'efficacité des médicaments est évaluée grâce à une surveillance intégrée de l'efficacité thérapeutique, les taux d'échec au traitement par DHA-PPQ et primaquine se sont avérés élevés dans la province du Sisaket. Cette province a donc modifié son traitement de première intention pour adopter l'artésunate-amodiaquine (AS-AQ) en 2020. Dans la sous-région du Grand Mékong, les mutations *PfKelch13* associées à la résistance à l'artémisinine affichent une forte prévalence au Myanmar et en Thaïlande.
- **Région Pacifique occidental de l'OMS:** sur les 63 études relatives à l'efficacité thérapeutique contre les infections à *P. falciparum* menées dans la région Pacifique occidental de l'OMS avec la participation d'au moins 20 patients, quatorze ont constaté un taux d'échec supérieur à 10 %. Seule une étude avec l'AL menée en République démocratique populaire lao en 2017 a détecté de forts taux d'échec (17,2 %), mais cette étude n'était basée que sur 29 patients et les études ultérieures ont prouvé la haute efficacité de l'AL. Deux études au Cambodge ont observé de forts taux d'échec avec l'artésunate-amodiaquine (AS-AQ), ce qui indique la présence d'une résistance à l'AQ au Cambodge. Des taux importants d'échec au traitement par DHA-PPQ ont été détectés au Cambodge, en République démocratique populaire lao et au Viet Nam, poussant ces pays à changer de médicament pour leur traitement de première intention. Dans la sous région du Grand Mékong, les mutations *PfKelch13* associées à la résistance à l'artémisinine affichent une forte prévalence au Cambodge, en République démocratique populaire lao et au Viet Nam. La mutation *PfKelch13* C580Y est également apparue en Papouasie Nouvelle Guinée et elle semble se propager.

Résistance des vecteurs aux insecticides

- De 2010 à 2020, quelque 88 pays ont transmis à l'OMS des données de surveillance sur la résistance aux insecticides, y compris sur l'intensité de la résistance aux pyréthoïdes (38 pays), ainsi que sur la capacité du butoxyde de pipéronyle (PBO) à restaurer la sensibilité aux pyréthoïdes (32 pays).
- En 2020, de nouveaux dosages discriminants et de nouvelles procédures de surveillance de la résistance des vecteurs du paludisme au chlorofénapyr, à la clothianidine, à la transfluthrine, au flupyradifurone et au pyriproxyfène ont été mis à disposition. Par ailleurs, les dosages discriminants pour le pyrimiphos-méthyl et l'alpha-cyperméthrine ont été révisés. Les pays doivent ajuster la surveillance de la résistance des vecteurs du paludisme aux insecticides conformément à ces nouvelles procédures. L'OMS n'a pas reçu de données sur la résistance des vecteurs à la transfluthrine, au flupyradifurone et au pyriproxyfène. Même si l'OMS a reçu quelques données sur la surveillance de la résistance au chlorfénapyr et à la clothianidine, ces données restent insuffisantes pour évaluer toute résistance potentielle à l'un de ces deux insecticides.
- Sur les 88 pays d'endémie ayant fourni des données pour la période 2010-2020, 78 ont détecté une résistance à au moins une des classes d'insecticides chez l'un des vecteurs du paludisme et sur un site de collecte. Par ailleurs, 29 pays ont constaté une résistance aux pyréthoïdes, aux organochlorés, aux carbamates et aux organophosphorés sur différents sites, et 19 pays ont confirmé la résistance à ces quatre classes d'insecticides chez au moins un des vecteurs du paludisme et sur au moins un site de collecte.
- Au niveau mondial, la résistance aux pyréthoïdes, la principale classe d'insecticides actuellement utilisés dans les MII, est largement répandue. Elle a été détectée chez au moins un des vecteurs du paludisme sur 68 % des sites pour lesquels des données sont disponibles. La résistance aux organochlorés a été rapportée sur 64 % des sites. La résistance aux carbamates et aux

organophosphorés a été moins prévalente, mais a été détectée, respectivement, sur 34 % et 28 % des sites disposant de données de surveillance.

- Sur les 38 pays ayant fourni des données sur l'intensité de la résistance aux pyréthoïdes, une résistance de forte intensité a été observée sur 293 sites répartis dans 27 pays.
- Depuis 2010, il a été noté que le butoxyde de pipéronyle (PBO) avait complètement restauré la sensibilité aux pyréthoïdes sur 283 sites répartis dans 29 pays.
- Pour orienter la gestion de la résistance, les pays doivent développer et mettre en œuvre des plans nationaux de suivi et de gestion de la résistance aux insecticides, en se basant sur le *Cadre conceptuel d'un plan national de suivi et de gestion de la résistance aux insecticides chez les vecteurs du paludisme* élaboré par l'OMS. Le nombre de pays ayant établi un tel plan est passé de 53 en 2019 à 67 en 2020.
- Un support technique et financier est nécessaire pour aider les pays à surveiller et à gérer la résistance aux insecticides.
- Toutes les données standard sur la résistance aux insecticides rapportées à l'OMS sont intégrées à la base de données mondiales de l'OMS sur la résistance aux insecticides chez les vecteurs du paludisme, et leur accès à des fins d'exploration est possible via la Carte des menaces du paludisme.

Efficacité des MII

- Les MII sont considérées comme la raison principale de la baisse de la transmission du paludisme et du poids de la maladie durant la période 2005-2015, surtout dans les zones de transmission modérée à élevée. Les moustiquaires imprégnées d'insecticide longue durée (MILD) restent efficaces et l'OMS en recommande l'utilisation continue pour prévenir le paludisme.
- Comme les MILD constituent le principal outil de lutte antivectorielle, les facteurs nuisant à leur efficacité dans le cadre de la prévention du paludisme sont importants pour les progrès réalisés contre la maladie. Ces facteurs comprennent la résistance physique de la moustiquaire (c'est-à-dire l'intégrité de sa structure) et sa longévité chimique (à savoir sa bio efficacité, qui correspond à la disponibilité de l'ingrédient actif à la surface de la moustiquaire au fil du temps), les contraintes opérationnelles et comportementales (livraison, accès, couverture et acceptation, utilisation, maintenance et préservation) et la dynamique des vecteurs (comportements des espèces lors des piqûres et au repos).
- L'émergence et la large propagation géographique de la résistance aux pyréthoïdes forment la menace la plus reconnue à l'efficacité des moustiquaires imprégnées de pyréthoïdes longue durée.
- Une étude clinique réalisée dans plusieurs pays, commandée par l'OMS et publiée en 2018 a montré que les MII continuaient de représenter un haut niveau de protection contre le paludisme, même en présence d'une forte résistance aux pyréthoïdes.
- À l'inverse, les données tirées de plusieurs études sur le terrain dans des cases expérimentales suggèrent que, plus la sensibilité des vecteurs aux pyréthoïdes diminue, plus les effets de répulsion et de mortalité sur les moustiques s'amenuisent.
- Une analyse par modélisation suggère d'ailleurs que l'impact épidémiologique des MII diminue en cas de hauts niveaux de résistance aux pyréthoïdes.
- La plus grande efficacité observée lors des essais aléatoires et contrôlés de certaines des MII de nouvelle génération (par rapport aux MII imprégnées uniquement de pyréthoïdes) laisse penser que la résistance aux insecticides a un impact sur les résultats épidémiologiques.
- En Afrique subsaharienne, destinataire de la plupart des MII, près de 590 millions de MII ont été distribuées aux communautés sur la période 2019-2021. Toutefois, en 2021, le pourcentage de la population ayant eu accès à une MII au sein des ménages et le pourcentage de la population dormant sous MII a été estimé à 54 % et 47 %, respectivement, du fait de plusieurs facteurs.
- Répartir efficacement les MII, les employer et les préserver comptent parmi les facteurs affectant la part de la population qui possède et utilise une moustiquaire. La répartition équitable des MII s'appuie sur l'identification des écarts de couverture au niveau local et l'élargissement de la distribution dans les zones concernées. La préservation des MII est déterminée par les attitudes des ménages vis-à-vis des moustiquaires, les comportements lors de leur manipulation et d'autres aléas, ainsi que la résistance des matériaux et de la structure des moustiquaires. Même si elle varie d'une zone à l'autre, la durée de vie médiane des MII est égale à 1,9 an. Pour finir, les moustiquaires ne sont pas utilisées 100 % du temps même si elles sont à disposition des membres du foyer : leur usage dépend de l'âge et du sexe de chaque membre, de la saison et du risque de paludisme.

- Une analyse d'illustration a été lancée par modélisation. Elle a pour point de départ une MILD « idéale » (à savoir une moustiquaire parfaitement répartie, jamais laissée de côté, toujours utilisée, hautement insecticide et de longue durée) et explore des scénarios au cours desquels chacune des contraintes précitées est réintroduite au fur et à mesure.
- Cette analyse a démontré que l'efficacité en baisse de l'insecticide et la diminution de la résistance physique de la moustiquaire sont les principaux facteurs de réduction de son efficacité. En combinant ces facteurs avec les obstacles liés à l'accès aux MII, leur taux d'utilisation et leur préservation, l'impact d'une campagne de distribution de MII décroît considérablement à la fin de la troisième année.
- Des solutions sont nécessaires pour améliorer la durabilité chimique et physique des MILD, leur répartition efficace, leur maintenance et leur utilisation par les membres des ménages. De plus, des moustiquaires à double substance active ou des MILD totalement non pyréthoïdes sont essentielles pour atténuer l'impact de la résistance répandue aux insecticides.

Efficacité de la PID

- La PID est la deuxième intervention de lutte antivectorielle la plus mise en œuvre par les programmes nationaux de lutte contre le paludisme (PNLP). Il n'existe toutefois que très peu de résultats d'essais sur l'efficacité de la PID.
- À partir des données d'observation, il apparaît qu'une PID menée correctement est une intervention de poids pour réduire la densité et la longévité des moustiques adultes vecteurs, et donc la transmission du paludisme.
- Certains des facteurs ayant des répercussions sur l'efficacité de la PID et des MII sont identiques. Par exemple, la majeure partie de la population de vecteurs se nourrit et se repose à l'intérieur, les gens dorment généralement la nuit à l'intérieur, et les niveaux d'acceptation au sein de la communauté sont élevés. Les facteurs spécifiques à la PID comprennent la période de pulvérisation et le niveau de formation des opérateurs de pulvérisation (ce qui en affecte la qualité).
- Mettre en œuvre la PID avec le niveau de qualité requis est plus compliqué sur le plan logistique et coûte nettement plus cher que de distribuer des MII.
- Une étude récente a démontré que le coût annuel d'une personne protégée par la PID était cinq fois supérieur au coût d'une personne protégée par MII, ce qui signifie que la PID est nettement moins rentable.
- Une étude menée en Éthiopie suggère que les services communautaires de PID (où les opérateurs de pulvérisation et le matériel nécessaire sont plus proches des ménages, et où les agents de santé communautaires sont impliqués) peuvent réduire les coûts, améliorer l'efficacité et élargir la couverture sans nuire à la performance.
- Même dans le cas de services communautaires, les coûts totaux restent élevés. S'il faut y ajouter le coût de la maintenance de l'équipement et de la supervision continue des opérateurs, il est clair que l'intensification à grande échelle des campagnes de PID réclame un budget conséquent.
- Ces coûts vont probablement continuer d'augmenter du fait de l'apparition de la résistance aux insecticides utilisés pour les PID et de la nécessité d'opter pour des produits chimiques plus onéreux.

Au-delà des MII et de la PID : résoudre le problème de la transmission résiduelle

- Au-delà de l'adaptation génétique des moustiques aux insecticides (i. e. résistance aux insecticides), comprendre l'adaptation comportementale des moustiques, à savoir la modification des habitudes de piqûres, d'alimentation et de repos, s'avère tout aussi important.
- De plus en plus d'éléments tendent à prouver que les vecteurs s'efforcent de réduire les contacts avec les insecticides (en piquant plus tôt dans la journée, avant que les gens ne se mettent au lit, en passant plus de temps à se reposer dehors ou en se nourrissant sur le bétail plutôt que sur la population, par exemple).
- Les vecteurs affichant cette malléabilité comportementale se taillent une place dominante par rapport aux vecteurs dont les changements comportementaux sont limités. L'adaptation comportementale des vecteurs va exiger des investissements en matière de R&D pour développer des interventions ciblant la transmission en extérieur.

R&D EN MATIÈRE DE PALUDISME ET PRODUITS EN COURS DE DÉVELOPPEMENT

Caractéristiques produits préférés et profils de produits ciblés

- Le programme mondial de lutte antipaludique de l'OMS a participé à l'élaboration de caractéristiques produits préférés (PPC) et de profils de produits ciblés (TPP), afin qu'ils servent d'outils essentiels pour inciter et guider le développement de produits à fort impact sur la santé publique et adaptés à une utilisation dans les pays à revenu faible et intermédiaire.
- L'OMS coordonne actuellement l'établissement de TPP pour les essais sur les lieux de soins de la glucose-6-phosphate déshydrogénase (G6PD) afin de répondre aux exigences de la lutte contre les infections à *P. vivax*.
- En se fondant sur l'expérience acquise avec le vaccin RTS,S, l'OMS a publié en 2022 des PCC actualisées au sujet des vaccins antipaludiques. Ces PPC comprennent un ensemble plus large d'objectifs stratégiques en matière de R&D autour des vaccins antipaludiques en vue de prévenir les infections au stade sanguin, de réduire la morbidité et la mortalité, ainsi que de diminuer la transmission au niveau communautaire.
- L'OMS a également élaboré plusieurs PPC dans le domaine de la lutte antivectorielle, y compris des PCC pour les MII servant à lutter contre la transmission du paludisme au sein des populations de moustiques résistantes aux insecticides (publication en 2021) ; pour les interventions de lutte antivectorielle afin de lutter contre le paludisme dans des situations d'urgences humanitaires complexes et en réponse aux catastrophes naturelles (publication en 2021) ; pour les produits endectocides et ectocides destinés à la lutte contre la transmission du paludisme (publication en 2022) ; et pour le traitement, avec effet rémanent, des surfaces intérieures pour lutter contre la transmission du paludisme dans les zones où les moustiques sont résistants aux insecticides (publication en 2022).
- L'OMS a développé des PPC pour les médicaments antipaludiques en chimioprévention, qui ont pour but d'aborder divers cas d'utilisation : la chimioprévention chez les enfants (chimioprévention du paludisme saisonnier [CPS], chimioprévention du paludisme pérenne [CPP, précédemment appelée « traitement préventif intermittent du nourrisson »], traitement préventif intermittent chez les enfants d'âge scolaire [TPIsc] et chimioprévention du paludisme après la sortie de l'établissement de soins [PDMC], durant la grossesse (TPIp) et chez les voyageurs non immunisés.
- En novembre 2021, le Programme mondial de lutte antipaludique de l'OMS et son Département Vaccination, vaccins et produits biologiques ont rassemblé un groupe de développement scientifique afin d'élaborer des PPC et d'examiner les considérations liées au développement clinique d'anticorps monoclonaux (AcM) pour la prévention du paludisme. La priorité la plus urgente en matière de santé publique est de réduire la morbidité et la mortalité dues à *P. falciparum* chez les nourrissons et les enfants.
- L'OMS a également travaillé en étroite coordination avec des partenaires de développement de produits, tels que FIND (Foundation for Innovative New Diagnostics), MMV (Medicines for Malaria Venture) et le Consortium innovant de lutte antivectorielle (IVCC), pour collecter une base de données sur des produits antipaludiques actuellement en phase de R&D.

Tests de diagnostic et médicaments antipaludiques

- A sujet des tests de diagnostic du paludisme, la propagation de parasites *P. falciparum* avec des suppressions des gènes *pfhrp2/3* représente une menace grave pour la fiabilité des diagnostics. Un éventail diversifié d'outils de diagnostic est nécessaire pour résoudre ce problème de fiabilité. La sensibilité inadaptée des outils face aux espèces non-*P. falciparum* et une gamme plus large de cas d'utilisation de diagnostics (par exemple, un dépistage non invasif extrêmement sensible pour la prévention de la réintroduction) représentent les principaux défis en matière de R&D.
- Les travaux de R&D en cours englobent des produits qui permettront de combler ces lacunes en déployant des efforts pour améliorer les plates-formes de soins existantes (en particulier, la microscopie et les tests de détection d'un antigène par immunochromatographie à flux latéral) et pour développer des alternatives basées sur une sélection de types d'échantillons et de technologies.
- Pour l'heure, les activités de R&D autour des médicaments antipaludiques donnent la priorité au développement de médicaments de nouvelle génération capables de sauver des vies parmi la population adulte, plus particulièrement les femmes enceintes, et les enfants présentant un risque

élevé par les conséquences d'une infection palustre. Une autre des priorités concerne la fourniture d'une option thérapeutique non ACT afin de simplifier le traitement ou de se prémunir contre l'intensification éventuelle de la résistance à l'artémisinine ou aux médicaments partenaires.

- Sous la coordination de MMV, les travaux de R&D dans le domaine des médicaments antipaludiques tournent autour de deux grands axes : innover sur la base des traitements antipaludiques actuels et développer la prochaine génération de traitements antipaludiques. En ce qui concerne les traitements existants, des projets sont en cours sur une ACT triple, une ACT additionnée à une seule dose faible de primaquine pour bloquer la transmission et l'artéméther-luméfantrine pour les nouveau nés.
- Plusieurs médicaments de nouvelle génération entrent dans différentes phases d'essai : ganaplacide-luméfantrine, M5717-pyronaridine, ZY19489-ferroquine et cipargamine. Sept molécules de nouvelle génération sont également à l'étude à l'heure actuelle.

Lutte antivectorielle

- L'Observatoire mondial de la recherche-développement en santé (GOHRD) de l'OMS répertorie à l'heure actuelle 28 produits de lutte antivectorielle en phase de R&D. Onze de ces produits (39 %) sont des MII et sept (25 %) sont des traitements à effet rémanent pour les murs intérieurs des habitations. Treize produits (46 %) en sont à l'étape de génération des données concernant l'évaluation de la sécurité, la qualité et l'efficacité entomologique. Sept produits (25 %) sont soumis à des essais épidémiologiques, six (21 %) sont en cours d'évaluation par l'OMS en vue de répondre aux exigences de préqualification ou des recommandations de politiques de l'OMS, et deux (7 %) en sont au stade du développement d'un prototype.
- Le Consortium innovant de lutte antivectorielle (IVCC) a fourni une vue d'ensemble des produits destinés aux interventions antipaludiques, qui ont été ou sont encore en cours de développement. Cette vue d'ensemble dresse la liste de plusieurs insecticides, nouveaux ou recyclés, offrant différents modes d'action, à utiliser pour les MII et la PID afin de soutenir les meilleures pratiques en matière de gestion de la résistance aux insecticides.
- Le pyrimiphos-méthyl (listé par l'OMS dans le système OMS d'évaluation des pesticides utilisés en santé publique [WHOPES] en janvier 2013), la clothianidine (préqualifiée par l'OMS en 2017) et la clothianidine associée à la deltaméthrine (préqualifiée par l'OMS en 2018) figurent parmi les produits que l'IVCC a aidé à commercialiser pour la PID.
- Le chlorfenapyr et le broflanilide sont également soumis à étude et devraient figurer sous peu dans la liste de préqualification.
- Interceptor® G2, une nouvelle MII, combine un pyréthoïde et un insecticide recyclé, le chlorfenapyr, qui offre un mode d'action différent. Le mélange de ces deux agents actifs est un pas de plus pour lutter contre la résistance aux insecticides. Trois autres agents actifs en sont soit au dernier stade de la recherche, soit en voie de développement intégral. Il est prévu qu'ils obtiennent une préqualification entre 2026 et 2030.
- Une boîte à outils, enrichie, est en cours de développement pour la lutte antivectorielle. Elle comprend un larvicide, des pièges à moustiques (« Eave Tubes ») et des appâts sucrés toxiques attrayants (ATSB). Ces outils font partie intégrante de l'arsenal de gestion de la résistance aux insecticides et de réduction du nombre de piqûres à l'extérieur.

Vaccins

- Les vaccins antipaludiques actuellement en cours de développement clinique ciblent la phase pré érythrocytaire du parasite. Autrement dit, ils se focalisent sur les sporozoïtes ou la phase hépatique du paludisme, la libération des parasites dans la circulation sanguine, les gamétocytes ou le développement du parasite chez le moustique.
- Le tableau de bord sur les vaccins du GOHRD fournit des informations détaillées à ce sujet. Pour résumer, sur les divers vaccins expérimentaux en cours de développement, six ciblent le parasite au stade pré érythrocytaire (*P. falciparum*), trois ciblent la phase sanguine (*P. falciparum*) et six ciblent l'étape sexuelle ou le blocage de la transmission (dont quatre s'intéressent au paludisme à *P. vivax* et deux au paludisme à *P. falciparum* durant la grossesse).

Prefacio

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Cada año, el *Informe Mundial sobre la Malaria* resalta los avances y las deficiencias en la lucha contra esta enfermedad en todo el mundo. El informe de este año se organiza en torno a cuatro temas: respuesta, riesgos, resiliencia e investigación.

Los países afectados por la malaria siguen respondiendo a una serie de retos, entre ellos las alteraciones derivadas de la pandemia de COVID-19. Aunque duramente golpeados, la mayoría de los países resistieron y pudieron mantener los servicios de prevención, detección y tratamiento de la malaria, una hazaña notable en medio de una pandemia.

No obstante, más de 600 000 personas siguen muriendo por malaria cada año, la mayoría niños. Incluso con los heroicos esfuerzos por mantener los servicios durante la pandemia, los esfuerzos de control de malaria se enfrentan a muchos obstáculos, además de las ya importantes alteraciones relacionadas con la COVID y otros retos de los sistemas de salud, como las largas crisis humanitarias, la limitada financiación por parte de los donantes y el posible efecto del cambio climático en la propagación de la enfermedad.

Estos retos se han visto agravados por la disminución de la efectividad de nuestras principales herramientas de lucha contra la malaria. El aumento de la resistencia a los mosquiteros tratados con insecticida y a los regímenes de tratamientos antimaláricos sigue siendo motivo de gran preocupación, sobre todo en África. En algunas zonas, los parásitos de la malaria escapan a la detección de las pruebas de diagnóstico más utilizadas. Y la invasión de un mosquito que se adapta fácilmente a los entornos urbanos, el *Anopheles stephensi*, supone un riesgo real.

Para apoyar la capacidad de recuperación de los programas contra la malaria, la OMS ha publicado nuevas orientaciones, entre ellas una nueva estrategia para contener la resistencia a los medicamentos antimaláricos en África; un nuevo marco, elaborado conjuntamente por la OMS y ONU-Hábitat, para orientar a los dirigentes de las ciudades en la lucha contra la malaria urbana; y recomendaciones para detener la propagación del *Anopheles stephensi* en entornos urbanos. Se recomienda a los países adaptar las orientaciones de la OMS a las necesidades locales.

El control de la malaria está íntimamente ligado a los sistemas de salud. Las inversiones para que los sistemas de salud funcionen bien, sean equitativos y resilientes y se basen en la atención primaria son fundamentales para el éxito de la respuesta contra la malaria.

La investigación y el desarrollo también desempeñan un papel fundamental. Como se describe en estas páginas, se están desarrollando nuevos tipos de tecnologías de control de vectores, incluida una nueva generación de mosquiteros para combatir la resistencia de los mosquitos. También se están preparando nuevos diagnósticos e innovaciones en los medicamentos contra la malaria.

Otro gran avance es la vacuna antimalárica RTS,S, la primera y única vacuna recomendada para prevenir la malaria en niños. Más de 1,2 millones de niños están protegidos por la vacuna en Ghana, Kenia y Malawi, y pronto se ampliará a otros países. Se están desarrollando otras herramientas prometedoras contra la malaria.

Sin embargo, sigue habiendo un importante déficit de financiación para la investigación básica y el desarrollo de productos. Hay una necesidad urgente de aumentar la inversión en nuevas herramientas contra la malaria para hacer frente a amenazas emergentes como la malaria urbana y la propagación de la resistencia a los medicamentos antimaláricos.

Nos enfrentamos a muchos retos, pero hay muchas razones para la esperanza. Al fortalecer la respuesta, comprender y mitigar los riesgos, aumentar la resiliencia y acelerar la investigación, habría muchas razones para soñar con un futuro libre de malaria.

El informe de este año de un vistazo

EVENTOS CLAVE EN 2021–2022

La séptima reposición del Fondo Mundial de Lucha contra el Sida, la Tuberculosis y la Malaria

- En 2021, más del 40% de la inversión mundial en malaria se canalizó a través del Fondo Mundial de Lucha contra el Sida, la Tuberculosis y la Malaria (Fondo Mundial).
- En septiembre de 2022, los países y socios del Fondo Mundial recaudaron un total de 15.900 millones de dólares durante su reposición, lo que supuso la mayor reposición en la historia del Fondo Mundial.
- La reposición no alcanzó el objetivo de 18.000 millones de dólares en un momento en que el coste de productos sanitarios está aumentando debido a la pandemia del coronavirus (COVID-19), los conflictos y la recesión mundial.
- El déficit significa que la reposición actual estará sometida a una presión considerable para mantener y ampliar los niveles de cobertura de las intervenciones contra la malaria.
- Para optimizar el impacto de la financiación disponible, será aún más necesario maximizar el uso de los recursos para luchar contra la malaria y otros recursos del sistema de salud, de forma eficiente, eficaz y equitativa.
- Los países deben ser capaces de identificar la combinación óptima de intervenciones que se adapten a su contexto local, y los mejores medios para hacerlas llegar a todas las personas que las necesiten, guiándose por datos locales.

Nuevas recomendaciones de la Organización Mundial de la Salud

- En junio de 2022, la Organización Mundial de la Salud (OMS) publicó orientaciones con recomendaciones nuevas y actualizadas. Las directrices alientan a los países a adaptar las recomendaciones a los entornos locales para lograr el máximo impacto.
- Las directrices actualizadas proporcionan recomendaciones sobre el tratamiento preventivo intermitente de la malaria en el embarazo (TPI), la quimio prevención de la malaria perenne (QMP) y la quimio prevención de la malaria estacional (QME), el tratamiento preventivo intermitente de la malaria en niños en edad escolar (TPIesc), la quimio prevención de la malaria después del alta (QMDA), la administración masiva de medicamentos (AMM) y la eliminación.
- Se sigue recomendando encarecidamente el uso de TPI con sulfadoxina-pirimetamina (SP) en zonas de transmisión de *Plasmodium falciparum* moderada o alta de malaria.
- El TPI-SP se recomienda ahora para todas las mujeres embarazadas, independientemente del número de embarazos.
- La recomendación actualizada de la quimio prevención de la malaria estacional y de la malaria perenne promueve el uso más amplio de la quimio prevención entre los niños pequeños con alto riesgo de malaria grave en zonas con transmisión estacional y durante todo el año.
- La OMS también ha emitido una nueva recomendación sobre el uso de tratamiento preventivo intermitente de la malaria en niños en edad escolar (TPIesc) en entornos con transmisión de malaria moderada a alta perenne o estacional. El TPIesc debe cubrir a los niños de 5 a 15 años, y su introducción no debe comprometer las intervenciones de quimio prevención para los niños menores de 5 años, que son los que corren mayor riesgo de padecer malaria grave.

- La quimio prevención de la malaria después del alta (QMDA) se recomienda ahora para prevenir la malaria en niños con anemia grave que viven en zonas de transmisión moderada o alta después de recibir el alta hospitalaria, cuando corren un alto riesgo de reingreso o muerte.
- Las nuevas recomendaciones sobre la administración masiva de medicamentos AMM para malaria dan orientación para reducir rápidamente la carga de la enfermedad en situaciones de emergencia y en zonas de transmisión moderada a alta. También ofrecen orientación sobre el uso de la AMM para reducir la malaria por *P. falciparum* en entornos con una transmisión muy baja o baja, y para reducir la transmisión por *P. vivax*.
- Las recomendaciones para la eliminación incluyen estrategias "masivas" aplicadas a toda la población de una zona geográfica delimitada, ya sea una localidad, un municipio o un distrito; estrategias "selectivas" aplicadas a personas con mayor riesgo de infección que la población general; y estrategias "reactivas" que se deben activar en respuesta a casos individuales.

Nuevas iniciativas regionales lanzadas por la OMS en colaboración con socios

Estrategia para responder a la resistencia a medicamentos antimaláricos en África

- La aparición de resistencia parcial a la artemisinina en la región africana de la OMS, con la aparente rápida propagación de mutaciones asociadas a esta resistencia, es muy preocupante. Esta aparición no se ha propagado desde la subregión del Gran Mekong, sino que ha aparecido *de novo* en el continente.
- Las terapias combinadas basadas en la artemisinina (TCA) siguen siendo eficaces, pero, aunque no se ha confirmado la resistencia a los medicamentos asociados a las TCA que se utilizan actualmente, hay algunas señales preocupantes que deben investigarse y hay que actuar antes de que las TCA empiecen a fallar.
- Dada la gran dependencia en las TCA en África, la amenaza de la resistencia parcial a la artemisinina y la resistencia a los medicamentos asociados debe vigilarse y abordarse con urgencia.
- En noviembre de 2022, la OMS lanzó la *Estrategia para responder a la resistencia a los medicamentos antimaláricos en África*, cuyo objetivo es proporcionar orientación a las principales partes interesadas en la comunidad de la malaria.
- La estrategia aborda la amenaza de la resistencia a los medicamentos antimaláricos en la Región de África de la OMS a través de cuatro pilares:
    - **Pilar I** – Reforzar la vigilancia de la eficacia de y la resistencia a los medicamentos antimaláricos.
    - **Pilar II** – Optimizar y regular mejor el uso del diagnóstico y tratamiento para limitar la presión de los medicamentos mediante medidas preventivas.
    - **Pilar III** – Reaccionar ante la resistencia limitando la propagación de parásitos resistentes a los medicamentos antimaláricos.
    - **Pilar IV** – Estimular la investigación y la innovación para aprovechar mejor las herramientas existentes y desarrollar otras nuevas contra la resistencia.
- Cada pilar comprende un conjunto de intervenciones que pueden aplicarse a nivel local, regional y mundial. Los países deben adaptar las intervenciones de la estrategia a su contexto local.

Iniciativa para detener la propagación de *Anopheles stephensi*

- *Anopheles stephensi*, originario del sur de Asia y partes de la Península Arábiga, ha ido ampliando su área de distribución en la última década, con detecciones notificadas en Yibuti (2012), Etiopía y Sudán (2016), Somalia (2019) y Nigeria (2020).
- En los casos en que se ha notificado la presencia de *An. stephensi* en la Región de África de la OMS, se ha descubierto que es resistente a muchos de los insecticidas utilizados en salud pública, lo que supone un reto adicional para su control.
- La invasión de *An. stephensi* en el África subsahariana –donde la carga de malaria es mayor y más del 40% de la población vive en entornos urbanosha suscitado preocupación, porque se cree que ha impulsado el resurgimiento de la malaria en la ciudad de Yibuti y que es el origen de al menos un brote en Etiopía.

- En septiembre de 2022 se puso en marcha una nueva iniciativa destinada a detener la propagación de *An. stephensi* en el continente africano y a determinar si se puede eliminar de las zonas que ya han sido invadidas.
- La iniciativa exhorta a que la respuesta nacional a *An. stephensi* forme parte de una respuesta integral a los vectores de la malaria, reforzando la colaboración, aumentando la vigilancia, mejorando el intercambio de información, elaborando orientaciones y priorizando la investigación.

Marco global para la respuesta a la malaria en zonas urbanas

- Para 2050, casi siete de cada diez personas en el mundo vivirán en ciudades y otros entornos urbanos. En los países donde la malaria es endémica, es probable que haya más personas en las zonas urbanas que en las rurales.
- En los 10 países con mayor carga de la Región de África de la OMS, se considera que más del 40% de la población ya vive en zonas urbanas.
- Las zonas urbanas y las rurales pueden diferir en la dinámica de la transmisión y la carga de la malaria y otras enfermedades transmitidas por vectores.
- En general, la urbanización reducirá la transmisión de la malaria. Sin embargo, la urbanización no planificada llevará a una transmisión focal, lo que dará lugar a una carga de enfermedad desproporcionadamente alta entre los más pobres de las áreas urbanas.
- La invasión de vectores cuya reproducción se ha adaptado a los entornos urbanos, como la reciente propagación de *An. stephensi* en la región africana de la OMS, puede poner en mayor riesgo a las poblaciones urbanas.
- Las estrategias que funcionan para reducir la carga de la enfermedad en las zonas rurales pueden no funcionar en los entornos urbanos, o pueden tener que producirse a una escala más pequeña y específica.
- La respuesta a la malaria en las zonas urbanas requiere de datos sobre los determinantes propios de los ecosistemas urbanos, y que ayuden a identificar si la transmisión de la malaria y la carga de la enfermedad son focales.
- El liderazgo de los departamentos gubernamentales, la industria y el sector financiero, la investigación, la academia y otros sectores tiende a concentrarse en las zonas urbanas, lo que ofrece una mayor oportunidad para realizar políticas, estrategias y acciones integradas y multisectoriales.
- A medida que la urbanización aumenta rápidamente, hay una mayor atención hacia ciudades más saludables, incluida la voluntad política mundial de hacer frente a las amenazas que plantea el cambio climático.
- En octubre de 2022, la OMS y el Programa de las Naciones Unidas para los Asentamientos Humanos (ONU-Hábitat) lanzaron conjuntamente el *Marco mundial para la respuesta a la malaria en zonas urbanas*, que está dirigido a los formuladores de políticas y a las partes interesadas.
- El marco es una respuesta a la malaria en pueblos y ciudades; destaca el papel central del liderazgo de las ciudades y la necesidad de garantizar que la respuesta a la malaria forme parte de una agenda más amplia de desarrollo urbano y salud. También hace hincapié en la necesidad de aplicar una respuesta específica basada en evidencia, para el diseño de las intervenciones contra la malaria. Si se aplica, se espera que el marco tenga muchos beneficios para mejorar la salud y el bienestar.

Despliegue de la vacuna antimalárica RTS,S/AS01 en zonas de transmisión de malaria de moderada a alta

- En octubre de 2021, la OMS recomendó la vacuna contra la malaria RTS,S/AS01 para la prevención de la malaria por *P. falciparum* en niños que viven en regiones con transmisión de moderada a alta, según la definición de la OMS. En julio de 2022, la OMS emitió la aprobación de precalificación para la vacuna RTS,S.
- En diciembre de 2021, la junta de la Alianza para las Vacunas (Gavi) aprobó una inversión inicial de casi 160 millones de dólares (para 2022-2025) para apoyar el despliegue más amplio de la vacuna contra la malaria en los países elegibles para Gavi.
- Gavi ha calculado que la demanda estable de la vacuna superará los 80-100 millones de dosis al año. Dada la previsión de un desfase entre la oferta y la demanda, la OMS coordinó el desarrollo de un marco para la asignación del suministro limitado de vacunas contra la malaria, con el fin de orientar dónde deben asignarse las dosis limitadas de forma justa y transparente, basándose en principios éticos y en los mejores datos disponibles.

- En agosto de 2022, el Fondo de las Naciones Unidas para la Infancia (UNICEF) anunció que había asegurado el suministro de la vacuna producida por GSK, para un suministro disponible de vacunas contra la malaria de 18 millones de dosis para los próximos 3 años (2023-2025).
- Desde junio de 2022, la OMS y Gavi han apoyado a más de 20 países a través de talleres multinacionales centrados en el desarrollo de solicitudes a Gavi. Una parte clave de esta iniciativa ha sido la adaptación subnacional del despliegue de la vacuna contra la malaria, apoyada por la OMS, basada en la orientación del marco para la asignación del suministro limitado de vacunas.

Emergencias humanitarias y sanitarias

- Varios países donde la malaria es endémica han estado lidiando con emergencias sanitarias y humanitarias no relacionadas con la pandemia de COVID-19. Se calcula que en 2021 hubo 268 millones de personas que se enfrentaron a emergencias humanitarias, frente a los 301 millones de 2020.
- Los conflictos, la hambruna y las inundaciones fueron los principales causantes de estas emergencias humanitarias, que en ocasiones se vieron agravadas por brotes de enfermedades.
- Los países con mayores necesidades en 2021 en términos de personas afectadas fueron Afganistán, Colombia, la República Democrática del Congo, Etiopía, Malí, Myanmar, Nigeria, Somalia, Sudán del Sur, Sudán, Uganda y Yemen.

Interrupciones en los servicios de malaria durante la pandemia de COVID-19

- Cuarenta y seis países tenían previstas campañas de redes mosquiteras tratados con insecticida (MTI) en 2020, para distribuir unos 272 millones de redes. A finales de 2020, se había distribuido el 74% de todas las redes mosquiteras previstas para 2020.
- En 2021, 43 países planearon campañas de distribución de MTI, de los cuales, 14, planificaron distribuir MTIs que sobraron del 2020.
- Se planificó la distribución de un total de 171 millones de redes mosquiteras en 2021 y 70 millones de estas redes fueron los que quedaron de 2020. En total, se distribuyeron 128 millones (75%) de redes mosquiteras en 2021.
- Ocho países – Benin, Eritrea, Indonesia, Nigeria, las Islas Salomón, Tailandia, Uganda, y Vanuatu distribuyeron menos del 60% de sus MTIs en 2021. Siete países – Botswana, la República Centroafricana, el Chad, Haití, India, Pakistán, y Sierra Leona no distribuyeron los MTIs que habían planificado distribuir. India, Nigeria y Uganda -países apoyados bajo el enfoque de alta carga y alto impacto (ACAI) distribuyeron el 0%, 53% y el 26%, respectivamente, de sus MTI previstas para ser distribuidas en 2021.
- Los resultados de la tercera ronda de la encuesta sobre los servicios sanitarios esenciales (SSE), realizada entre noviembre y diciembre de 2021, sugieren que en la Región de África de la OMS las interrupciones en el diagnóstico y tratamiento han disminuido considerablemente en la última parte de 2021, con siete países que informaron de interrupciones, en comparación con 16 en 2020 y nueve en el primer trimestre de 2021.

TENDENCIAS DE LA CARGA DE LA MALARIA

Casos de malaria

- A nivel mundial, se estima que en 2021 hubo 247 millones de casos de malaria en 84 países donde la enfermedad es endémica (incluido el territorio de la Guayana Francesa), lo que supone un aumento respecto a los 245 millones de 2020, siendo la mayor parte de este aumento procedente de los países de la Región de África de la OMS. En 2015, el año de referencia de la *Estrategia Técnica Mundial contra la Malaria 2016-2030* (ETM), se estimó que había 230 millones de casos de malaria.
- La incidencia de casos de malaria (es decir, casos por cada 1000 habitantes en riesgo) se redujo de 82 en 2000 a 57 en 2019, antes de aumentar a 59 en 2020. No ha habido cambios en la incidencia de casos entre 2020 y 2021. El aumento en 2020 se asoció a la interrupción de los servicios durante la pandemia de COVID-19.

- Entre 2019 y 2021, se estima que 13,4 millones de casos adicionales se atribuyeron a las interrupciones durante la pandemia de COVID-19.
- La proporción de casos debidos a *P. vivax* se redujo de aproximadamente el 8% (20,5 millones) en 2000 al 2% (4,9 millones) en 2021.
- El 96% de los casos de malaria en el mundo se produjeron en 29 países, y cuatro países -Nigeria (27%), la República Democrática del Congo (12%), Uganda (5%) y Mozambique (4%)representaron casi la mitad de todos los casos en el mundo.
- La Región de África de la OMS, con una estimación de 234 millones de casos en 2021, representó alrededor del 95% de los casos mundiales.
- Entre 2000 y 2019, la incidencia de casos en la Región Africana de la OMS se redujo de 373 a 225 por cada 1000 habitantes en riesgo, pero aumentó a 234 en 2020, principalmente debido a las interrupciones de los servicios durante la pandemia de COVID-19. En 2021, la incidencia de casos se redujo a 229 por cada 1000 habitantes.
- Cabo Verde notificó cero casos autóctonos durante 3 años consecutivos, poniendo fin a la epidemia de malaria.
- La Región de Asia Sudoriental de la OMS representó alrededor del 2% de la carga de casos de malaria a nivel mundial. Los casos de malaria se redujeron en un 76%, pasando de 23 millones en 2000 a unos 5 millones en 2021. La incidencia de casos de malaria en esta región se redujo en un 82%, pasando de unos 18 casos por cada 1000 habitantes en riesgo en 2000 a unos tres casos por cada 1000 habitantes en riesgo en 2021.
- El 79% de los casos de la región se produjeron en India. Sri Lanka fue certificada como libre de malaria en 2016 y sigue estando libre de malaria.
- Entre 2020 y 2021, hubo un aumento de 400 000 casos en la región, con más de la mitad de estos casos reportados en Myanmar.
- Los casos de malaria en la Región del Mediterráneo Oriental de la OMS se redujeron en un 38%, pasando de unos 7 millones de casos en 2000 a unos 4 millones en 2015. Entre 2016 y 2021, los casos aumentaron un 44%, hasta los 6,2 millones.
- Durante el período 2000-2020, la incidencia de casos de malaria en la Región del Mediterráneo Oriental de la OMS se redujo de 20 a 12 casos por cada 1000 habitantes en riesgo. Sudán fue el principal contribuyente de casos de malaria en esta región, con cerca del 54% de los casos. En 2021, la República Islámica de Irán no tuvo ningún caso autóctono de malaria después de 4 años consecutivos y Arabia Saudita notificó cero casos autóctonos por primera vez.
- La Región del Pacífico Occidental de la OMS tuvo un estimado de 1,4 millones de casos en 2021, lo que supone un descenso del 49% respecto a los 3 millones de casos del año 2000. En el mismo periodo, la incidencia de casos de malaria se redujo de cuatro a dos casos por cada 1000 habitantes en riesgo. Papúa Nueva Guinea representó casi el 87% de todos los casos de esta región en 2021. China fue certificada libre de malaria en 2021 y Malasia no tuvo casos de malaria no zoonótica durante 4 años consecutivos.
- En la Región de las Américas de la OMS, los casos de malaria se redujeron en un 60% (de 1,5 millones a 0,60 millones) y la incidencia de casos en un 70% (de 14 a 4) entre 2000 y 2021. El progreso de la región en los últimos años se ha visto afectado por el gran aumento de la malaria en la República Bolivariana de Venezuela, que tenía unos 35 500 casos en 2000 y más de 482 000 en 2017. En 2020, los casos se redujeron a más de la mitad en comparación con 2019, con 223 000, y se redujeron aún más en 2021, con 205 000 casos. Este descenso se debió a las restricciones a la circulación durante la pandemia de la COVID-19 y a la escasez de combustible que afectó a la industria minera, que es el principal contribuyente al reciente aumento de la malaria en el país. Estas restricciones también pueden haber afectado al acceso a la atención, reduciendo los casos notificados desde los centros de salud.
- Los casos estimados se duplicaron en Honduras y Panamá en 2021 en comparación con 2019. En el mismo periodo de tiempo se observaron reducciones sustanciales de casos en la República Bolivariana de Venezuela (–263 000), Brasil (–17 000), Colombia (–17 000) y Perú (–22 000).
- La República Bolivariana de Venezuela, Brasil y Colombia representaron más del 79% de todos los casos en esta región.
- Argentina, El Salvador y Paraguay fueron certificados como libres de malaria en 2019, 2021 y 2018, respectivamente. Belice informó de cero casos autóctonos de malaria por tercer año consecutivo, poniendo fin a la epidemia de malaria.
- Desde 2015, la Región Europea de la OMS está libre de malaria.

Muertes por malaria

- A nivel mundial, las muertes por malaria se redujeron constantemente durante el período 2000-2019, pasando de 897 000 en 2000 a 577 000 en 2015 y a 568 000 en 2019. En 2020, las muertes por malaria aumentaron un 10% en comparación con 2019, hasta una estimación de 625 000. Las muertes estimadas disminuyeron ligeramente en 2021, hasta 619 000. Entre 2019 y 2021, hubo 63 000 muertes que se debieron a las interrupciones de los servicios esenciales de malaria durante la pandemia de COVID-19.
- El porcentaje de muertes totales por malaria en niños menores de 5 años se redujo del 87% en 2000 al 76% en 2015. Desde entonces no ha habido ningún cambio.
- A nivel mundial, la tasa de mortalidad por malaria (es decir, las muertes por cada 100 000 habitantes en riesgo) se redujo a la mitad, pasando de unos 30 en 2000 a 15 en 2015; luego siguió disminuyendo, pero a un ritmo más lento, hasta llegar a 14 en 2019. En 2020, la tasa de mortalidad volvió a aumentar, a 15,1, antes de disminuir ligeramente a 14,8 en 2021.
- Alrededor del 96% de las muertes por malaria a nivel mundial se produjeron en 29 países. Cuatro países -Nigeria (31%), la República Democrática del Congo (13%), Níger (4%) y la República Unida de Tanzania (4%)representaron algo más de la mitad de todas las muertes por malaria a nivel mundial en 2021.
- Las muertes por malaria en la Región de África de la OMS disminuyeron de 841 000 en 2000 a 541 000 en 2018, antes de aumentar a 599 000 en 2020. Las muertes estimadas volvieron a disminuir a 593 000 en 2021. La tasa de mortalidad por malaria se redujo en un 62% entre 2000 y 2019, de 148 a 56 por cada 100 000 habitantes en riesgo, antes de aumentar a 60 en 2020 y volver a disminuir a 58 en 2021.
- Cabo Verde ha notificado cero muertes por malaria desde 2018.
- En la Región de Asia Sudoriental de la OMS, las muertes por malaria se redujeron en un 74%, pasando de unas 35 000 en 2000 a 9000 en 2019. El número de muertes se ha mantenido igual en los últimos 3 años.
- En India se reportaron alrededor del 83% de todas las muertes por malaria de la Región de Asia Sudoriental de la OMS.
- En la Región del Mediterráneo Oriental de la OMS, las muertes por malaria se redujeron en un 45%, de alrededor de 13 600 en 2000 a 7500 en 2014, y luego aumentaron en un 79% entre 2014 y 2021, hasta 13 400 muertes. La mayor parte del aumento se observó en Sudán, donde más del 90% de los casos fueron por *P. falciparum*, que se asocia a una mayor tasa de letalidad que los casos de *P. vivax*.
- En la Región del Mediterráneo Oriental de la OMS, la tasa de mortalidad por malaria se redujo en un 60% entre 2000 y 2009; sin embargo, desde 2016, las tasas de mortalidad se han mantenido prácticamente sin cambios, con un ligero aumento del 28%, de 2 a 2,5 muertes por cada 100 000 habitantes en riesgo.
- En la Región del Pacífico Occidental de la OMS, las muertes por malaria se redujeron en un 58%, pasando de unos 6200 casos en 2000 a 2600 en 2021. La tasa de mortalidad se redujo en un 67% durante el mismo período, pasando de 0,9 a 0,3 muertes por malaria por cada 100 000 habitantes en riesgo. En Papúa Nueva Guinea sucedieron más del 94% de las muertes por malaria en 2021.
- En la Región de las Américas de la OMS, las muertes por malaria se redujeron en un 64% (de 919 a 334) y la tasa de mortalidad en un 73% (de 0,8 a 0,2). La mayoría de las muertes en esta región sucedieron en adultos (78%).

Casos de malaria y muertes evitadas

- A nivel mundial, se estima que se evitaron 2.000 millones de casos de malaria y 11,7 millones de muertes por malaria en el periodo 2000-2021.
- La mayoría de los casos (82%) y muertes (95%) evitados se produjeron en la Región de África de la OMS, seguida por la Región de Asia Sudoriental de la OMS (casos 10% y muertes 3%).

Carga de la malaria en el embarazo

- En 2021, en 38 países de transmisión moderada y alta de la Región de África de la OMS, se estimó que hubo 40 millones de embarazos, de los cuales 13,3 millones (32%) estuvieron expuestos a la infección por malaria durante el embarazo.

- Por subregiones de la OMS, África occidental tuvo la mayor prevalencia de exposición a la malaria durante el embarazo (40,7%), seguida de cerca por África central (39,8%), mientras que la prevalencia fue del 20% en África oriental y meridional.
- Se calcula que, sin una intervención específica en el embarazo, la infección por malaria durante el mismo en estos 38 países habría provocado 961 000 niños con bajo peso al nacer. En los 33 países en los que se aplicó el tratamiento preventivo intermitente (TPI), se estima que se evitó que 457 000 niños tuvieran bajo peso al nacer.
- Si todas las mujeres embarazadas que acuden a las clínicas de atención prenatal (CAP) al menos una vez reciben una sola dosis de TPI -suponiendo que todas fueran elegibles y que la segunda y tercera dosis de TPI (TPI2 y TPI3) se mantuvieran en los niveles actualesse habría evitado adicionalmente que unos 55 000 niños tuvieran bajo peso al nacer en 33 países para los cuales existe información sobre TPI.
- Si la cobertura de la TPI3 se elevara a los mismos niveles que la cobertura de la primera visita al centro de atención prenatal, y si las visitas posteriores al centro de atención prenatal fueran igual de elevadas, se evitarían adicionalmente 162 000 niños con bajo peso al nacer.
- Si la cobertura de TPI3 se optimizara hasta el 90% de todas las mujeres embarazadas, se evitaría que otros 265 000 niños tuvieran bajo peso al nacer.
- Dado que el bajo peso al nacer es un importante factor de riesgo para la mortalidad neonatal e infantil, evitar un número considerable de niños con bajo peso al nacer salvará muchas vidas.

ELIMINACIÓN DEL MALARIA Y PREVENCIÓN DE SU RESTABLECIMIENTO

- El progreso hacia la eliminación de la malaria está aumentando; en 2021, hubo 84 países con malaria endémica, frente a 108 en 2000.
- El número de países en los que la malaria era endémica en 2000 y que notificaron menos de 100 casos de malaria aumentó de 6 en 2000 a 27 en 2021, permaneciendo sin cambios en 2021 en comparación con 2020.
- Entre 2000 y 2021, el número de países con menos de 10 casos autóctonos aumentó de 4 a 25.
- En el periodo 2010-2021, el total de casos de malaria en los países E-2025 (países que eliminarán la malaria en 2025) se redujo en un 82,8%; sin embargo, en comparación con 2020, estos países y territorios experimentaron un aumento del 30,4% en 2021.
- En la Región de Asia Sudoriental de la OMS, se ha producido un notable aumento del número de personas infectadas por *P. knowlesi* en algunos países, especialmente en Malasia. En los últimos 4 años no se han notificado casos autóctonos ni muertes por malaria humana en Malasia. Sin embargo, desde 2017, se han notificado un total de 17 125 casos de *P. knowlesi* y 48 muertes en este país.
- Solo en 2021, se notificaron 3575 casos de *P. knowlesi* que provocaron 13 muertes. Durante el mismo periodo, se notificaron otros 435 casos de *P. knowlesi* en la Región de Asia Sudoriental de la OMS, en Indonesia, Filipinas y Tailandia.
- Belice y Cabo Verde notificaron cero casos de malaria por tercer año consecutivo, e Irán (República Islámica de) y Malasia notificaron cero casos autóctonos por cuarto año consecutivo. En 2021, Timor Oriental, tras un brote en el año anterior, notificó cero casos autóctonos de malaria, y Arabia Saudita notificó cero casos autóctonos por primera vez.
- Cinco países -Azerbaiyán, Belice, Cabo Verde, Irán (República Islámica de) y Tayikistánhan presentado una solicitud oficial de certificación de estar libres de malaria.
- A pesar de las interrupciones que se produjeron durante la pandemia de COVID-19, el 61,5% de los países del E-2025 que notificaron casos siguieron avanzando hacia la eliminación y la reducción de la carga de malaria. Los países que siguieron mostrando una reducción de casos en 2021 en comparación con 2020 fueron Bután (59,1%), Botsuana (20,5%), la República Dominicana (65,6%), México (32%), Nepal (56,2%), la República de Corea (23%), Arabia Saudita (100%), Sudáfrica (33,7%), Surinam (85,9%), Tailandia (22,3%), Timor Oriental (100%) y Vanuatu (36,7%).
- En comparación con 2020, los siguientes países (y un territorio) experimentaron un aumento de casos en 2021: Comoras (56,9%), Costa Rica (52,4%), República Popular Democrática de Corea (22,8%), Ecuador (11,1%), Eswatini (53,9%), Guayana Francesa (2,1%), Guatemala (16,9%), Honduras (47,4%),

Panamá (55,3%) y Santo Tomé y Príncipe (28,9%). Ecuador, por segundo año consecutivo, informó del aumento del número de casos autóctonos.

- A pesar de los contratiempos, muchos países siguen haciendo inmensos progresos: entre 2011 y 2021, las tasas de clasificación dentro de los países del E-2025 aumentaron del 7,6% al 90,8%, lo que demuestra los continuos esfuerzos de los países en pro de sus objetivos de eliminación.
- Entre 2000 y 2021, los seis países de la subregión del Gran Mekong Camboya, China (provincia de Yunnan), la República Democrática Popular Lao, Myanmar, Tailandia y Vietnamnotificaron en conjunto una disminución del 76,5% de los casos de malaria autóctona y del 94,1% de los casos de malaria autóctona por *P. falciparum.* La reducción ha sido la más drástica desde el 2012, cuando se puso en marcha el programa de eliminación de la malaria del Mekong. Entre 2012 y 2021, la región experimentó un asombroso descenso de los casos de malaria autóctonos (86,4%) y de los casos de malaria autóctonos por *P. falciparum* (95,7%). En 2021, se notificaron un total de 90 082 casos de malaria autóctonos y 16 484 casos autóctonos de *P. falciparum*, lo que supone un aumento del 17,3% en los casos autóctonos de malaria y un descenso del 12,2% en los casos autóctonos de *P. falciparum* en comparación con 2020.
- En 2021, Myanmar experimentó un aumento en el número de casos tanto de *P. falciparum* como de *P. vivax* debido a la continua inestabilidad política en la zona. En 2021, Myanmar siguió representando la mayor parte de los casos de malaria autóctona (87,7%) y de malaria autóctona por *P. falciparum* (80,9%).
- Mientras los casos de *P. falciparum* siguen disminuyendo, *P. vivax* se ha convertido en la especie dominante en la subregión. En 2021, Camboya notificó recaídas por primera vez; notificando un total de 1978, lo que representa el 48% del total de casos autóctonos del país.
- Los países de la SGM están aprovechando el ejercicio de verificación subnacional para reforzar sus programas de prevención de recidivas y prepararse para la certificación de su país por la OMS.
- Entre 2000 y 2021, no se ha detectado el restablecimiento de la transmisión de la malaria en ningún país que haya sido certificado como libre de malaria.

ENFOQUE DE ALTA CARGA A ALTO IMPACTO (ACAI)

- Desde noviembre de 2018, los 11 países del enfoque ACAI han implementado actividades relacionadas con el enfoque en los cuatro elementos de respuesta.
- En 2020 y 2021, la OMS y la Asociación Hacer Retroceder la Malaria para poner fin a la malaria apoyaron a los países para implementar autoevaluaciones rápidas sobre el progreso de los objetivos de ACAI en los cuatro elementos de respuesta.
- En 2021, con el aumento continuo de los casos de malaria, los países del enfoque ACAI representaron el 68% de todos los casos y el 70% de las muertes a nivel mundial.
- Entre 2020 y 2021, los casos de malaria en los países de ACAI aumentaron de 163 millones a 168 millones, mientras que hubo una reducción de las muertes de 444 600 a 427 854.
- Con los aumentos en curso en 2021, los siguientes países representaron la mayoría de los casos de malaria: Nigeria (39%), la República Democrática del Congo (18,2%), Uganda (7,8%) y Mozambique (6,1%).
- Cinco de los 11 países ACAI -la República Democrática del Congo, Ghana, India, Níger y la República Unida de Tanzaniamostraron un descenso en el número de muertes, aunque su contribución a la carga de malaria dentro de los países ACAI sigue siendo considerable.

VIGILANCIA

- Más de 40 países utilizan paquetes de vigilancia de la malaria diseñados para el Sistema de Información Sanitaria de los Distritos 2 (DHIS2), y 34 países han adoptado el módulo de malaria agregada.
- También se han desarrollado módulos estándar específicos para la entomología y el control de vectores con el fin de ayudar a los países a mejorar la recopilación y el uso de los datos de las intervenciones entomológicas y de control de vectores.

- Se ha desarrollado o mejorado un conjunto de herramientas para apoyar la vigilancia de la eliminación de la malaria utilizando la plataforma web DHIS2 y la aplicación de captura DHIS2 (app) para Android. Estas herramientas pueden utilizarse para la notificación, investigación y respuesta a los casos, así como para la investigación y respuesta focalizadas.
- Un total de 12 países han comenzado a establecer repositorios de malaria, que son almacenes de datos para todos los datos relacionados con la malaria.
- La OMS ha lanzado el kit de herramientas de evaluación de la vigilancia de la malaria, que proporciona una forma sistemática y estandarizada de evaluar el rendimiento de los sistemas de vigilancia.
- Cuatro países -Burkina Faso (2020), Camerún (2021), la República Democrática del Congo (2021) y Ghana (2021)han llevado a cabo una evaluación del sistema de vigilancia utilizando el conjunto de herramientas. Las evaluaciones de tres de estos países que están disponibles para su publicación (excluyendo a Camerún) mostraron que la exhaustividad y la puntualidad de los informes eran buenas, pero la concordancia de las variables básicas entre los registros y los informes agregados era pobre.

INVERSIONES EN LOS PROGRAMAS E INVESTIGACIÓN SOBRE LA MALARIA

- La Estrategia Técnica Mundial (ETM) establece estimaciones de la financiación necesaria para alcanzar los hitos para 2025 y 2030. El total de recursos anuales necesarios se estimó en 6.800 millones de dólares para el 2020, aumentando a 9.300 millones en 2025 y a 10.300 millones en 2030. Se calcula que se necesitarán otros 850 millones de dólares anuales para investigación y desarrollo (I+D) de la malaria a nivel mundial durante el periodo 2021-2030.
- La financiación total para el control y la eliminación de la malaria en 2021 se estimó en 3.500 millones de dólares, frente a 3.300 millones en 2020 y 3.000 millones en 2019. La cantidad invertida en 2021 fue inferior a los 7.300 millones de dólares que se calcula que se necesitan en todo el mundo para mantener el rumbo hacia los hitos de la ETM de lucha contra la Malaria.
- La brecha de financiación entre la cantidad invertida y los recursos necesarios ha seguido aumentando drásticamente en los últimos años, pasando de 2.600 millones de dólares en 2019 a 3.500 millones en 2020 y 3.800 millones en 2021.
- Durante el periodo 2010-2021, el 67% de la financiación total para el control y la eliminación de la malaria, casi 2.400 millones de dólares, provienen de fuentes internacionales. Los Estados Unidos de América (EE.UU.) contribuyeron con más de 1.300 millones de dólares a través de la financiación bilateral prevista y por parte de las agencias de contribuciones multilaterales. Le siguieron los desembolsos bilaterales y multilaterales del Reino Unido de Gran Bretaña e Irlanda del Norte (Reino Unido) y de Alemania, que ascendieron a unos 200 millones de dólares; las contribuciones de Canadá, Francia y Japón, que ascendieron a unos 100 millones de dólares; y un total de 400 millones de dólares de otros países miembros del Comité de Ayuda al Desarrollo y de contribuyentes del sector privado.
- Los gobiernos de los países donde la malaria es endémica aportaron más de un tercio de la financiación total en 2021, con inversiones de más de 1.100 millones de dólares, de los cuales más de 300 millones se destinaron al manejo de casos de malaria en el sector público y 800 millones a otras actividades de control de la malaria, lo que supone un aumento de 100 millones de dólares respecto a 2020.
- De los 3.500 millones de dólares invertidos en 2020, más de 1.500 millones (44%) se canalizaron a través del Fondo Mundial. En comparación con años anteriores, los desembolsos del Fondo Mundial a los países donde la malaria es endémica aumentaron en unos 100 millones de dólares desde 2020 y en 300 millones desde 2019.
- Las clasificaciones del Banco Mundial por grupos de ingresos varían de un año a otro. En 2021, los 27 países del grupo de ingresos bajos representaron el 47% de la financiación total, experimentando un aumento de la financiación de más del 50% desde 2010 y representando más del 90% de los casos y muertes por malaria a nivel mundial. Los 39 países de ingresos bajos y medios representaron el 41% de la financiación total en 2021, mientras que el resto de países y las regiones no especificadas en las que no se disponía de información geográfica sobre los receptores representaron el 12% de la financiación para la malaria.

- La evaluación de la financiación de la malaria por persona en riesgo pone de manifiesto la variación de la financiación nacional e internacional en las regiones de la OMS, y ha mostrado cambios considerables en la última década. En la mayoría de las regiones de la OMS la financiación por persona en riesgo ha descendido a niveles inferiores a los de 2010, salvo en la Región de África de la OMS, donde la financiación se duplicó en 2021 en comparación con 2010.
- De los 3.500 millones de dólares invertidos en 2021, más de tres cuartas partes (78%) se destinaron a la Región de África de la OMS, un 5% a la Región de Asia Sudoriental y a la Región del Mediterráneo Oriental, un 4% a la Región de las Américas y un 3% a la Región del Pacífico Occidental. El 5% restante de la financiación total en 2021 se asignó a regiones no especificadas.
- Muchos países han experimentado cambios en su producto interno bruto (PIB) real debido a la pandemia de COVID-19 y a otras crisis; a su vez, esto ha afectado a la economía mundial, que se expandió un 5,5% en 2021 tras una contracción del 3,4% en 2020. En 2021, se produjo un crecimiento significativo entre los países de ingreso bajo y los países de ingreso mediano bajo, ya que solo el 11% de estos países experimentaron un impacto negativo en el crecimiento de su PIB real, en comparación con el 70% en 2020. A pesar del continuo aumento de la financiación para la malaria, el impacto real de la pandemia de COVID-19, la crisis económica asociada, otros factores globales y el aumento de la población en riesgo seguirán desarrollándose en los próximos años.
- La financiación total para investigación y desarrollo (I+D) en malaria fue de 626 millones de dólares en 2021.
- Este es el tercer año consecutivo de disminución de la financiación desde su pico de 2018, con la financiación de la I+D en malaria disminuyendo en casi todas las categorías de productos. En particular, la Fundación Bill y Melinda Gates redujo su inversión; sin embargo, siguió siendo el tercer mayor financiador general de I+D de vacunas contra la malaria, solo por detrás de los Institutos Nacionales de Salud (NIH) de los Estados Unidos y la industria.
- La investigación básica pareció experimentar el mayor descenso absoluto de la financiación en 2021 (-12%) y la producción de control de vectores experimentó un descenso de algo menos del 20% desde 2020. La financiación del diagnóstico recibió el 2,5% del total de la financiación de la malaria en 2021, su porcentaje más bajo desde 2013. Solo la I+D para productos terapéuticos se libró de la tendencia general a la baja, ya que la I+D de medicamentos aumentó un 2,3% y la de productos biológicos un 7,0%.
- Los Institutos Nacionales de Salud (NIH) de EE.UU. siguieron siendo el principal financiador de la I+D en malaria en 2021, con una financiación estable de 189 millones de dólares, seguidos por la industria y la Fundación Bill y Melinda Gates.

DISTRIBUCIÓN Y COBERTURA DE LA PREVENCIÓN DE LA MALARIA

- Los datos de entrega de los fabricantes para el periodo 2004-2021 muestran que se suministraron casi 2.500 millones de mosquiteros tratados con insecticidas (MTI) en todo el mundo en ese periodo, de los cuales 2.200 millones (el 87%) se suministraron al África subsahariana.
- Los fabricantes entregaron unos 220 millones de MTI a los países donde la malaria es endémica en 2021. De ellos, el 46% fueron mosquiteros con piretroides y butóxido de piperonilo (PBO) y el 9% fueron mosquiteros con doble ingrediente activo.
- En 2021, el 68% de los hogares del África subsahariana tenía al menos un MTI, lo que supone un aumento con respecto al 5% del año 2000. El porcentaje de hogares que poseen al menos un MTI por cada dos personas aumentó del 1% en 2000 al 38% en 2021. En el mismo periodo, el porcentaje de la población con acceso a un MTI en su hogar aumentó del 3% al 54%.
- El porcentaje de la población que duerme bajo un mosquitero también aumentó considerablemente entre 2000 y 2021, para toda la población (del 2% al 47%), para los niños menores de 5 años (del 3% al 53%) y para las mujeres embarazadas (del 3% al 53%).
- En general, el acceso y el uso de los mosquiteros sigue siendo inferior a los niveles observados en 2017.
- A nivel mundial, el porcentaje de la población en riesgo protegida por el rociado residual intradomiciliar (RRI) en los países donde la malaria es endémica disminuyó del 5,5% en 2010 al 2,4% en 2021. El porcentaje de población protegida por el RRI se ha mantenido estable desde 2016, con menos del 6% de la población protegida en cada región de la OMS.

- El número de personas protegidas por el RRI a nivel mundial se redujo de 153 millones en 2010 a 112 millones en 2015, y siguió disminuyendo hasta 80 millones en 2021.
- El promedio de niños tratados por ciclo de quimio prevención de la malaria estacional (QME) aumentó de unos 0,2 millones en 2012 a casi 45 millones en 2021.
- El número total de dosis de tratamiento administradas en los 15 países que aplican la QME en 2021 fue de unos 180 millones.
- Utilizando los datos de 33 países de la Región de África de la OMS, se calculó el porcentaje de uso del tratamiento preventivo intermitente (TPI) por dosis. En 2021, el 72% de las mujeres embarazadas utilizaron los servicios de control prenatal al menos una vez durante su embarazo. Alrededor del 55% de las mujeres embarazadas recibió una dosis de TPI, el 45% recibió dos dosis y el 35% recibió tres dosis.

DISTRIBUCIÓN Y COBERTURA DEL DIAGNÓSTICO Y TRATAMIENTO DE LA MALARIA

- A nivel mundial, los fabricantes vendieron 3.500 millones de pruebas de diagnóstico rápido (PDR) para la malaria en 2010-2021, y casi el 82% de estas ventas se realizaron en países del África subsahariana. En el mismo periodo, los programas nacionales de malaria (PNM) distribuyeron 2.400 millones de PDR, el 88% en el África subsahariana.
- En 2021, los fabricantes vendieron 413 millones de PDR y los PNM distribuyeron 262 millones.
- Los fabricantes suministraron casi 3.800 millones de tratamientos combinados con artemisinina (TCA) en todo el mundo entre 2010 y 2021. Alrededor de 2.600 millones de estas entregas fueron para el sector público en los países donde la malaria es endémica; el resto fueron de mecanismos de copago del Fondo Mundial o del Affordable Medicines Facility-malaria (AMFm) del sector público o privado, o entregas al sector privado fuera del mecanismo de copago del Fondo Mundial para esos años.
- Los datos nacionales notificados por los PNM en 2010-2021 muestran que se entregaron 2.400 millones de TCA a los proveedores de servicios de salud para tratar a los pacientes de malaria en el sector público.
- En 2021, los fabricantes entregaron unos 225 millones de TCA al sector público; en ese mismo año, los PNM distribuyeron 242 millones de TCA a este sector, de los cuales el 97% fueron en el África subsahariana.
- Para analizar la cobertura de la búsqueda de tratamiento, diagnóstico y el uso de TCA en niños menores de 5 años, se utilizaron datos agregados de las encuestas de hogares realizadas en el África subsahariana entre 2005 y 2021 en 20 países con al menos dos encuestas (la de referencia 2005-2011 y la más reciente 2015-2021).
- Comparando las encuestas de referencia y las más recientes, hubo pocos cambios en la prevalencia de fiebre en las dos semanas anteriores a las encuestas (mediana del 25% frente al 20%) o en la búsqueda de tratamiento para la fiebre (mediana del 65% frente al 67%).
- Las comparaciones de la fuente de tratamiento entre las encuestas de referencia y las más recientes muestran que la proporción que recibió atención en centros de salud públicos aumentó de una mediana del 58% al 69%, la proporción que recibió atención del sector privado disminuyó de una mediana del 40% al 28%, y el uso de trabajadores sanitarios de la comunidad siguió siendo bajo, con medianas del 2% y el 1%, respectivamente.
- La tasa de diagnóstico entre los niños menores de 5 años con fiebre y para los que se buscó atención aumentó considerablemente, de una mediana del 30% en la línea de base al 57% en las últimas encuestas de hogares.
- El uso de TCA entre los que buscaron atención también aumentó, del 14% al inicio al 24% en las últimas encuestas.
- Entre las personas que solicitaron atención y que recibieron un pinchazo en el dedo o en el talón, el uso de TCA fue del 29% en la encuesta más reciente, en comparación con el 21% al inicio.

PROGRESO HACIA LOS HITOS DE LA ETM DE 2020

- El objetivo de la Estrategia Técnica Mundial (ETM) es reducir la incidencia y la tasa de mortalidad de la malaria en al menos un 75% para 2025 y en un 90% para 2030 con respecto a la base de referencia de 2015. Para 2020, el objetivo de la ETM era una reducción del 40%.
- El número de países que alcanzaron los objetivos de la ETM para 2021 se derivó de las estimaciones oficiales de la carga, en lugar de las proyecciones (como se hizo en el Informe Mundial sobre la Malaria 2020).
- En 2020 y 2021, las estimaciones incluyeron el efecto de las interrupciones de los servicios de malaria durante la pandemia y se basaron en un nuevo método para cuantificar la fracción de causa de muerte de la malaria.
- A pesar de los considerables progresos realizados desde el año 2000, los hitos de la ETM 2020 en materia de morbilidad y mortalidad no se han alcanzado a nivel mundial. Si se mantienen las tendencias actuales, los objetivos de la ETM 2025 tampoco se alcanzarán a nivel mundial.
- La incidencia de casos de malaria de 59 casos por cada 1.000 habitantes en riesgo en 2021, en lugar de los 31 casos por 1.000 esperados si el mundo estuviera en camino de alcanzar el hito de morbilidad de la ETM 2021, significa que, a nivel mundial, estamos desviados del objetivo en un 48%.
- Aunque el progreso relativo en la tasa de mortalidad es mayor que el de la incidencia de casos, el objetivo de la ETM de 7,8 muertes por malaria por cada 100.000 habitantes en riesgo en 2021 era un 48% inferior a la tasa de mortalidad de 14,8 observada en el mismo año.
- De los 93 países que eran endémicos de malaria (incluido el territorio de la Guayana Francesa) en todo el mundo en 2015, 39 (42%) cumplieron el hito de morbilidad de la ETM para 2021, al haber logrado una reducción del 40% o más en la incidencia de casos o haber notificado cero casos de malaria.
- Diecinueve países (20%) también redujeron la incidencia de casos de malaria, pero por debajo del objetivo previsto.
- Veintisiete países (29%) aumentaron la incidencia de casos y 14 países (15%) observaron un aumento del 40% o más en la incidencia de casos de malaria en 2021 en comparación con 2015.
- En ocho países (8,6%), la incidencia de casos de malaria en 2021 fue similar a la de 2015.
- Cuarenta y tres países (46%) que eran endémicos de malaria en 2015 alcanzaron el hito de mortalidad de la ETM para 2021, y 28 de ellos informaron de cero muertes por malaria.
- Veintidós países (24%) lograron reducir las tasas de mortalidad por malaria, pero por debajo del objetivo del 40%.
- Las tasas de mortalidad por malaria se mantuvieron al mismo nivel en 2021 que en 2015 en nueve países (9,7%), mientras que las tasas de mortalidad aumentaron en 19 países (20%), 11 de los cuales tuvieron aumentos del 40% o más.
- La Región de Asia Sudoriental de la OMS cumplió los hitos de la ETM 2020 tanto para la mortalidad como para la morbilidad. Todos los países de la región, excepto Indonesia, redujeron la incidencia de casos y la mortalidad en un 40% o más.

AMENAZAS BIOLÓGICAS Y DE OTRO TIPO PARA LAS HERRAMIENTAS DE INTERVENCIÓN CONTRA LA MALARIA

Deleción de los genes *pfhrp2/3* del parásito

- Los parásitos que no pueden expresar la proteína rica en histidina 2 (HRP2) pueden no ser detectables por las pruebas de diagnóstico rápido (PDR) basadas en la HRP2, y los que ya no expresan tanto la HRP2 como la proteína rica en histidina 3 (HRP3) son completamente indetectables por dichas PDR.
- La OMS ha recomendado que los países con informes de deleciones de *pfhrp2/3*, y sus países vecinos, lleven a cabo estudios de línea de base representativos entre los casos sospechosos de malaria, para determinar si la prevalencia de deleciones de *pfhrp2/3* que causan resultados de falsos negativos en las PDR ha alcanzado un umbral que requiere un cambio en la PDR (>5% de deleciones de *pfhrp2* causan falsos negativos en las PDR).

- Las opciones de PDR alternativas (por ejemplo, basadas en la detección de la deshidrogenasa láctica del parásito) son limitadas; en particular, actualmente no hay pruebas precalificadas por la OMS que no estén basadas en la detección combinada de HRP2, que puedan detectar y distinguir entre *P. falciparum* y *P. vivax*.
- La OMS está haciendo un seguimiento de los informes publicados sobre deleciones de *pfhrp2/3* utilizando la aplicación Mapa de los desafíos de la Malaria (Malaria Threats Map) y está fomentando un enfoque armonizado para el mapeo y la notificación de las deleciones de *pfhrp2/3* a través de protocolos de encuesta disponibles públicamente.
- En 2022, varios países de la Región de África de la OMS comenzaron a planificar o implementar encuestas representativas para las deleciones de *pfhrp2/3*, esperándose resultados en 2022 y 2023.
- La OMS ha puesto en marcha un tablero de control para el seguimiento de las actividades de vigilancia a nivel mundial con el fin de informar sobre las prioridades y la asignación de recursos y la previsión de PDR, y para evitar la duplicación de esfuerzos. El tablero presenta las características clave de las actividades de vigilancia, así como los plazos.
- Entre septiembre de 2021 y septiembre de 2022, se informó de investigaciones de deleciones de *pfhrp2/3* en 17 publicaciones de 17 países: Benín, Brasil, Camerún, República Democrática del Congo, Yibuti, Ecuador, Guinea Ecuatorial, Eritrea, Etiopía, Gabón, Ghana, India, Kenia, Madagascar, Ruanda, Sierra Leona y República Unida de Tanzania. De ellos, sólo en Guinea Ecuatorial, Kenia y Ruanda no se identificó ninguna deleción de *pfhrp2*, aunque en estos tres países se han notificado deleciones en publicaciones anteriores.
- Según los datos de las publicaciones incluidas en el Mapa de los desafíos de la Malaria, se ha realizado algún tipo de investigación en 47 países, confirmándose la presencia de deleciones en 40 de ellos.
- El Plan de Respuesta Global de la OMS para las deleciones de *pfhrp2/3* describe varias áreas de acción más allá de la ampliación de la vigilancia. Estas otras áreas de acción incluyen la identificación de nuevos biomarcadores, la mejora del rendimiento de las pruebas de diagnóstico rápido que no son de tipo HRP2, la realización de previsiones de mercado y el fortalecimiento de las redes de laboratorios para apoyar la demanda de uso de la caracterización molecular para determinar la presencia o ausencia de estas deleciones genéticas.

Resistencia de los parásitos a los medicamentos antimaláricos

- La eficacia de los medicamentos antimaláricos se vigila mediante estudios de eficacia terapéutica (EET), que hacen un seguimiento de los resultados clínicos y parasitológicos de los pacientes que reciben tratamiento antimalárico. Los EET se consideran la norma para que los países puedan determinar mejor sus políticas nacionales de tratamiento.
- La resistencia a los medicamentos antimaláricos puede evaluarse mediante varias herramientas. Para algunos medicamentos, se han identificado cambios genéticos asociados a una menor sensibilidad a los mismos. La resistencia parcial a la artemisinina se vigila mediante una lista establecida de marcadores validados y candidatos de *PfKelch13* asociados a un retraso en la eliminación parasitaria tras un tratamiento con artemisinina.
- La OMS recopila los resultados de los estudios sobre la eficacia y la resistencia de los medicamentos antimaláricos y los pone a disposición en el Mapa de los desafíos de la Malaria.
- **Región de África de la OMS:** En la Región Africana de la OMS se realizaron un total de 266 EET de *P. falciparum* de acuerdo con el protocolo estándar de la OMS entre 2015 y 2021, con la participación de al menos 20 pacientes. Entre estos EET, seis estudios han demostrado una tasa de falla superior al 10%: cuatro estudios con arteméter-lumefantrina (AL) en Burkina Faso y en Uganda, y dos estudios con dihidroartemisinina-piperaquina (DHA-PPQ) en Burkina Faso. Otros cinco estudios con AL y dos estudios con DHA-PPQ que utilizaron una metodología para distinguir entre reinfección y recrudescencia, que difiere de la metodología recomendada por la OMS, informaron de tasas de fallas terapéuticas superiores al 10%; estos incluyen estudios en Angola, la República Democrática del Congo y Uganda. Las mutaciones de *PfKelch13* han aparecido en Eritrea, Ruanda y Uganda. Las tasas de falla terapéutica se mantienen por debajo del 10%, porque el medicamento asociado sigue siendo eficaz. Se necesitan más estudios para determinar el alcance de la propagación de las mutaciones de *PfKelch13* y para investigar cualquier cambio en el tiempo de eliminación del parásito y la resistencia in vitro.
- **Región de las Américas de la OMS:** Los datos de los EET de la Región de las Américas de la OMS son limitados. Los EET de AL realizadas entre 2015 y 2021 en Brasil y Colombia demostraron una alta eficacia. En Guyana, la mutación *PfKelch13* C580Y asociada con la resistencia parcial a la artemisinina se observó esporádicamente entre 2010 y 2017, pero no se ha encontrado en ninguna de las muestras más recientes, lo que indica que la mutación probablemente ha desaparecido.

- **Región del Mediterráneo Oriental de la OMS:** De los 36 EET de *P. falciparum* realizados en la Región del Mediterráneo Oriental de la OMS en los que participaron al menos 20 pacientes, dos estudios con artesunato más SP (AS+SP) en Somalia y Sudán demostraron una tasa de falla superior al 10%. En estos países, el tratamiento de primera línea se cambió posteriormente a AL.
- **Región de Asia Sudoriental de la OMS:** De los 67 EET de *P. falciparum* realizados en la región de Asia Sudoriental de la OMS que incluyeron al menos a 20 pacientes, ningún EET informó de una tasa de falla del tratamiento superior al 10%. Sin embargo, la presencia de mutaciones asociadas a la resistencia a la SP en la India central podría ser una señal de alerta temprana antes del fracaso de la AS+SP. En Tailandia, donde la eficacia de los fármacos se evalúa con la vigilancia integrada de la eficacia de los medicamentos, se descubrió que las tasas de fallas del tratamiento con DHA-PPQ más primaquina eran elevadas en la provincia de Sisaket. Esto llevó a la provincia a cambiar su tratamiento de primera línea por el de artesunato-pironaridina (AS-PY) en 2020. En la subregión del Gran Mekong (SGM), las mutaciones de *PfKelch13* asociadas a la resistencia parcial a la artemisinina tienen una alta prevalencia en Myanmar y Tailandia.
- **Región del Pacífico Occidental de la OMS:** De los 63 EET de *P. falciparum* realizados en la Región del Pacífico Occidental de la OMS que incluyeron al menos 20 pacientes, 14 estudios demostraron una tasa de falla superior al 10%. Un estudio con AL en la República Democrática Popular Lao en 2017 encontró altas tasas de falla (17,2%), pero este estudio solo tenía 29 pacientes y los estudios posteriores encontraron una alta eficacia de AL. Dos estudios en Camboya encontraron altas tasas de falla con artesunato-amodiaquina (AS-AQ), lo que indica la presencia de resistencia a AQ en Camboya. Se detectaron altas tasas de falla del tratamiento con DHA-PPQ en Camboya, la República Democrática Popular Lao y Vietnam, lo que provocó el cambio del uso de este fármaco como tratamiento de primera línea. En la SGM, las mutaciones de *PfKelch13* asociadas a la resistencia parcial a la artemisinina tienen una alta prevalencia en Camboya, la República Democrática Popular Lao y Vietnam. Además, en Papúa Nueva Guinea ha aparecido la mutación *PfKelch13* C580Y y parece estar extendiéndose.

Resistencia de los vectores a los insecticidas

- Entre 2010 y 2020, 88 países enviaron datos a la OMS sobre la vigilancia de la resistencia a los insecticidas, incluidos 38 con datos sobre la intensidad de la resistencia a los piretroides, y 32 sobre la capacidad del PBO para restaurar la susceptibilidad a los piretroides.
- En 2020, se dispuso de nuevas concentraciones discriminantes y procedimientos para la vigilancia de la resistencia en los vectores de la malaria a clorfenapir, clotianidina, transflutrina, flupiradifurona y piriproxifeno, y se revisaron las concentraciones discriminantes para pirimifos-metilo y alfa-cipermetrina. Los países deben ajustar la vigilancia de la resistencia a los insecticidas en los vectores de malaria a estos nuevos procedimientos. La OMS no ha recibido datos de vigilancia de la resistencia de los vectores a transflutrina, flupiradifurona y piriproxifeno. Aunque la OMS ha recibido algunos datos de vigilancia de la resistencia a clorfenapir y clotianidina, estos datos son insuficientes para evaluar la posible presencia de resistencia a cualquiera de estos dos insecticidas.
- De los 88 países endémicos de malaria y que proporcionaron datos para 2010-2020, 78 han detectado resistencia a al menos una clase de insecticida en al menos un vector de la malaria y en un sitio de recolección; 29 ya han detectado resistencia a los piretroides, organoclorados, carbamatos y organofosforados en diferentes sitios; y 19 han confirmado la resistencia a todas estas cuatro clases en al menos un sitio y al menos un vector local.
- A nivel mundial, la resistencia a los piretroides -la principal clase de insecticida utilizada actualmente en los mosquiteros tratados con insecticidasestá muy extendida, habiéndose detectado en al menos un vector de la malaria en el 68% de los lugares de los que se dispone de datos. La resistencia a los organoclorados se registró en el 64% de los lugares. La resistencia a los carbamatos y a los organofosforados es menos frecuente, ya que se detectó en el 34% y el 28% de los lugares que comunicaron datos de vigilancia, respectivamente.
- De los 38 países que notificaron datos sobre la intensidad de la resistencia a los piretroides, se detectó una resistencia de alta intensidad en 27 países y 293 lugares.
- Desde 2010, se ha observado que el PBO restablece totalmente la susceptibilidad en 283 lugares de 29 países.
- Para orientar el manejo de la resistencia, los países deben elaborar e implementar planes nacionales de vigilancia y manejo de la resistencia a los insecticidas, basándose en el *Marco de la OMS para un plan nacional de vigilancia y manejo de la resistencia a los insecticidas en los vectores de malaria.* El número de países que informaron que tenían un plan de este tipo aumentó de 53 en 2019 a 67 en 2020.

- Se requiere de asistencia técnica y financiera para apoyar a los países en la vigilancia y manejo de la resistencia a los insecticidas.
- Los datos de resistencia a los insecticidas notificados a la OMS se incluyen en la base de datos mundial de la OMS sobre la resistencia a los insecticidas en los vectores de malaria y pueden explorarse a través del Mapa de Amenazas de la Malaria.

Efectividad de los MTI

- Se considera que los mosquiteros tratados con insecticida (MTI) fueron los principales impulsores de la disminución de la transmisión y la carga de malaria en el periodo 2005-2015, especialmente en entornos con una transmisión moderada a alta. Los mosquiteros tratados con insecticidas de larga duración siguen siendo eficaces y la OMS recomienda su uso continuo para prevenir la malaria.
- Dado que los mosquiteros tratados con insecticidas de larga duración son la principal herramienta de control de vectores, los factores que disminuyen su eficacia en la prevención de la malaria son relevantes en el avance de la lucha contra esta enfermedad. Estos factores incluyen la durabilidad física del mosquitero (es decir, la integridad del tejido) y su durabilidad química (es decir, la bioeficacia del insecticida, que es la disponibilidad del ingrediente activo en la superficie del mosquitero a lo largo del tiempo), las limitaciones operativas y del comportamiento humano (es decir, la entrega, el acceso, la cobertura y la aceptabilidad, el uso, el mantenimiento y la retención), y la dinámica de los vectores (comportamientos de picadura y reposo de las especies vectoras).
- La aparición y la amplia expansión geográfica de la resistencia a los piretroides es la amenaza más reconocida para la eficacia de los mosquiteros tratados con piretroides de larga duración.
- Un estudio multinacional comisionado por la OMS y publicado en 2018 mostró que los MTI seguían siendo altamente protectores contra la malaria, incluso en presencia de una alta resistencia de los vectores a los piretroides.
- Por el contrario, datos de varios estudios en casas experimentales sugieren que, a medida que la susceptibilidad de los vectores a los piretroides disminuye, los efectos repelente y de mortalidad de los insecticidas sobre los mosquitos se reducen en gran medida.
- Los análisis con modelos sugieren además que el impacto epidemiológico de los mosquiteros tratados con insecticidas se reduce en zonas con vectores con niveles elevados de resistencia a los piretroides.
- La mayor eficacia observada en ensayos controlados aleatorizados de algunos MTI de la nueva generación (en comparación con los MTI que tienen sólo piretroides) sugiere que la resistencia a los insecticidas está teniendo un efecto en los resultados epidemiológicos.
- En el África subsahariana, donde se distribuyen la mayoría de los MTI, se entregaron unos 590 millones de MTI a las comunidades en el período 2019-2021. Sin embargo, en 2021, el porcentaje estimado de la población con acceso a un MTI dentro de su hogar y el porcentaje de la población que duerme bajo un MTI fue del 54% y el 47%, respectivamente, debido a varios factores.
- Los factores que afectan la tenencia y el uso universal de los MTI son la eficacia en la asignación, la retención y el uso. Una asignación equitativa de los MTI se debe apoyar en la identificación de las brechas de cobertura a nivel local y en la ampliación de la distribución a estas áreas. La retención de los mosquiteros está determinada por las actitudes de las personas hacia sus mosquiteros, los comportamientos de manipulación de estos, y otros riesgos, la durabilidad del tejido y la calidad en su elaboración. La vida media de los mosquiteros actuales, aunque varía según el entorno, es de aproximadamente 1,9 años. Por último, incluso cuando los mosquiteros están a disposición de los miembros del hogar, no se utilizan el 100% de las veces; la variación en el uso se ve afectada por la edad, la estación, el género y el riesgo de malaria.
- Se llevó a cabo un modelo de análisis ilustrativo. El análisis partió de un MTI "ideal" (es decir, uno que se asigna perfectamente, que nunca se desecha, que siempre se utiliza, que es altamente insecticida y altamente duradero), y se exploraron escenarios en los que se reintrodujo secuencialmente cada una de las limitaciones enumeradas anteriormente.
- El análisis mostró que los principales factores que reducen la eficacia de los mosquiteros son la disminución de la eficacia insecticida y la durabilidad física. Cuando se combinan con las barreras al acceso, la tasa de uso y la retención de los mosquiteros, el impacto de una campaña de mosquiteros disminuye drásticamente al final del tercer año.
- Se necesitan soluciones para mejorar la durabilidad física y química de los MTI, eficacia en la asignación y en el mantenimiento y uso por parte de los miembros de la familia. Además, los mosquiteros de doble ingrediente activo o los mosquiteros tratados con no-piretroides son esenciales para mitigar el impacto de la resistencia generalizada a los insecticidas.

Efectividad del RRI

- El rociado residual intradomiciliar (RRI) es la segunda intervención de control de vectores más implementada por los PNM. Sin embargo, las pruebas de la eficacia de RRI son limitadas.
- A partir de los datos observados, cuando el RRI se lleva a cabo correctamente es una intervención poderosa para reducir la densidad y la longevidad de los mosquitos adultos, y por tanto para reducir la transmisión de la malaria.
- Algunos de los factores que influyen en la eficacia del RRI son similares a los que afectan a los MTI. Por ejemplo, la mayor parte de la población de vectores se alimenta y reposa en el interior de las viviendas, la gente duerme principalmente en el interior por la noche y hay altos niveles de aceptación en la comunidad. Los factores específicos del RRI incluyen el momento de la fumigación y el nivel de formación de los operarios fumigadores (que afecta la calidad de la fumigación).
- La aplicación del RRI con la calidad requerida es logísticamente más difícil y considerablemente más costosa que la distribución de mosquiteros tratados con insecticida.
- Un estudio reciente demostró que, en comparación con los mosquiteros tratados con insecticida, el RRI era unas cinco veces más caro por persona protegida al año, lo que significa que el RRI es considerablemente menos rentable.
- Un estudio realizado en Etiopía sugiere que realizar el RRI con participación comunitaria (en la que los operarios fumigadores entrenados y los materiales están más cerca de los hogares y se cuenta con la participación de los promotores de salud locales) puede reducir los costos, mejorar el rendimiento y aumentar la cobertura sin reducir la calidad.
- Incluso cuando se recurre a la participación comunitaria, los costes totales se mantienen, y cuando se añaden los costes de mantenimiento de los equipos y la supervisión regular de los fumigadores, está claro que la implementación a gran escala del RRI requiere de un gran presupuesto.
- Es probable que los costes aumenten aún más a medida que surja la resistencia a los insecticidas utilizados en el RRI y se necesiten productos químicos más caros.

Más allá del alcance de los MTI y del RRI: abordaje de la transmisión residual

- Más allá de la adaptación genética de los mosquitos a los insecticidas (es decir, la resistencia a los insecticidas), es igualmente importante comprender la adaptación del comportamiento del mosquito, en términos de cambios en el comportamiento de picadura, alimentación y reposo.
- Cada vez hay más pruebas de que los vectores intentan reducir el contacto con los insecticidas (es decir, pican antes de que las personas se acuesten, pasan más tiempo en reposo fuera de las viviendas o se alimentan del ganado en lugar de los humanos).
- Los vectores con esta plasticidad de comportamiento se vuelven más dominantes que los que tienen cambios de comportamiento limitados. La adaptación del comportamiento por parte del vector requerirá inversiones en I+D de intervenciones dirigidas a la transmisión fuera de las viviendas.

INVESTIGACIÓN Y DESARROLLO PARA LA MALARIA Y PRODUCTOS EN PREPARACIÓN

Características preferidas de los productos y perfiles de productos objetivo

- El Programa Mundial contra la Malaria de la OMS (WHO/GMP) ha participado en el desarrollo de las características preferidas de los productos (CPP) y los perfiles de los productos objetivo (PPO), como herramientas clave para incentivar y guiar el desarrollo de productos con un alto impacto en la salud pública y adecuados para su uso en los países de bajo y mediano ingreso.
- La OMS está coordinando el desarrollo de PPO para las pruebas de glucosa-6-fosfato deshidrogenasa (G6PD) en los puntos de atención para satisfacer las necesidades de control de *P. vivax*.
- Basándose en la experiencia de la vacuna contra la malaria RTS,S, la OMS publicó en 2022 unas CPPs actualizadas para vacunas contra la malaria. Los CPP incluyen un conjunto ampliado de objetivos estratégicos para la I+D de vacunas contra la malaria para la prevención de la infección en la fase

sanguínea, la reducción de la morbilidad y la mortalidad, y la reducción de la transmisión a nivel comunitario.

- La OMS también ha desarrollado varios CPPs para el control de vectores, incluidos los relativos a los mosquiteros tratados con insecticida para el control de la transmisión de la malaria en poblaciones de mosquitos resistentes a los insecticidas (publicados en 2021), para las intervenciones de control de vectores para controlar la malaria en emergencias humanitarias complejas y en respuesta a desastres naturales (publicados en 2021), para los productos endectocidas y ectocidas para el control de la transmisión de la malaria (publicados en 2022) y para el tratamiento residual de superficies en interiores para el control de la transmisión de la malaria en zonas con mosquitos resistentes a los insecticidas (publicados en 2022).
- En cuanto a la quimio prevención, la OMS ha desarrollado PPCs para los medicamentos de quimio prevención de la malaria destinados a abordar varios tipos de uso: quimio prevención en niños (quimio prevención de la malaria estacional, quimio prevención de la malaria perenne en lactantes (anteriormente conocido como tratamiento preventivo intermitente en infantes, o TPIi), tratamiento preventivo intermitente en escolares y quimio prevención de la malaria posterior al alta), durante el embarazo (TPIe) y en viajeros no inmunes.
- En noviembre de 2021, el Programa Mundial de Malaria de la OMS y el Departamento de Inmunización, Vacunas y Productos Biológicos (IVB) de la OMS convocaron un grupo de desarrollo científico para elaborar CPPs y abordar las consideraciones de desarrollo clínico de los anticuerpos monoclonales para la prevención de la malaria. La prioridad más inmediata en materia de salud pública es la reducción de la morbilidad y la mortalidad de los lactantes y los niños a causa del *P. falciparum*.
- La OMS también ha trabajado para el desarrollo de productos en estrecha coordinación con socios, como la Foundation for Innovative New Diagnostics (FIND), la Medicines for Malaria Venture (MMV) y el Innovative Vector Control Consortium (IVCC), con el fin de crear una base de datos de productos antimaláricos en fase de I+D.

Pruebas de diagnóstico y medicamentos

- En lo que respecta a las pruebas de diagnóstico de la malaria, la propagación de parásitos de *P. falciparum* con deleciones del gen *pfhrp2/3* representa una importante amenaza para un diagnóstico fiable; se necesita un panorama con diversas posibilidades de diagnóstico para hacer frente a este desafío. Los principales retos en materia de I+D son la sensibilidad inadecuada de las pruebas para las especies que no son *P. falciparum* y una gama más amplia de posibilidades para el diagnóstico (por ejemplo, una detección no invasiva y de alta sensibilidad para la prevención de la reintroducción).
- El proyecto actual de I+D incluye productos para abordar estos vacíos mediante esfuerzos para mejorar las plataformas existentes en los puntos de atención (concretamente, la microscopía y las pruebas de detección de antígenos por inmunocromatografía de flujo lateral) y desarrollar alternativas que utilicen una serie de tipos de muestras y tecnologías.
- La I+D de medicamentos contra la malaria se centra actualmente en el desarrollo de la nueva generación de medicamentos que salvan vidas para adultos, especialmente mujeres embarazadas, y niños que corren un riesgo elevado de sufrir las consecuencias de la infección por malaria. Otra gran prioridad es ofrecer una opción de tratamiento sin derivados de la artemisinina, para simplificar la terapia o como contingencia contra la intensificación de la resistencia a la artemisinina o al fármaco asociado.
- Bajo la coordinación de MMV (Medicines for Malaria Venture), la I+D en medicamentos contra la malaria se ha centrado en dos áreas principales: las innovaciones con los tratamientos antimaláricos existentes y los tratamientos antimaláricos de nueva generación. En relación con los tratamientos existentes, se está trabajando en la triple TCA, la TCA (tratamiento combinado con artemisinina) más una dosis única de primaquina para el bloqueo de la transmisión y el arteméter-lumefantrina para los neonatos.
- Hay varios medicamentos de nueva generación en diferentes fases de ensayo: ganaplacida-lumefantrina, M5717-pironaridina, ZY19489-ferroquina y cipargamina. Además, hay siete moléculas de nueva generación en fase de investigación.

Control de vectores

- El Observatorio Mundial de Investigación y Desarrollo Sanitarios (GOHRD) de la OMS tiene actualmente una lista de 28 productos de control de vectores en fase de investigación y desarrollo. Once (39%) de estos productos son mosquiteros tratados con insecticidas (MTI) y siete (25%) son tratamientos para el rociado residual intradomiciliar (RRI). Trece productos (46%) están en la fase de generación de datos sobre la evaluación de la seguridad, la calidad y la eficacia entomológica. Siete productos (25%) están siendo sometidos a ensayos epidemiológicos, seis (21%) están siendo evaluados por la OMS para ser incluidos en el listado de precalificación o para ser recomendados por la OMS y dos (7%) están en la fase de desarrollo de prototipos.
- El IVCC proporcionó una visión general de los productos de intervención contra la malaria en desarrollo, que incluye varios insecticidas nuevos y reutilizados con diferentes modos de acción, para su uso en los mosquiteros tratados con insecticida (MTI) y para el rociado residual intradomiciliar (RRI), como apoyo a las mejores prácticas en el manejo de la resistencia a los insecticidas.
- Entre los productos que el IVCC ha ayudado a introducir en el mercado para el RRI se encuentran el pirimifos-metilo (incluido en la lista del Plan de Evaluación de Plaguicidas de la OMS [WHOPES] en enero de 2013), la clotianidina (precalificada por la OMS en 2017) y la clotianidina más deltametrina (precalificada por la OMS en 2018).
- Además, el clorfenapir y la broflanilida se están revisando y se espera que se incluyan en la lista de precalificación en un futuro próximo.
- Interceptor® G2, un nuevo MTI, combina un piretroide con un insecticida reutilizado, el clorfenapir, que tiene un modo de acción diferente. La mezcla de estos dos ingredientes activos es un paso adelante para el manejo de la resistencia a los insecticidas. Otros tres ingredientes activos se encuentran en la fase final de investigación o han avanzado hasta su pleno desarrollo y se espera que obtengan el ingreso a la lista de precalificación entre 2026 y 2030.
- Se está desarrollando un conjunto ampliado de herramientas para el control de vectores que incluye larvicidas, trampas letales para viviendas (tubos de alero) y cebos tóxicos azucarados. Estas herramientas son fundamentales para el manejo de la resistencia a los insecticidas y reducir el contacto humano-vector fuera de las viviendas.

Vacunas

- Las vacunas contra la malaria actualmente en desarrollo clínico se dirigen a la fase preeritrocítica del parásito; es decir, se dirigen al esporozoito o fase hepática del parásito, a la fase sanguínea del parásito, a los gametocitos o al desarrollo del parásito en el mosquito.
- Se puede encontrar información detallada en el tablero de vacunas del GOHRD. En resumen, de las vacunas candidatas en desarrollo, seis se dirigen al parásito en la fase preeritrocítica (*P. falciparum*), tres se dirigen a la fase sanguínea (*P. falciparum*) y seis se dirigen a la fase sexual o bloqueo de la transmisión (de ellas, cuatro se dirigen a *P. vivax* y dos a la malaria por *P. falciparum* en el embarazo).

1 INTRODUCTION

The *World malaria report 2022* presents progress in several important health and development goals in the global efforts to reduce the burden of malaria overall and eliminate the disease where possible. These goals are outlined in the Sustainable Development Goals (SDGs) framework (*1*), the World Health Organization (WHO) *Global technical strategy for malaria 2016–2030* (GTS) (*2*) and the RBM Partnership to End Malaria *Action and investment to defeat malaria 2016–2030* (AIM) (*3*). For most indicators, the report covers the period 2000–2021. Specific analysis is implemented to track disruptions to essential malaria services since the start of the coronavirus (COVID-19) pandemic in 2020, and the impact of these disruptions on malaria cases and deaths.

There are several changes in this year's report. There are three new sections: one on new global and regional initiatives launched in 2021 and 2022, one on surveillance with case study systems assessments, and one on research and development. Also, the section on the threats faced by malaria tools has been expanded, with a focus on the effectiveness of insecticide-treated mosquito nets (ITNs). **Section 2** tracks some of the key events that are relevant to the global state of malaria. **Section 3** presents the global trends in malaria morbidity and mortality and estimates of the burden of malaria during pregnancy. **Section 4** shows the progress towards elimination and the trends in the 11 highest burden countries. **Section 5** provides updates on global malaria surveillance and country case studies on surveillance system assessments. **Section 6** focuses on the total funding for malaria control and elimination, and for malaria research and development (R&D). The supply of key commodities to endemic countries and population-level coverage achieved through these investments are presented in **Section 7**. **Section 8** summarizes global progress, by region and country, towards the GTS milestones for 2020 and the trajectory towards 2025 and 2030. **Section 9** describes the threats posed by *Plasmodium falciparum* parasites that no longer express histidine-rich protein 2 (HRP2), which is detected by the most widely used malaria rapid diagnostic test (RDT); the threats posed by drug and insecticide resistance; and the spread of the invasive species, *Anopheles stephensi*. This section also presents additional analysis on ITN durability and insecticide resistance, and their collective impact on the effectiveness of ITNs. **Section 10** presents an overview of malaria R&D, with a focus on preferred product profiles and products in the development pipeline. **Section 11** summarizes the findings of the report and presents concluding remarks.

The main text is followed by annexes that contain data sources and methods, regional profiles and data tables. Country profiles can be found online (*4*).

2 OVERVIEW OF KEY EVENTS IN 2021–2022

This section presents the key events relevant to the global malaria response that occurred in 2021–2022.

2.1 GLOBAL FUND SEVENTH REPLENISHMENT

The Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) invests US$ 4 billion a year in HIV, tuberculosis (TB) and malaria programmes (*5*). In 2021, more than 40% of the investment in malaria globally was channelled through the Global Fund (*5*). In September 2022, the Global Fund's Seventh Replenishment was hosted by the government of the United States of America (USA) during the United Nations (UN) General Assembly meeting (*6*) (**Section 6**). Although falling short of the original target of US$ 18 billion, countries and partners managed to raise a record US$ 15.7 billion (*7*). With the cost of most health commodities rising during the COVID-19 pandemic, the current replenishment will be under considerable strain to maintain and expand levels of malaria intervention coverage. To optimize the impact of the limited resources, there will be an even greater need to maximize the efficient, effective and equitable use of malaria and other health system resources. Countries need to be able to identify the optimal mix of interventions suited to their local context and the best means of delivering them to all people in need.

2.2 NEW WHO RECOMMENDATIONS

Clear, evidence-informed WHO recommendations guide managers of national malaria programmes (NMPs) as they develop policies and strategic plans to combat the disease; such recommendations support decisions around "what to do". WHO also develops implementation guidance, such as operational and field manuals, to advise countries on "how to" deliver the recommended tools and strategies.

In June 2022, WHO published consolidated guidelines for malaria that contained a package of new and updated recommendations across a number of technical areas – from case management, vector control, vaccines, malaria chemoprevention and mass drug administration (MDA) to elimination (*8*). The guidelines encourage countries to tailor the recommendations to local disease settings for maximum impact. The updated guidelines contain recommendations on intermittent preventive treatment of malaria in pregnancy (IPTp), perennial malaria chemoprevention (PMC) and seasonal malaria chemoprevention (SMC), intermittent preventive treatment of malaria in school-aged children (IPTsc), post-discharge malaria chemoprevention (PDMC), MDA and elimination recommendations, as summarized below.

2.2.1 Case management

In November 2022, WHO released the following treatment recommendations for case management (*8*): artesunate-pyronaridine is recommended as an artemisinin-based combination therapy (ACT) option for the treatment of uncomplicated *P. falciparum* malaria "(strong recommendation, low certainty of evidence)"; pregnant women with uncomplicated *P. falciparum* malaria should be treated during the first trimester with artemether-lumefantrine "(strong recommendation for, low-certainty evidence)"; with regards to primaquine treatment to prevent relapse, 0.5 mg/kg per day for 7 days is recommended to treat *P. vivax* or *P. ovale* malaria in children and adults (except pregnant women, infants aged <6 months, women breastfeeding infants aged <6 months, women breastfeeding older infants unless they are known not to be deficient in glucose-6-phosphate dehydrogenase [G6PD], and people with G6PD deficiency; "(strong recommendation, very low-certainty evidence)"; however, WHO recommends against using primaquine 1.0 mg/kg per day for 7 days to treat *P. vivax* or *P. ovale*.

2.2.2 Vector control

In March 2022, WHO released an update to the vector control guidelines (*8*). The conditional recommendation for the deployment of pyrethroid-PBO nets was updated based on a recently completed revision of an earlier systematic review. A recommendation for the deployment of pyrethroid-only long-lasting insecticidal nets (LLINs) or pyrethroid-piperonyl butoxide (PBO) nets and a separate conditional recommendation for the deployment of indoor residual spraying (IRS) in areas affected by humanitarian emergencies were formulated based on evidence on vector control interventions from a recent systematic review. The sections on insecticide selection for IRS were updated to provide further detail about the risks of using dichloro-diphenyl-trichloroethane (DDT) and the importance of considering alternative insecticides. Further information on resource considerations, cost and cost-effectiveness for WHO-recommended interventions was added to inform local costing studies and guide the selection of intervention packages. Areas where evidence gaps remain and research is needed to inform further revisions of the guidance for malaria vector control were updated.

2.2.3 Vaccines

WHO guidance is available to countries as they consider how to adopt the vaccine as an additional tool to reduce child illness and deaths from malaria. In March 2022, WHO's recommendation for the vaccine was added to the WHO guidelines for malaria (*8*).

2.2.4 Intermittent preventive treatment of malaria in pregnancy

Malaria infection during pregnancy poses substantial risks not only to the mother, but also to her fetus and the newborn. Evidence continues to show that IPTp with sulfadoxine-pyrimethamine (SP) is a safe and highly cost-effective strategy for reducing the disease burden in pregnancy and for reducing adverse pregnancy and birth outcomes (*8*).

In the updated guidance, WHO has reaffirmed its strong recommendation for the use of IPTp-SP in areas of moderate to high *P. falciparum* malaria transmission. The recommendation does not limit the delivery of IPT-SP to antenatal care (ANC) settings; where inequities in access to ANC services exist, other delivery methods, such as the use of community health workers, may be explored. IPT-SP is now recommended for all pregnant women, regardless of the number of pregnancies; previously, it was recommended only during a woman's first and second pregnancies.

2.2.5 Seasonal malaria chemoprevention and perennial malaria chemoprevention

WHO has also updated its recommendations for two key malaria chemoprevention strategies: SMC and PMC (previously known as intermittent preventive treatment of malaria in infants, or IPTi). When given to young children, malaria chemoprevention has been shown to be a safe, effective and cost-effective strategy for reducing the disease burden and saving lives (*8*). The updated WHO recommendations on SMC and PMC are less restrictive than the original recommendations; they do not specify strict age groups, transmission intensity thresholds, numbers of doses or cycles, or specific drugs. The new recommendations will support the broader use of chemoprevention among young children at high risk of severe malaria in areas with both seasonal and year-round transmission.

2.2.6 Intermittent preventive treatment of malaria in school-aged children

WHO is also issuing a new recommendation for the use of IPTsc in settings with moderate to high perennial or seasonal malaria transmission. The strategy and dosing schedule for IPTsc should cover children aged 5–15 years, and its introduction should not compromise chemoprevention interventions for children aged under 5 years, who are at highest risk of severe malaria.

2.2.7 Post-discharge malaria chemoprevention

WHO is now recommending PDMC – a strategy aimed at preventing malaria among children with severe anaemia living in areas of moderate to high transmission after they are discharged from a hospital, when they are at high risk of re-admission or death. Through PDMC, children are given a full antimalarial treatment course at regular intervals.

2.2.8 Mass drug administration

MDA is another chemoprevention strategy. Through MDA, all individuals in a target population are given a treatment course of antimalarial drugs, regardless of whether they are infected with malaria. The medication treats any existing malaria infections as well as new infections for a specific period. The new recommendations on malaria MDA provide guidance on rapidly reducing the malaria disease burden in emergency settings and in areas of moderate to high transmission. They also provide guidance on the use of MDA to reduce *P. falciparum* malaria in settings with very low to low transmission, and to reduce *P. vivax* transmission. The full set of MDA recommendations and supporting evidence can be found in the consolidated guidelines (*9*).

2.2.9 Elimination recommendations

In settings approaching elimination, interventions will be most effective at reducing transmission if they are tailored to detect and treat the residual foci of malaria transmission. WHO has issued a new set of recommendations for the final phase of malaria elimination. Some of these recommendations are also relevant to areas that have achieved elimination and are working to prevent re-establishment of transmission. Some of these evidence-based recommendations are positive (i.e. they favour specific interventions) and others are negative (i.e. they are against specific interventions). The recommendations are divided into three categories:

- "mass" strategies applied to the entire population of a delimited geographical area, whether it be a village, township or district; these strategies include MDA (described above), mass testing and treatment (MTaT) and mass relapse prevention (MRP);
- "targeted" strategies applied to people at greater risk of infection than the general population; these strategies include targeted drug administration (TDA); targeted testing and treatment (TTaT); routine testing and treatment at points of entry (border screening); and malaria testing of organized or identifiable groups arriving or returning from malaria endemic areas; and
- "reactive" strategies triggered in response to individual cases; these strategies include reactive drug administration (RDA), reactive case detection and treatment to reduce transmission of malaria (RACDT) and reactive IRS.

2.3 THE STRATEGY TO RESPOND TO ANTIMALARIAL DRUG RESISTANCE IN AFRICA

Recent studies have confirmed the emergence of artemisinin partial resistance in several areas of Africa, notably in Eritrea, Rwanda and Uganda (**Section 9.2**). Although resistance to the ACT partner drugs currently in use has not been confirmed, there are some worrying signals. Data are lacking from several countries and areas, meaning that resistance may be present in other areas.

Artemisinin partial resistance can be defined as delayed parasite clearance after treatment with a drug containing an artemisinin derivative. Significant reduction of treatment efficacy has not been observed in association with delayed parasite clearance after treatment with a drug containing an artemisinin derivative. However, increases in the proportion of parasites carrying *P. falciparum Kelch13* (*PfKelch13*) mutations indicate that parasites with this mutation have an advantage under current treatment strategies and transmission dynamics.

Given the heavy reliance on ACTs in Africa, the threat of artemisinin partial resistance and partner drug resistance must be monitored and addressed urgently. The apparent rapid spread of some mutations associated with artemisinin partial resistance means that vigorous measures must be taken before ACTs start to fail in Africa. With no alternative drugs likely to become available soon, it is essential to preserve the therapeutic lifespan of ACTs.

In November 2022, WHO launched the *Strategy to respond to antimalarial drug resistance in Africa* (*10*). This technical and advocacy document was developed to provide guidance to key stakeholders in the malaria community. The strategy builds on lessons learned from past global plans and complements existing strategies, including broader efforts to respond to antimicrobial resistance.

The goal of the strategy is to minimize the threat and impact of antimalarial drug resistance of *P. falciparum* in Africa. The strategy has three objectives that are instrumental to achieving the goal:

- improve the detection of resistance to ensure a timely response;
- delay the emergence of resistance to artemisinin and ACT partner drugs; and
- limit the selection and spread of drug-resistant parasites where resistance has been confirmed.

The strategy addresses the threat of antimalarial drug resistance in Africa through four pillars:

- **Pillar I** – Strengthen surveillance of antimalarial drug efficacy and resistance.
- **Pillar II** – Optimize and better regulate the use of diagnostics and therapeutics to limit drug pressure through pre-emptive measures.
- **Pillar III** – React to resistance by limiting the spread of antimalarial drug-resistant parasites.
- **Pillar IV** – Stimulate research and innovation to better leverage existing tools and develop new tools against resistance.

Each pillar consists of a set of interventions (**Fig. 2.1**) that can be implemented at the local, regional and global levels. Implementing countries need to tailor the interventions in the strategy to their local context.

FIG. 2.1.

Response interventions clustered into the strategy's four pillars to address antimalarial drug resistance in Africa *Source: WHO (2022) (10).*

I Strengthen surveillance of antimalarial drug efficacy and resistance

1. Enhance capacity and capabilities to generate better quality and standardized data on antimalarial drug efficacy and on parasite resistance
2. Increase coverage of surveillance systems on efficacy and resistance
3. Increase collection of additional, more detailed data at select sites
4. Improve data dissemination systems to facilitate reactive and coordinated response to resistance data

II Optimize and better regulate the use of diagnostics and therapeutics to limit drug pressure through pre-emptive measures

1. Develop national treatment policies that promote deliberate use of existing treatments to prevent and react to the emergence and spread of resistance
2. Promote the availability of a diversified drug portfolio in countries
3. Prevent exposure to subtherapeutic drug levels driven by substandard and falsified ACTs by promoting drug quality
4. Remove nonrecommended monotherapies and ensure that other monotherapies are used in accordance with guidelines
5. Promote equitable access to quality drugs
6. Promote equitable distribution of and access to high-quality diagnostics to reduce drug pressure
7. Empower patients, health care workers and other stakeholders to make informed decisions and provide appropriate treatment

III React to resistance by limiting the spread of antimalarial drug-resistant parasites

1. Ensure optimal malaria vector control intervention coverage in priority areas
2. Leverage preventive measures to reduce transmission of antimalarial drug-resistant parasites
3. Limit the risk of increased transmission of drug-resistant parasites
4. Strengthen cross-border collaboration on malaria activities to ensure coordinated resistance management

IV Stimulate research and innovation to better leverage existing tools and to develop new tools against resistance

1. Identify innovative approaches using currently available drugs to delay the development and spread of resistance
2. Identify areas and populations where drug resistance is deemed more likely to develop and spread
3. Develop new treatments and diagnostics with the objective of delaying the emergence and the spread of resistance
4. Identify and develop innovative tools to limit malaria infection and transmission
5. Conduct research and modelling to better understand and track resistance

ACT: artemisinin-based combination therapy; WHO: World Health Organization.

2.4 INITIATIVE TO STOP THE SPREAD OF *AN. STEPHENSI*

An. stephensi is a mosquito species that can transmit both *P. falciparum* and *P. vivax* malaria parasites. Originally, *An. stephensi* was native to south Asia and parts of the Arabian Peninsula but it has been expanding its range over the past decade, with detections reported in Djibouti (2012), Ethiopia and the Sudan (2016), Somalia (2019) and Nigeria (2020) (*11–14*). It is probable that *An. stephensi* has spread to other African countries but has not yet been detected because systematic, large-scale surveillance of the vector is still in its infancy.

An. stephensi can thrive in urban environments, setting it apart from the other main mosquito vectors of malaria that primarily breed in rural areas. Where *An. stephensi* has been reported in the WHO African Region, it has been found to be resistant to many of the insecticides used in public health, posing an added challenge to its control.

The invasion of *An. stephensi* in sub-Saharan Africa – where the burden of malaria is highest and over 40% of the population lives in urban environments – is particularly worrying (*15*). Since 2012, *An. stephensi* is thought to have contributed to a resurgence of malaria in Djibouti City and at least one outbreak of the disease in Ethiopia (*11, 16*). Although the overall contribution of *An. stephensi* to malaria transmission in the region is unclear, the rapid growth of many African cities, coupled with the invasion and spread of this highly efficient and adaptable malaria vector, could undermine the gains made in reducing the burden of the disease. In a 2019 vector alert (*17*), WHO identified the spread of *An. stephensi* as a significant threat to malaria control and elimination – particularly in the WHO African Region. A new WHO initiative, launched in September 2022, aims to stop the further spread of *An. stephensi* on the African continent and to determine whether it can be eliminated from areas that have already been invaded. The initiative has five key aims, outlined in **Fig. 2.2** (*18*).

The initiative calls for the national response to *An. stephensi* to be part of a comprehensive response to malaria vectors, guided by the WHO GTS (*2*). Where feasible, integration with efforts to control other vector-borne diseases should be explored; for example, in the area of breeding-site surveillance in urban and periurban areas. The WHO *Global vector control response 2017–2030* (*19*) and the *Global framework for the response to malaria in urban areas* (*20*) provide additional guidance.

2.5 THE GLOBAL FRAMEWORK FOR THE RESPONSE TO MALARIA IN URBAN AREAS

By 2050, almost seven in 10 people globally will live in cities and other urban settings (*21*). In the 10 highest burden countries in the WHO African Region, over 40% of the population are already considered to live in urban areas (*20*). Although many people will benefit from their urban status, rapid and unplanned urbanization will have negative social and environmental health impacts, particularly on the poorest and most vulnerable. Overall, urbanization will reduce malaria transmission. However, unplanned urbanization will lead to focal transmission, resulting in a disease burden that is disproportionately high among the urban poor.

In October 2022, WHO and the UN Human Settlements Programme (UN-Habitat) jointly launched the *Global framework for the response to malaria in urban areas* (*20*), which is targeted at policy-makers and relevant stakeholders. The framework has been developed through wide and multidisciplinary consultations, and is based on published evidence and best practices. The framework is a response to malaria in towns and cities, and is expected to have many benefits in improving health and well-being.

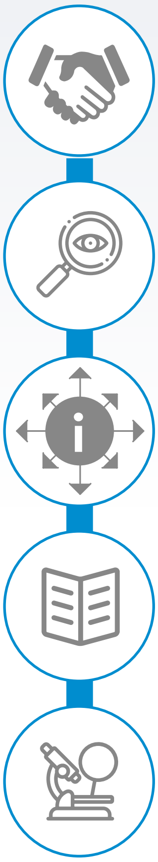
The framework provides guidance to countries on undertaking a comprehensive malaria response in urban areas, recognizing that:

- in a few years, most people living in malaria endemic countries will reside in urban areas;
- urban areas and rural areas can differ in the dynamics of the transmission and burden of malaria and other vector-borne diseases;
- invasion by vectors that are adapted to breeding in urban environments, such as the recent spread of *An. stephensi* in the WHO African Region, may be putting urban populations at increased risk;
- approaches that work to reduce disease burden in rural areas may not work in urban settings, or may need to occur at a smaller, more targeted scale;
- the malaria response in urban areas requires data on the determinants that are unique to urban ecosystems and that lead to a focal malaria transmission and disease burden;
- leadership from government departments, industry and finance, research, academia and other sectors tends to be concentrated in urban areas; this provides a greater opportunity for integrated, multisectoral policies, strategies and actions; and
- as urbanization rapidly increases, there is greater focus on healthier cities, including global political will to address the threats posed by climate change.

The framework has a leadership element, two strategic elements, three response pillars and one enabling element (**Fig. 2.3**).

FIG. 2.2.

Aims of the WHO initiative to support an effective response to *An. stephensi* on the African continent
Source: WHO (2022) (18).



Increasing COLLABORATION

National malaria control programmes, researchers, funders, and other actors conducting surveillance, research and control of *An. stephensi* must collaborate effectively to ensure that knowledge is shared, resources are used optimally, and key activities are prioritized. As *An. stephensi* has the potential to spread quickly, cross-border collaboration is essential, and countries should work together to ensure an effective regional approach.

Strengthening SURVEILLANCE

Entomological surveillance can determine the extent of the spread of *An. stephensi* and its role in transmission; it is essential to target specific control measures and assess their impact. Human malaria case surveillance should be used to investigate the potential impact of the vector's presence on malaria, particularly in urban areas. Such surveillance might provide an indication of the presence of *An. stephensi* in areas where it has not yet been detected.

Improving INFORMATION EXCHANGE

Information on the presence of *An. stephensi*, as well as on successes and failures in attempts to control the vector, needs to be documented and shared widely and rapidly – at both national and international levels – to determine best practices and inform the response across invaded areas.

Developing GUIDANCE

National malaria control programmes need evidence-based guidance on the appropriate ways to conduct surveillance, implement control measures, develop by-laws, and devote resources to their response to *An. stephensi*. WHO provided an initial set of recommendations in its 2019 vector alert (*17*). This guidance will be reviewed and, where appropriate, updated based on best practices and other evidence identified as part of the regional initiative.

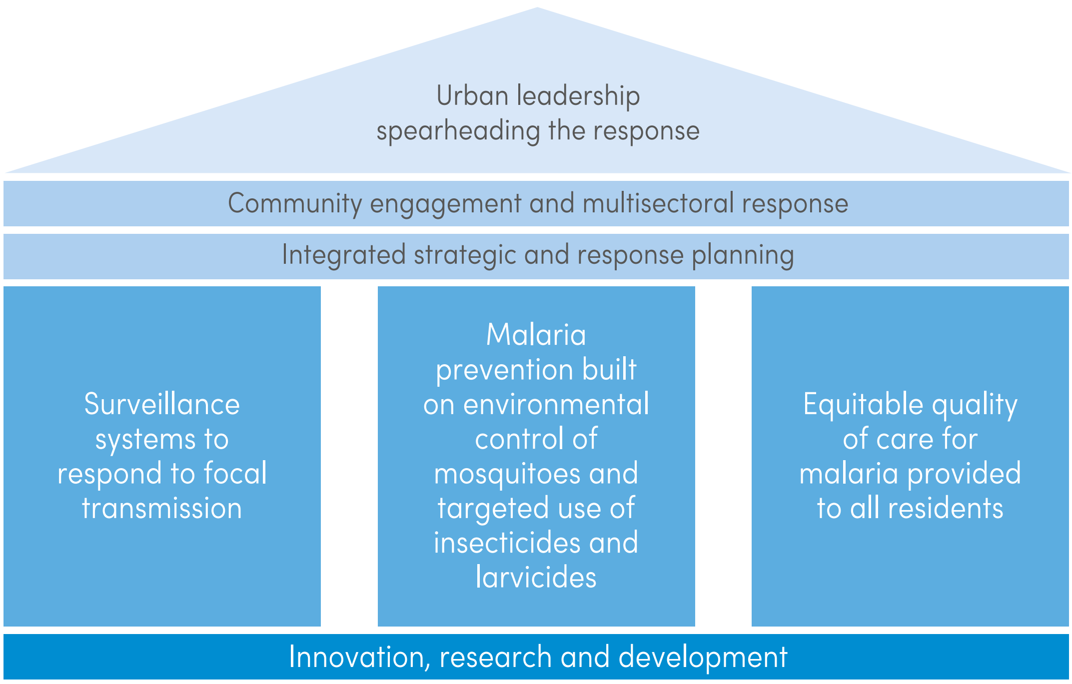
Prioritizing RESEARCH

It will be important to evaluate the impact of vector control interventions, and particularly new tools, against *An. stephensi*. Conducting research focused on *An. stephensi* will enable programmes to find better ways of responding to this invasive vector and of integrating control efforts with those targeted at other mosquito vectors.

An. stephensi: *Anopheles stephensi*; WHO: World Health Organization.

FIG. 2.3.

Building blocks of the *Global framework for the response to malaria in urban areas* *Source: WHO (2022) (20).*



WHO: World Health Organization.

2.6 ROLLOUT OF THE RTS,S/AS01 MALARIA VACCINE IN AREAS OF MODERATE TO HIGH MALARIA TRANSMISSION

In October 2021, WHO recommended the RTS,S/AS01 malaria vaccine for the prevention of *P. falciparum* malaria in children living in regions with moderate to high transmission, as defined by WHO (*22, 23*). In July 2022, WHO issued prequalification approval for the RTS,S vaccine (*24*). This is an important milestone for the vaccine rollout and country regulatory approval processes. The WHO Regional Office for Africa's African Vaccine Regulatory Forum (AVAREF) is committed to using its platform to facilitate the review and registration of the RTS,S vaccine in African countries.

Gavi, the Vaccine Alliance (Gavi) and WHO are supporting the rollout of the malaria vaccine. Following the WHO recommendation, in December 2021, the Gavi board approved an initial investment of almost US$ 160 million (2022–2025) to support broader rollout of the malaria vaccine in Gavi-eligible countries (*25*). Demand for the vaccine is expected to outpace supply in the initial years of rollout. Gavi has estimated that steady-state demand for the vaccine will exceed 80–100 million doses per year (*26*).

In anticipation of this gap in supply and demand, WHO coordinated the development of a framework for allocation of limited malaria vaccine supply, to guide where limited doses should be allocated in a fair and transparent way, based on ethical principles and the best available evidence. The main principle of the framework is to allocate the malaria vaccine across countries in areas of greatest need; that is, areas where the malaria disease burden in children and the risk of death are highest. A primary implication is that all countries will have to consider a phased subnational approach to vaccine implementation, starting in areas of highest need, until supply meets demand. The framework was published in July 2022 following a series of key stakeholder engagements (*27*). Gavi has published its guidelines for the malaria vaccine application (*28*); it recommends a phased approach to vaccine introduction, aligned with this allocation framework and within the context of national malaria control strategies.

Countries that have expressed interest in introducing the vaccine (including the pilot countries) have been supported through technical workshops to use the best available local data and evidence to guide the development of high-quality applications and national vaccine introduction plans. The workshops are facilitated by Gavi, the WHO Global Malaria Programme (WHO/GMP), the WHO Department of Immunization, Vaccines and Biologicals (IVB) and the WHO Regional Office for Africa, in collaboration with WHO country offices and global malaria partners. As of October 2022, about 20 countries had participated in the technical assistance workshops.

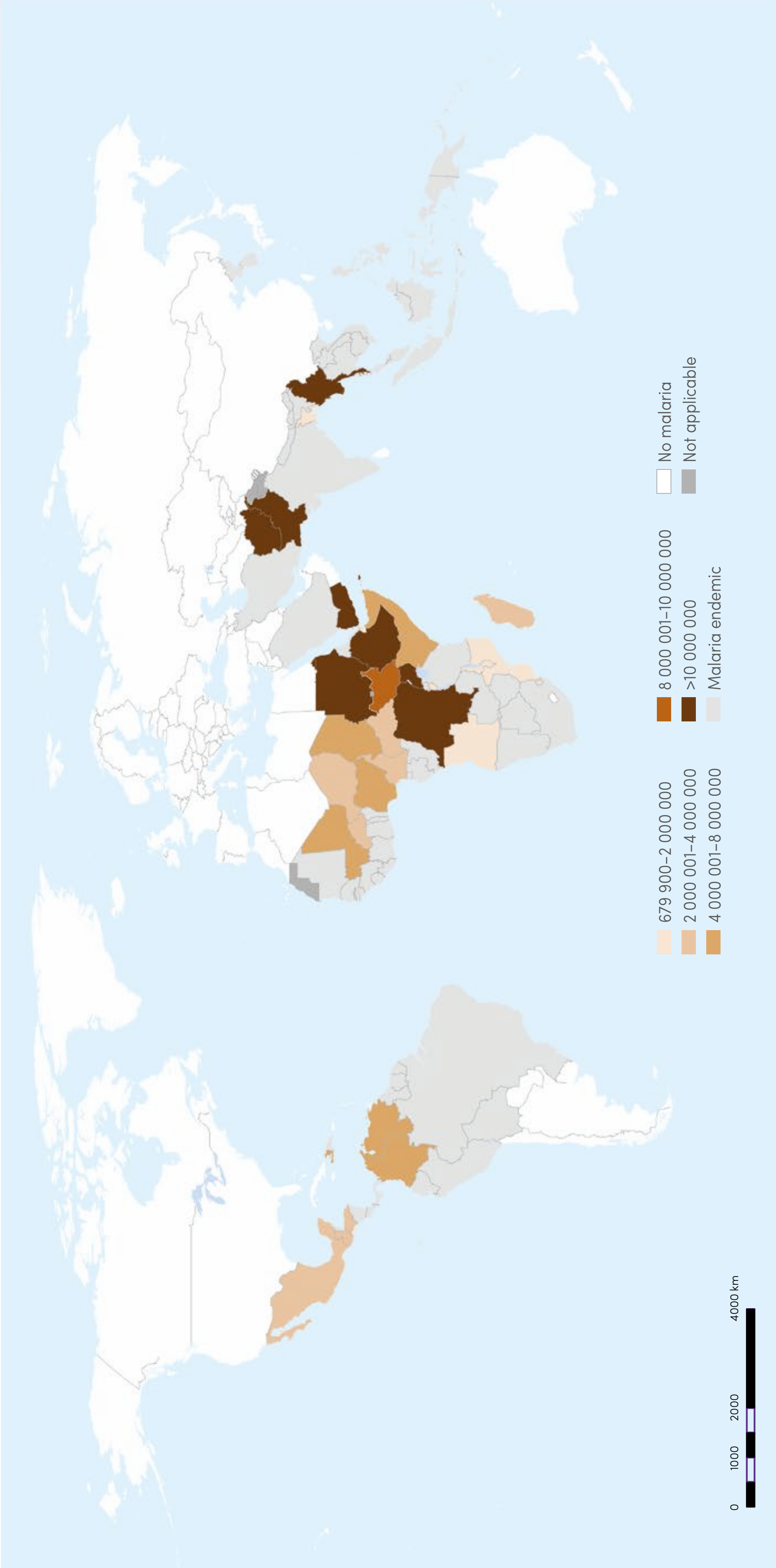
In August 2022, the United Nations Children's Fund (UNICEF) announced that it had secured supply of the GSK-produced vaccine (*29*, *30*). The contract is for an available malaria vaccine supply of 18 million doses over the next 3 years (2023–2025), with an expected price of €9.30 per dose. This initial price reflects the low supply volumes. Ongoing market-shaping efforts by WHO, Gavi, UNICEF and partners aim to increase vaccine supply and reduce costs over time, to ensure that more children can receive the malaria vaccine as rapidly as possible. Two ways to increase supply are increasing the supply of the current RTS,S/AS01 vaccine (by completing the ongoing product transfer to Bharat Biotech, Ltd) and having other malaria vaccines available.

2.7 HUMANITARIAN AND HEALTH EMERGENCIES

Section 2.8 presents an update of the malaria response during the COVID-19 pandemic and reported disruptions to provision of malaria services. However, many malaria endemic countries have been dealing with health and humanitarian emergencies unrelated to the COVID-19 pandemic. In 2019, there were an estimated 148 million people in 37 malaria endemic countries who needed assistance due to health and humanitarian emergencies, not including the COVID-19 pandemic (*31*). This number increased to 301 million in 2020 and 268 million in 2021 (**Fig. 2.4**). Conflicts, famine and flooding were the major contributors to these humanitarian emergencies, sometimes compounded by disease outbreaks. Among the countries with the highest need in 2021 in terms of people affected were Afghanistan, Colombia, the Democratic Republic of the Congo, Ethiopia, Mali, Myanmar, Nigeria, Somalia, South Sudan, the Sudan, Uganda and Yemen. In each of these countries, increases in malaria cases occurred above what could be attributed to the COVID-19 pandemic (**Section 3**).

FIG. 2.4.

People in humanitarian need in malaria endemic countries as of December 2021 *Source: Global humanitarian overview 2022 (31).*



WHO: World Health Organization.

2.8 MALARIA SERVICE DISRUPTIONS DURING THE COVID-19 PANDEMIC

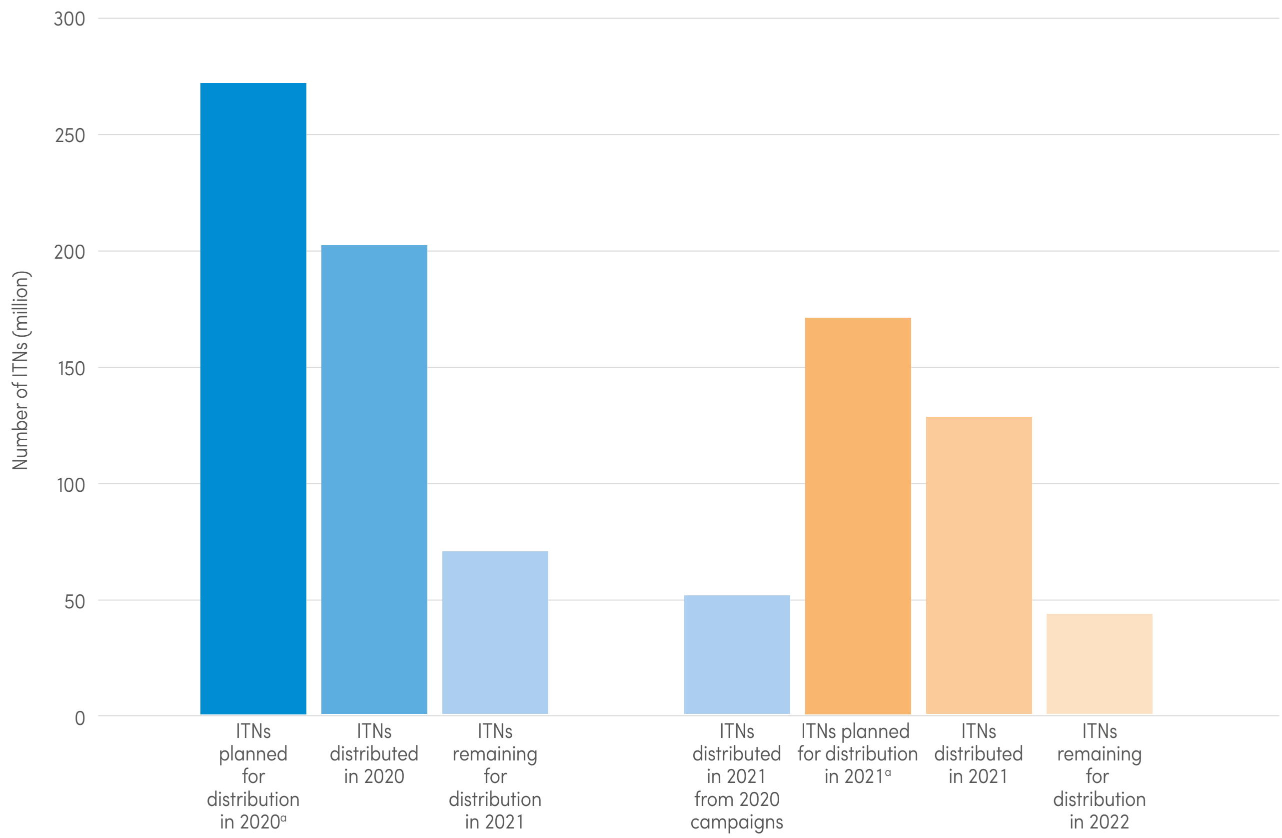
Disruptions to essential malaria services during the COVID-19 pandemic were monitored using various sources of data:

- country data assembled by the Alliance for Malaria Prevention (AMP) and the RBM Partnership to End Malaria;
- qualitative survey data from WHO essential health services (EHS) disruption surveys; and
- reports by NMPs to WHO on the number of malaria tests performed in each country.

Country data assembled by the AMP and the RBM Partnership to End Malaria show that 46 countries had ITN campaigns planned in 2020, to distribute about 272 million nets (**Annex 2**). By the end of 2020, 74% of all ITNs planned for distribution in 2020 had been distributed (**Annex 2**, **Fig. 2.5**). Six countries (Côte d'Ivoire, the Democratic Republic of the Congo, Eritrea, Eswatini, India and Kenya) had distributed less than 60% of their ITNs by the end of 2020 (**Annex 2**). Of concern, Kenya distributed less than 5% of their ITNs in 2020, while Côte d'Ivoire and Eswatini did not distribute any of their planned ITNs. In 2021, there were 43 countries that had ITN campaigns planned, including 14 countries that had planned to distribute only ITNs carried over from 2020 campaigns (**Annex 2**). There were 171 million ITNs planned for distribution in 2021, and 70 million of these ITNs were carried over

FIG. 2.5.

ITNs planned and distributed during mass campaigns in 52 malaria endemic countries, 2020–2022[a]
Source: AMP, RBM Partnership to End Malaria and NMP reports.



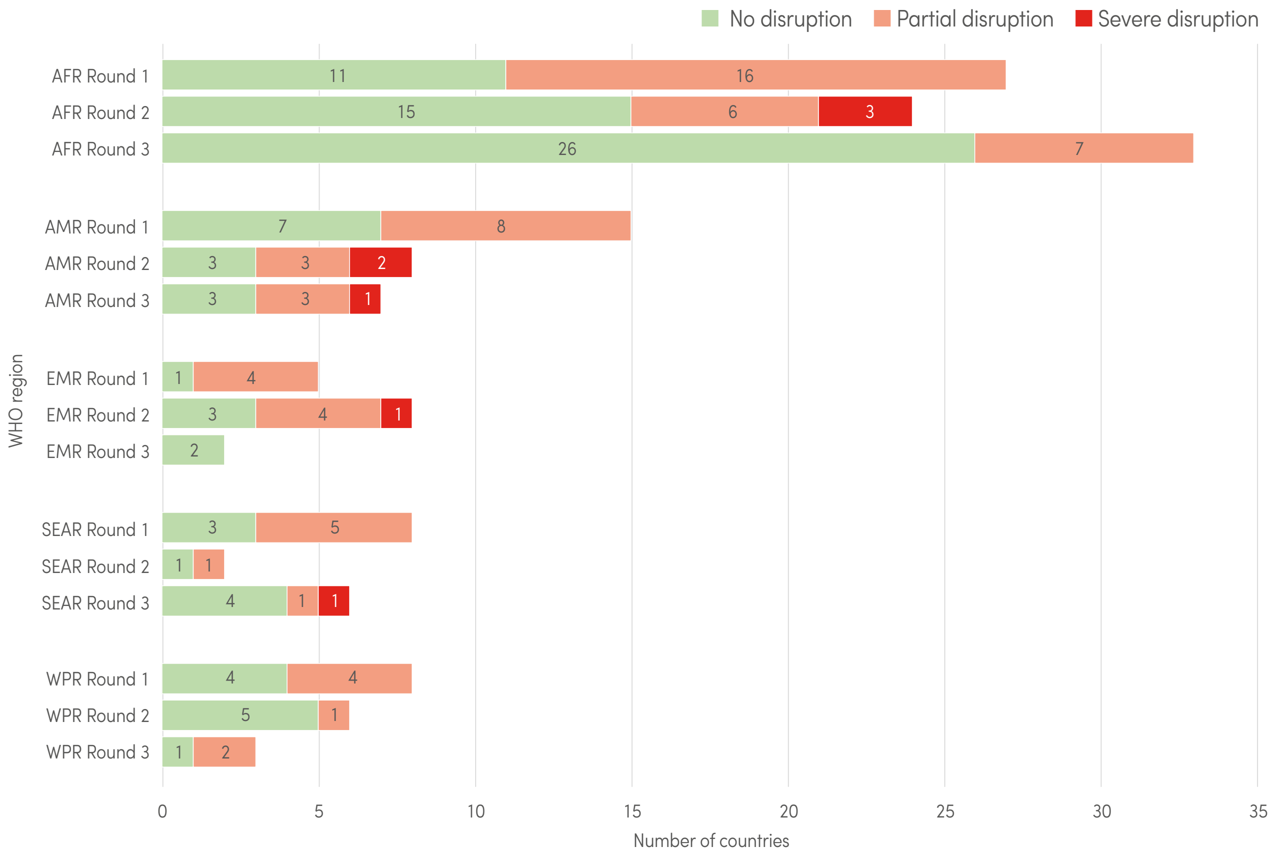
AMP: Alliance for Malaria Prevention; ITN: insecticide-treated mosquito net; NMP: national malaria programme.
[a] Mass campaigns were not scheduled in 3 countries in 2020 and 1 country in 2021. Data presented here do not include ITNs distributed through continuous distribution channels.

from 2020 (**Fig. 2.5**). Overall, 128 million ITNs (75%) were distributed in 2021. Eight countries – Benin, Eritrea, Indonesia, Nigeria, Solomon Islands, Thailand, Uganda and Vanuatu – had distributed less than 60% of their ITNs in 2021. Seven countries – Botswana, the Central African Republic, Chad, Haiti, India, Pakistan and Sierra Leone – did not distribute any of the planned ITNs. India, Nigeria and Uganda – countries supported under the high burden high impact (HBHI) approach – had distributed 0%, 53% and 26%, respectively, of their ITNs planned for distribution in 2021.

Since 2020, WHO has implemented three rounds of EHS pulse surveys (*32–34*). Round 1 (the 2020 survey) was implemented from mid-May to the end of May 2020, except in the countries of the WHO Region of the Americas, where responses were received in September 2020. Round 2 (the second survey) was implemented from December 2020 to March 2021. Round 3 (the third survey) was implemented in November to December 2021. Findings on disruptions to malaria diagnosis and treatment are summarized in **Fig. 2.6**. They suggest that, in the WHO African Region, disruptions in diagnosis and treatment had eased considerably in the latter part of 2021, with seven countries reporting disruptions, compared with 16 in 2020 and nine in the first quarter of 2021. The number of countries undertaking EHS surveys reduced in most of the other WHO regions in Round 3 of the EHS survey; however, overall, fewer countries reported disruptions to malaria diagnosis and treatment in Round 3.

FIG. 2.6.

Results from WHO surveys on disruptions to malaria diagnosis and treatment services during the COVID-19 pandemic from three rounds of surveys in 2020–2021 No disruption (<5%); partial disruption (<50%); severe disruption (≥50%). Surveys were conducted between May 2020 and December 2021. *Source: WHO Integrated Health Services.*

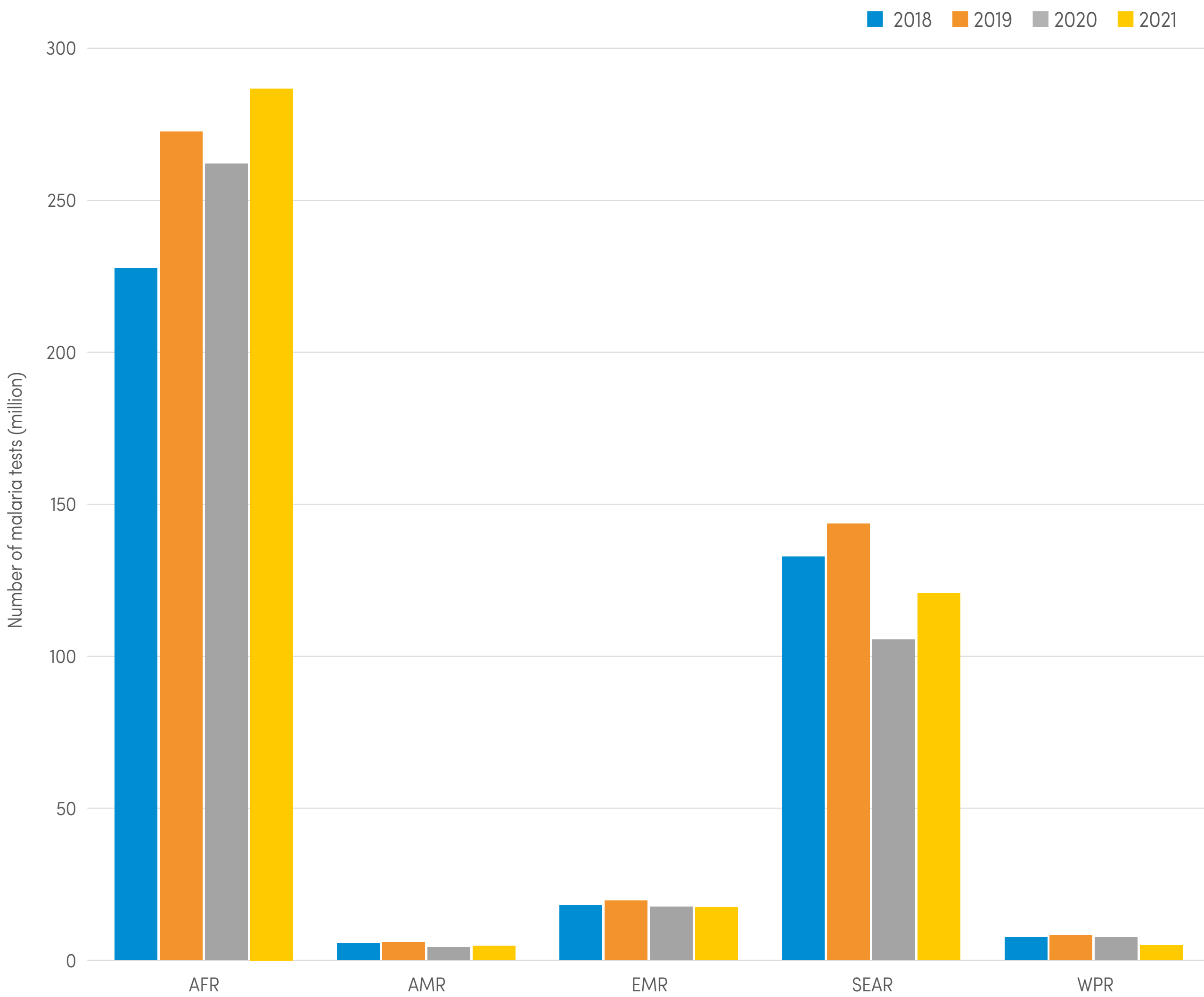


AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

An additional indicator for tracking disruptions in malaria diagnosis and a proxy for overall disruption in case management was the trend in the number of tests performed by year, comparing the 2 years preceding the pandemic (2018 and 2019) with the 2 peak years of the pandemic (2020 and 2021). The results (which are based on reports to WHO by NMPs) are summarized, by region, in **Fig. 2.7**. In total, 392 million and 450 million tests were performed in malaria endemic countries in 2018 and 2019, respectively. In 2020 and 2021, 398 million and 435 million malaria tests were performed, respectively. The drop in tests in 2020, compared with 2019, was mainly because fewer tests were performed in the WHO African Region (10.5 million fewer tests) and the South-East Asia Region (38 million fewer tests), the latter driven primarily by reductions in testing in India (a reduction of 37 million tests in 2020 compared with 2019). By 2021, testing in the WHO South-East Asia Region had increased by 15 million, mainly owing to recovery in India.

FIG. 2.7.

Number of malaria tests performed, by WHO region, in 86 malaria endemic countries *Source: NMP reports.*



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; NMP: national malaria programme; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

3 GLOBAL TRENDS IN THE BURDEN OF MALARIA

This section presents the number of malaria cases and deaths estimated to have occurred between 2000 and 2021, and the malaria case incidence and mortality rates for the same period. These estimates were used to compute the number of cases and deaths averted, globally and by WHO region, since 2000. This section also presents estimates of the prevalence of exposure to malaria during pregnancy and the burden of low birthweights averted under different scenarios of IPTp coverage.

The methods used to estimate the burden of malaria cases and deaths depend on the quality of the national surveillance systems and the availability of data over time (**Annex 1**). Most of the global malaria burden is accounted for by countries with moderate to high transmission in sub-Saharan Africa; however, these countries generally have weak surveillance systems. Case estimates for these countries are calculated using an approach that transforms modelled community parasite prevalence into case incidence within a geospatial framework. Each year, population estimates are updated in line with UN population growth projections (*35*). As these population estimates change, the number of malaria cases estimated for a given level of incidence may also change.

Malaria deaths for these countries are also estimated from a cause of death (CoD) fraction (*36*) for malaria that is applied to the trends in all-cause mortality in children aged under 5 years (*37*), and to which a factor for malaria deaths among those aged 5 years and over is applied. For countries with stronger surveillance systems, either reported data are used or cases are estimated by adjusting national data for rates of treatment seeking, testing and reporting. Where adjustments are applied to national case data, malaria deaths are estimated by applying a species-specific case fatality rate to these data.

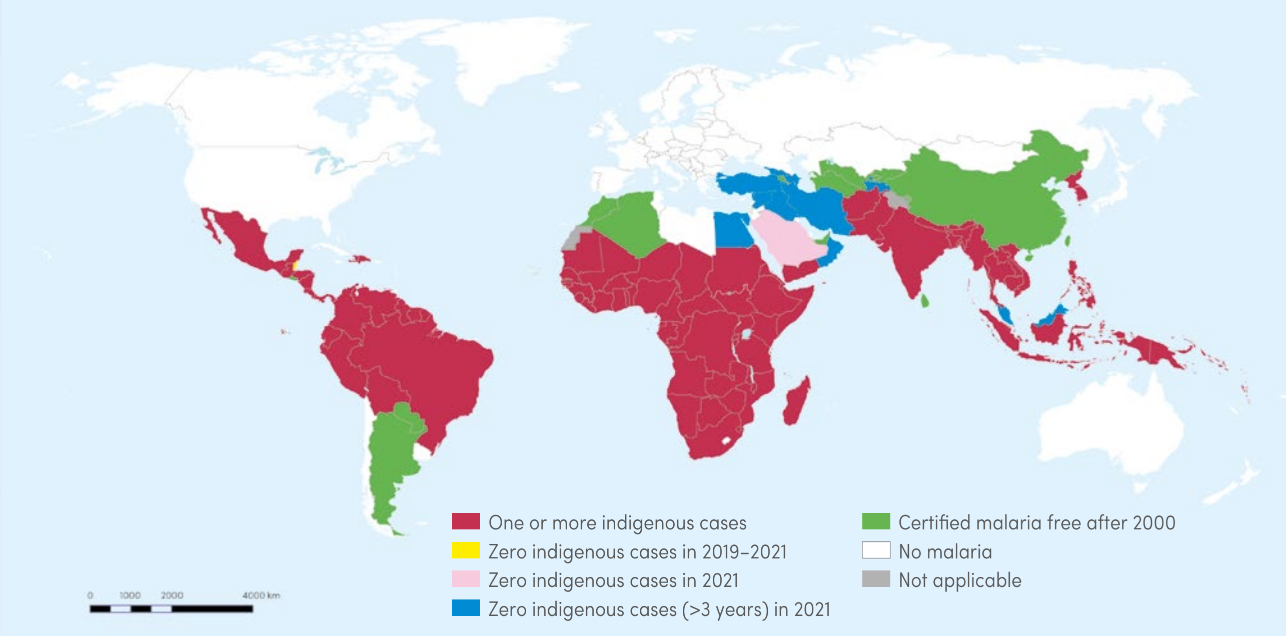
Estimates for both cases and deaths now include the impact of disruptions to essential malaria services during the COVID-19 pandemic. For both 2020 and 2021, new country epidemiological and service disruption data have affected the estimation of cases and deaths and the percentage attributable to the COVID-19 pandemic.

3.1 GLOBAL ESTIMATES OF MALARIA CASES AND DEATHS, 2000–2021

Globally in 2021, there were an estimated 247 million malaria cases (**Table 3.1**) in 84 malaria endemic countries (including the territory of French Guiana) (**Fig. 3.1**), an increase of 2 million cases compared with 2020. Between 2000 and 2015, case numbers steadily decreased from 245 million to 230 million across the 108 countries that were malaria endemic in 2000. Since 2016, malaria cases have increased; the largest annual increase of 13 million cases was observed between 2019 and 2020 during the first year of the

FIG. 3.1.

Countries with indigenous cases in 2000 and their status by 2021 Countries with zero indigenous cases for at least 3 consecutive years are considered to have eliminated malaria. In 2021, the Islamic Republic of Iran and Malaysia reported zero indigenous cases for the fourth consecutive year; also, Belize and Cabo Verde reported zero indigenous cases for the third time. China and El Salvador were certified malaria free in 2021, following 4 years of zero malaria cases. *Source: WHO database.*



WHO: World Health Organization.

TABLE 3.1.

Global estimated malaria cases and deaths, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**245 000**	229 000	266 000	8.4%	**897 000**	866 000	938 000
2001	**250 000**	231 000	273 000	8.3%	**888 000**	855 000	933 000
2002	**246 000**	228 000	268 000	7.7%	**847 000**	816 000	890 000
2003	**249 000**	232 000	272 000	8.1%	**825 000**	794 000	870 000
2004	**251 000**	232 000	278 000	7.9%	**807 000**	773 000	866 000
2005	**249 000**	231 000	272 000	8.0%	**783 000**	751 000	832 000
2006	**244 000**	226 000	268 000	7.0%	**771 000**	739 000	820 000
2007	**241 000**	224 000	263 000	6.6%	**751 000**	721 000	794 000
2008	**241 000**	224 000	262 000	6.4%	**731 000**	700 000	773 000
2009	**246 000**	228 000	269 000	6.3%	**721 000**	685 000	771 000
2010	**248 000**	229 000	272 000	6.6%	**704 000**	667 000	757 000
2011	**242 000**	225 000	262 000	7.0%	**660 000**	629 000	704 000
2012	**238 000**	222 000	258 000	6.9%	**622 000**	593 000	664 000
2013	**233 000**	217 000	253 000	5.9%	**603 000**	572 000	648 000
2014	**231 000**	211 000	253 000	5.5%	**584 000**	549 000	639 000
2015	**230 000**	211 000	253 000	4.9%	**577 000**	540 000	635 000
2016	**232 000**	214 000	253 000	4.6%	**580 000**	545 000	642 000
2017	**237 000**	219 000	257 000	3.7%	**587 000**	553 000	654 000
2018	**231 000**	214 000	252 000	3.0%	**567 000**	532 000	642 000
2019	**232 000**	213 000	255 000	2.7%	**568 000**	532 000	654 000
2020	**245 000**	222 000	273 000	1.8%	**625 000**	583 000	747 000
2021	**247 000**	224 000	276 000	2.0%	**619 000**	577 000	754 000

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

COVID-19 pandemic. The increase in cases between 2020 and 2021 was considerably smaller, with 2 million additional cases. Overall, an estimated additional 13.4 million cases were attributed to disruptions during the COVID-19 pandemic.

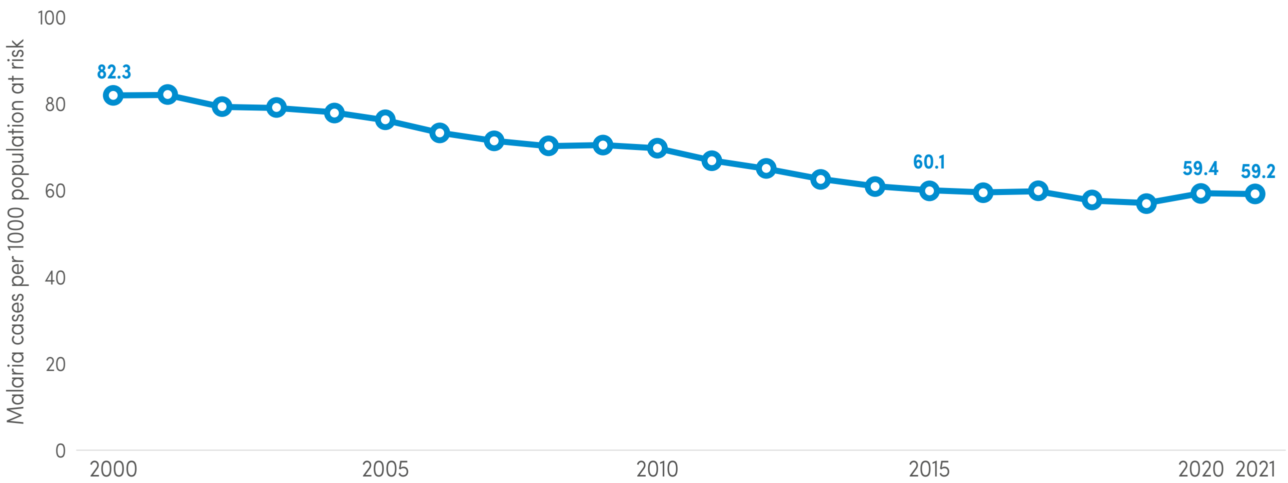
Most of the increase in case numbers over the past 5 years occurred in countries in the WHO African Region (**Section 3.2**). Malaria case incidence declined from 82.3 per 1000 population at risk in 2000 to 57.2 in 2019, before increasing by 4% to 59.4 in 2020. There was no change in case incidence between 2020 and 2021 (**Fig. 3.2a**). Despite the increase in cases, the results suggest that efforts by countries and partners averted the worst-case scenario projected at the start of the pandemic (*38*).

Since 2000, malaria deaths declined steadily from 897 000 to 577 000 in 2015, and to 568 000 in 2019. The malaria mortality rate halved between 2000 and 2015, from 30.1 per 100 000 population at risk to 15.0 per 100 000; it then continued to decline, reaching 14.0 per 100 000 in 2019 (**Fig. 3.2b**). In 2020, the mortality rate increased to about 15.1 per 100 000 population at risk before decreasing slightly to 14.8 in 2021.

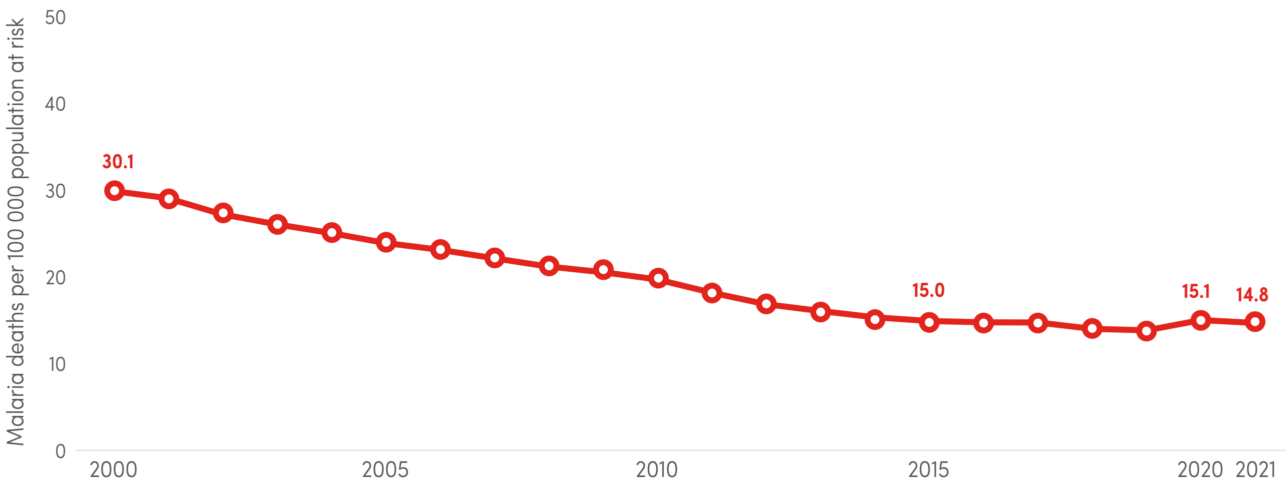
FIG. 3.2.

Global trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) distribution of malaria cases and d) deaths by country, 2021 *Source: WHO estimates.*

a)



b)

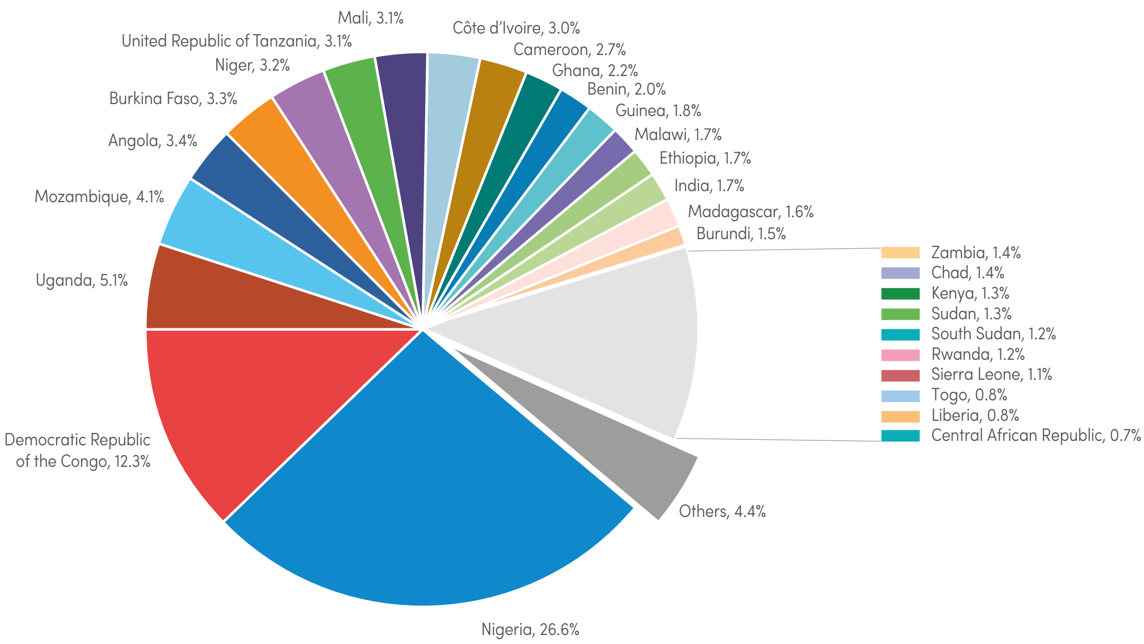


However, in 2020, malaria deaths increased to an estimated 625 000, an increase of 57 000 deaths from 2019 (**Table 3.1**). The estimated deaths in 2021 were 619 000, a slight decline compared with 2020. Between 2019 and 2021 there were 63 000 deaths that were due to disruptions to essential malaria services during the COVID-19 pandemic (**Annex 1**, **Table 3.1**).

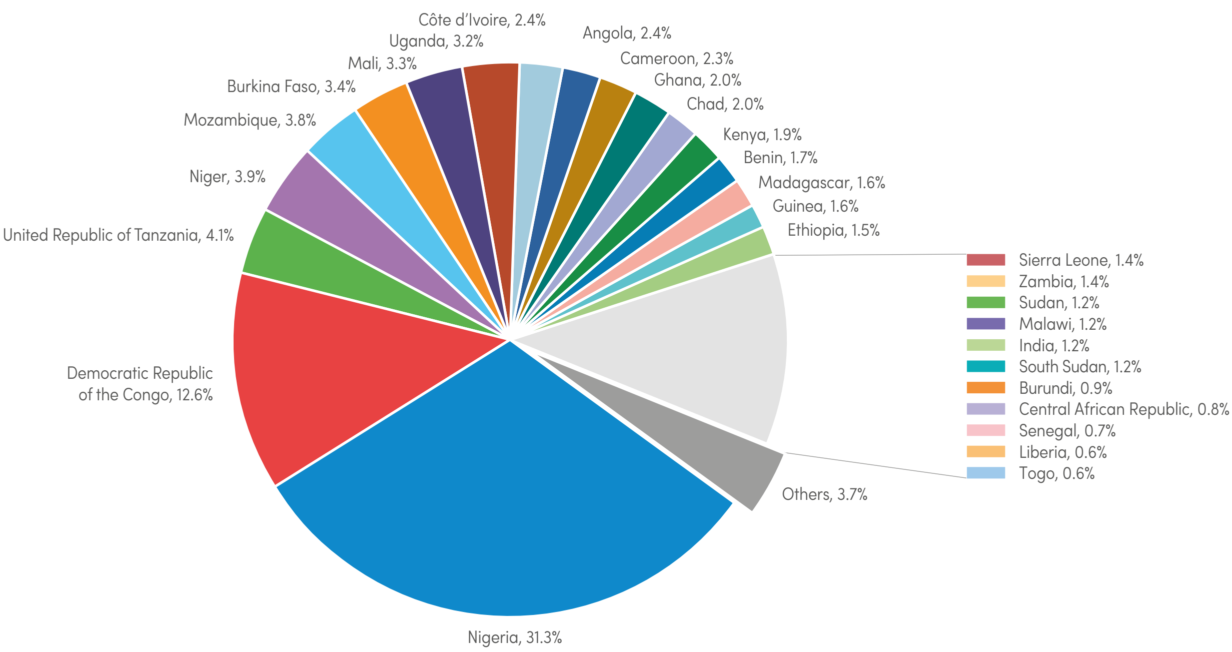
The percentage of total malaria deaths among children aged under 5 years declined over the past 20 years, from 87.3% in 2000 to 76.8% in 2015, but since then it has remained unchanged. In 2021, 29 of the 84 countries that were malaria endemic (including the territory of French Guiana) accounted for about 96% of malaria cases and deaths globally (**Fig. 3.2c** and **Fig. 3.2d**).

Four countries accounted for almost half of all cases: Nigeria (26.6%), the Democratic Republic of the Congo (12.3%), Uganda (5.1%) and Mozambique (4.1%) (**Fig. 3.2c**). Also, four countries accounted for just over half of all malaria deaths globally: Nigeria (31.3%), the Democratic Republic of the Congo (12.6%), the United Republic of Tanzania (4.1%) and the Niger (3.9%) (**Fig. 3.2d**). Nigeria accounted for 38.4% of global malaria deaths in children aged under 5 years.

c)



d)



WHO: World Health Organization.

3.2 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO AFRICAN REGION, 2000–2021

Between 2019 and 2020, estimated malaria cases increased from 218 million to 232 million, and deaths from 544 000 to 599 000 in the WHO African Region (**Table 3.2**). In 2021, while cases increased to 234 million, deaths decreased to 593 000. This region accounted for about 95% of cases and 96% of deaths globally; 78.9% of all deaths in this region were among children aged under 5 years in 2021 compared with 91.0% in 2000.

Since 2000, malaria case incidence reduced from 372.6 to 225.5 cases per 1000 population at risk in 2019. As a result of service disruptions owing to the COVID-19 pandemic, malaria case incidence increased to 233.6 per 1000 population at risk in 2020, but then declined to 229.4 in 2021 (**Fig. 3.3a**). Between 2000 and 2019, the malaria mortality rate reduced by 62%, from 148.4 to 56.3 per 100 000 population at risk (**Fig. 3.3b**). In

TABLE 3.2.

Estimated malaria cases and deaths in the WHO African Region, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**211 000**	195 000	229 000	2.9%	**841 000**	815 000	875 000
2001	**216 000**	197 000	237 000	2.6%	**834 000**	806 000	873 000
2002	**214 000**	196 000	234 000	2.3%	**796 000**	769 000	831 000
2003	**216 000**	199 000	237 000	2.3%	**774 000**	748 000	810 000
2004	**216 000**	198 000	242 000	1.8%	**754 000**	725 000	807 000
2005	**213 000**	196 000	235 000	1.3%	**729 000**	704 000	771 000
2006	**212 000**	195 000	234 000	1.3%	**722 000**	696 000	764 000
2007	**212 000**	195 000	232 000	1.3%	**705 000**	679 000	742 000
2008	**212 000**	196 000	230 000	1.2%	**685 000**	660 000	717 000
2009	**216 000**	199 000	237 000	1.3%	**671 000**	642 000	715 000
2010	**217 000**	199 000	239 000	1.6%	**653 000**	623 000	700 000
2011	**214 000**	198 000	234 000	2.3%	**617 000**	590 000	656 000
2012	**214 000**	199 000	233 000	2.7%	**584 000**	556 000	622 000
2013	**214 000**	197 000	232 000	2.6%	**570 000**	542 000	613 000
2014	**211 000**	191 000	233 000	2.8%	**549 000**	516 000	601 000
2015	**211 000**	192 000	232 000	2.2%	**542 000**	509 000	598 000
2016	**211 000**	193 000	231 000	1.5%	**542 000**	511 000	600 000
2017	**218 000**	201 000	238 000	1.0%	**555 000**	522 000	619 000
2018	**215 000**	198 000	236 000	0.2%	**541 000**	508 000	614 000
2019	**218 000**	199 000	240 000	0.3%	**544 000**	509 000	628 000
2020	**232 000**	208 000	260 000	0.3%	**599 000**	559 000	722 000
2021	**234 000**	210 000	262 000	0.3%	**593 000**	553 000	728 000

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

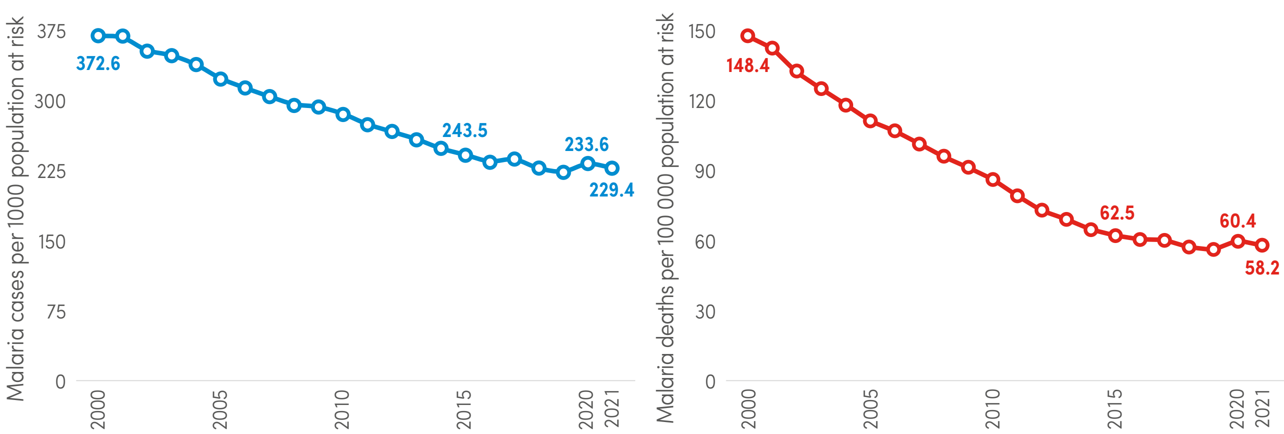
2020, the mortality rate increased to 60.4 per 100 000 population before decreasing in 2021 to 58.2.

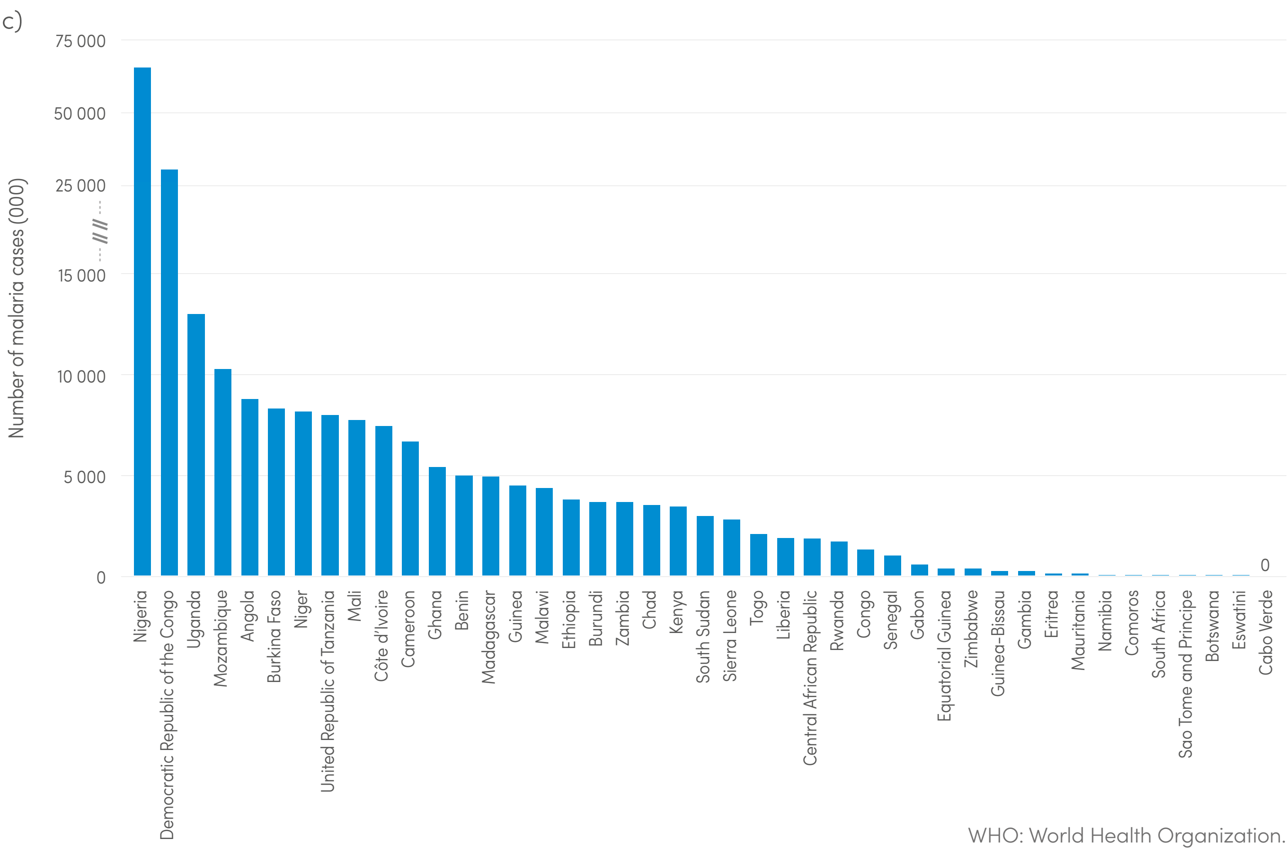
Cabo Verde has reported zero malaria deaths since 2018. In 2021, Botswana, the Comoros, Eritrea, Eswatini and Sao Tome and Principe all reported fewer than 10 deaths. Since 2015, the rate of progress in both cases and deaths has stalled in several countries with moderate or high transmission; the situation was made worse, especially in sub-Saharan Africa, by disruptions during the COVID-19 pandemic and other humanitarian emergencies (**Fig. 3.3a–b**).

Between 2019 and 2021 there were substantial increases in estimated case numbers in Nigeria (4.0 million), Madagascar (2.8 million), Uganda (1.7 million), the Democratic Republic of the Congo (1.6 million) and Angola (1.4 million). Over the same period, Rwanda saw a decrease of more than 3.6 million cases. The distribution of cases by country in 2021 is shown in **Fig. 3.3c**.

FIG. 3.3.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO African Region, 2021
Source: WHO estimates.





WHO: World Health Organization.

3.3 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO SOUTH-EAST ASIA REGION, 2000–2021

The WHO South-East Asia Region had nine malaria endemic countries in 2021, accounting for 5.4 million cases and contributing 2% of the burden of malaria cases globally (**Table 3.3**). In 2021, India accounted for about 79% of all malaria cases (**Fig. 3.4c**). About 40% of all cases in the region were due to *P. vivax*.

Over the past 20 years, malaria cases have reduced by 76%, from 22.8 million in 2000 to 5.4 million in 2021, and incidence has reduced by 82%, from 17.9 to 3.2 per 1000 population at risk (**Fig. 3.4a**). Sri Lanka was certified malaria free in 2016. Timor-Leste reported zero indigenous cases in 2021.

TABLE 3.3.

Estimated malaria cases and deaths in the WHO South-East Asia Region, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**22 800**	18 400	28 800	47.6%	**35 000**	19 000	54 000
2001	**23 100**	18 800	29 100	50.5%	**34 000**	19 000	52 000
2002	**21 900**	17 800	27 700	49.9%	**32 000**	18 000	50 000
2003	**23 100**	18 600	29 100	52.3%	**33 000**	18 000	50 000
2004	**25 400**	20 300	32 300	51.9%	**36 000**	20 000	57 000
2005	**27 200**	21 100	35 900	53.7%	**38 000**	21 000	61 000
2006	**22 500**	17 400	30 500	51.4%	**32 000**	18 000	52 000
2007	**22 000**	16 900	29 900	49.5%	**33 000**	18 000	53 000
2008	**23 200**	17 600	31 900	47.4%	**35 000**	19 000	58 000
2009	**23 700**	17 800	33 200	45.2%	**37 000**	20 000	63 000
2010	**24 000**	18 700	32 100	44.8%	**38 000**	21 000	60 000
2011	**20 600**	16 000	27 700	46.0%	**32 000**	18 000	51 000
2012	**17 700**	13 900	23 600	47.7%	**27 000**	16 000	42 000
2013	**13 200**	10 400	17 500	46.1%	**20 000**	11 000	32 000
2014	**12 800**	10 000	17 000	35.0%	**23 000**	12 000	38 000
2015	**13 200**	10 400	17 600	34.3%	**24 000**	12 000	39 000
2016	**13 700**	10 100	19 500	34.9%	**25 000**	12 000	42 000
2017	**10 200**	7 700	14 100	37.3%	**18 000**	9 000	30 000
2018	**7 500**	5 400	10 300	50.6%	**11 000**	6 000	18 000
2019	**6 400**	4 600	8 800	51.3%	**9 000**	5 000	15 000
2020	**5 000**	3 600	6 800	36.3%	**9 000**	5 000	15 000
2021	**5 400**	4 000	7 300	39.7%	**9 000**	5 000	15 000

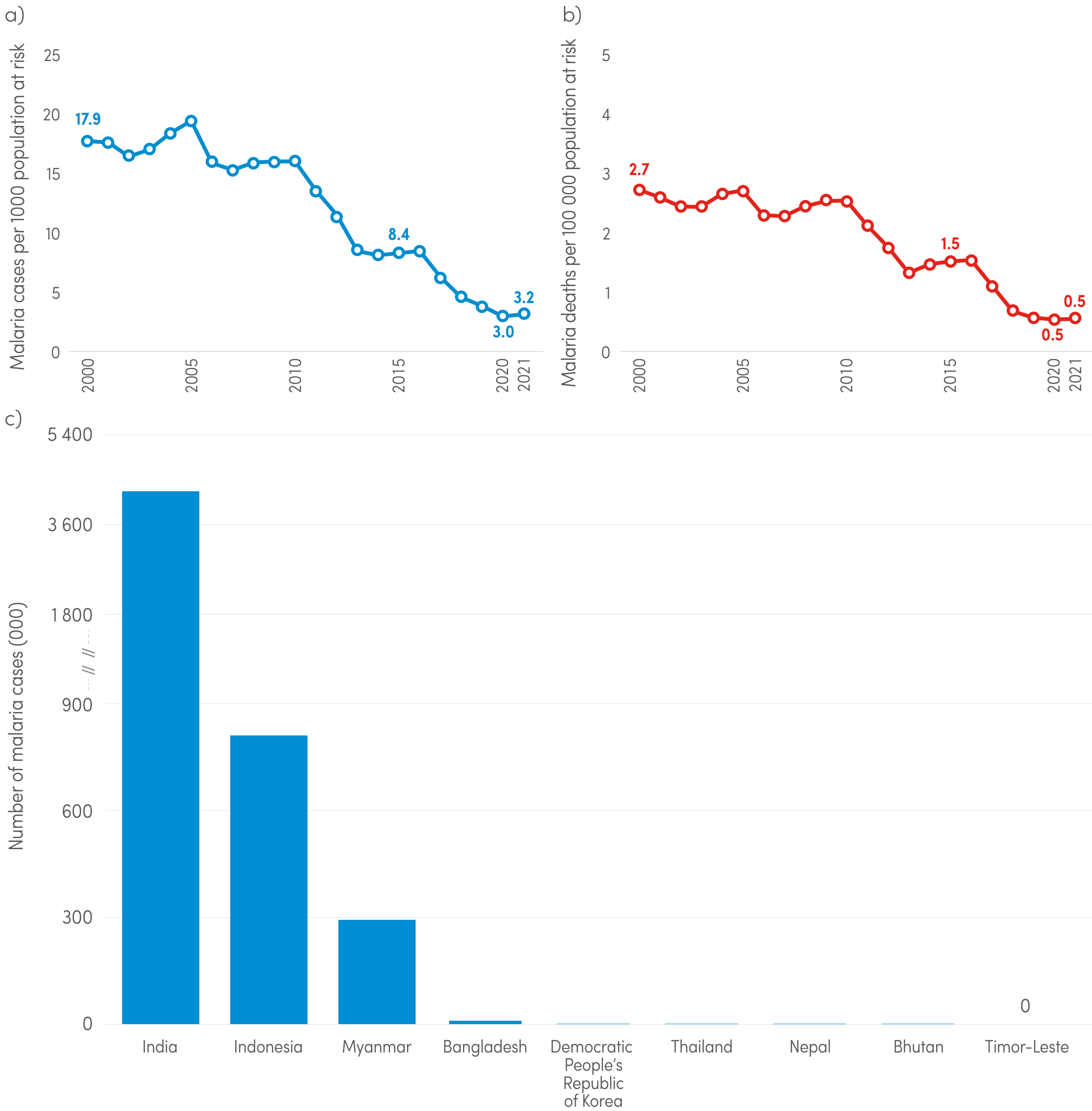
P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

Between 2020 and 2021 there was an increase of 400 000 cases in the region, and over half of these cases were in Myanmar. Increases in cases and incidence were also seen in Bangladesh, the Democratic People's Republic of Korea, India and Indonesia.

Malaria deaths reduced by 74%, from about 35 000 in 2000 to 9000 in 2019. The number of estimated deaths has remained the same for the past 3 years. Between 2000 and 2021, the malaria mortality rate reduced by 81%, from 2.7 to 0.5 per 100 000 population at risk (**Fig. 3.4b**). India accounted for about 83% of all malaria deaths in this region in 2021. Between 2020 and 2021, all countries in this region in which malaria deaths occurred had reported either a reduction or no change in the malaria mortality rate except for Myanmar, where the mortality rate increased more than three times, from 0.2 to 0.74 per 100 000 population at risk. Bhutan and Timor-Leste have reported zero malaria deaths since 2013 and 2015, respectively. In 2021, Thailand reported zero indigenous deaths for the first time and Nepal reported one death.

FIG. 3.4.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO South-East Asia Region, 2021 *Source: WHO estimates.*



WHO: World Health Organization.

3.4 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO EASTERN MEDITERRANEAN REGION, 2000–2021

Estimated malaria cases in the WHO Eastern Mediterranean Region reduced by 38% between 2000 and 2015, from 6.9 million to 4.3 million, before increasing by 44% between 2015 and 2021 to reach 6.2 million cases (**Table 3.4**). Between 2020 and 2021, increases in estimated malaria cases were seen in Somalia, the Sudan and Yemen, with an additional 205 000, 64 000 and 180 000 cases, respectively. Estimated cases reduced in Afghanistan, Djibouti and Pakistan. In 2021, 18% of the cases in this region were due to *P. vivax*, mainly in Afghanistan and Pakistan. Due to instabilities in Afghanistan, Somalia, the Sudan and Yemen, it has been difficult to obtain sufficiently reliable data to estimate the recent trends of the burden of malaria in these countries. As such, current estimates should be interpreted with caution. Furthermore, recent floods in Pakistan suggest a malaria upsurge, which will probably lead to a considerably higher estimate in 2022. WHO will be supporting subnational burden estimation analyses in these countries to verify the trends in estimated cases.

Estimated malaria deaths also reduced by about 45%, from 13 600 in 2000 to 7500 in 2014, and then increased by 79% between 2014 and 2021 to reach

TABLE 3.4.

Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**6 900**	5 500	11 100	27.3%	**13 600**	8 500	25 600
2001	**7 200**	5 600	11 900	27.2%	**14 100**	8 900	25 700
2002	**6 800**	5 200	11 900	28.3%	**13 100**	8 400	25 900
2003	**6 400**	5 000	11 100	29.2%	**12 200**	7 700	24 300
2004	**5 200**	4 200	8 900	25.0%	**10 500**	6 600	20 600
2005	**5 400**	4 200	9 400	22.3%	**11 200**	7 000	22 200
2006	**5 400**	4 100	10 100	20.5%	**11 300**	7 000	24 500
2007	**4 700**	3 800	6 500	24.4%	**9 600**	6 100	14 700
2008	**3 700**	2 900	5 200	28.8%	**7 100**	4 500	10 800
2009	**3 600**	2 800	5 300	29.7%	**6 900**	4 400	10 800
2010	**4 500**	3 400	6 400	28.8%	**8 600**	5 500	13 300
2011	**4 600**	3 500	6 500	39.1%	**7 800**	5 100	11 500
2012	**4 300**	3 300	6 100	33.1%	**8 000**	5 100	11 500
2013	**4 200**	3 300	5 600	34.3%	**7 500**	4 900	10 700
2014	**4 000**	3 300	5 100	31.1%	**7 500**	4 800	10 900
2015	**4 300**	3 500	5 700	30.0%	**8 200**	5 200	12 100
2016	**5 400**	4 300	6 900	36.1%	**9 500**	5 900	14 500
2017	**5 400**	4 100	7 300	30.1%	**10 200**	6 000	16 800
2018	**5 600**	4 200	8 000	26.7%	**11 100**	6 400	18 700
2019	**5 700**	4 200	8 200	22.0%	**11 900**	6 700	20 000
2020	**5 900**	4 200	8 500	17.7%	**12 700**	7 000	21 800
2021	**6 200**	4 400	9 000	18.0%	**13 400**	7 500	23 000

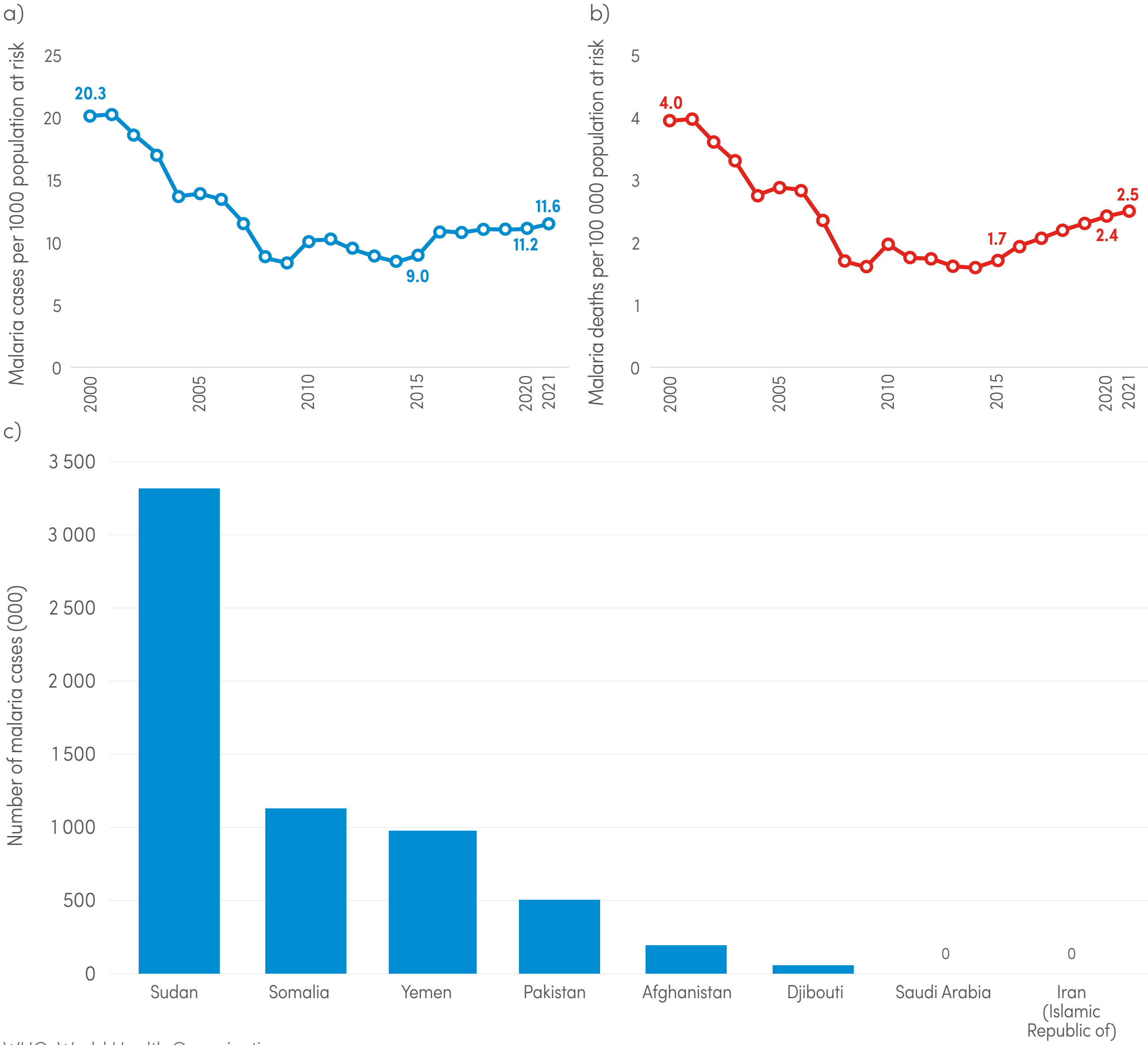
P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

13 400 deaths (**Table 3.4**). This increase in deaths was due to increases in Djibouti, Somalia, the Sudan and Yemen. Most of the estimated deaths were observed in the Sudan, where more than 90% of cases are due to *P. falciparum*, which is responsible for almost all malaria-related fatalities. About 58% of the deaths in the region were in the Sudan.

Over the period 2000–2021, malaria case incidence declined from 20.3 to 11.6 cases per 1000 population at risk and the mortality rate declined from 4.0 to 2.5 deaths per 100 000 population at risk (**Fig. 3.5a–b**). Although case incidence and mortality rates reduced overall between 2000 and 2021, the largest reductions (of 58% and 60%, respectively), were seen between 2000 and 2009. Apart from two small increases in incidence rates in 2010 and 2016, there has been little change over the past 10 years. Mortality rates have gradually increased since 2016 by a total of 28%. In 2021, the Sudan accounted for most of the estimated malaria cases in this region (54%), followed by Somalia, Yemen, Pakistan, Afghanistan and Djibouti (**Fig. 3.5c**). In 2021, Saudi Arabia reported zero indigenous malaria cases for the first time and the Islamic Republic of Iran reported no indigenous malaria cases for a fourth consecutive year. Iraq, Morocco, Oman and the Syrian Arab Republic last reported indigenous malaria cases in 2008, 2004, 2007 and 2004, respectively (**Annex 4-I**). In 2021, all countries in the region reported zero malaria deaths apart from Djibouti, the Sudan and Yemen.

FIG. 3.5.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Eastern Mediterranean Region, 2021 *Source: WHO estimates.*



WHO: World Health Organization.

3.5 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO WESTERN PACIFIC REGION, 2000–2021

Malaria cases decreased by 49% in the WHO Western Pacific Region, from 2.8 million cases in 2000 to an estimated 1.4 million cases in 2021. An increase of 15% was observed between 2019 and 2020; however, in 2021, cases decreased again by 14% (**Table 3.5**). Malaria deaths also decreased significantly, by 58%, from about 6200 deaths in 2000 to 2600 deaths in 2021, with an increase between 2019 and 2020 (from 2600 to 3200 deaths). Increases in cases and deaths between 2019 and 2020 were mainly due to increases in Papua New Guinea. Between 2020 and 2021, increases in cases were observed in the Lao People's Democratic Republic and Solomon Islands. The proportion of cases in the region due to *P. vivax* has increased over time, from about 17% in 2000 to almost a third of all cases in 2021, with effective malaria prevention and treatment contributing to reductions in the burden of *P. falciparum*.

TABLE 3.5.

Estimated malaria cases and deaths in the WHO Western Pacific Region, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

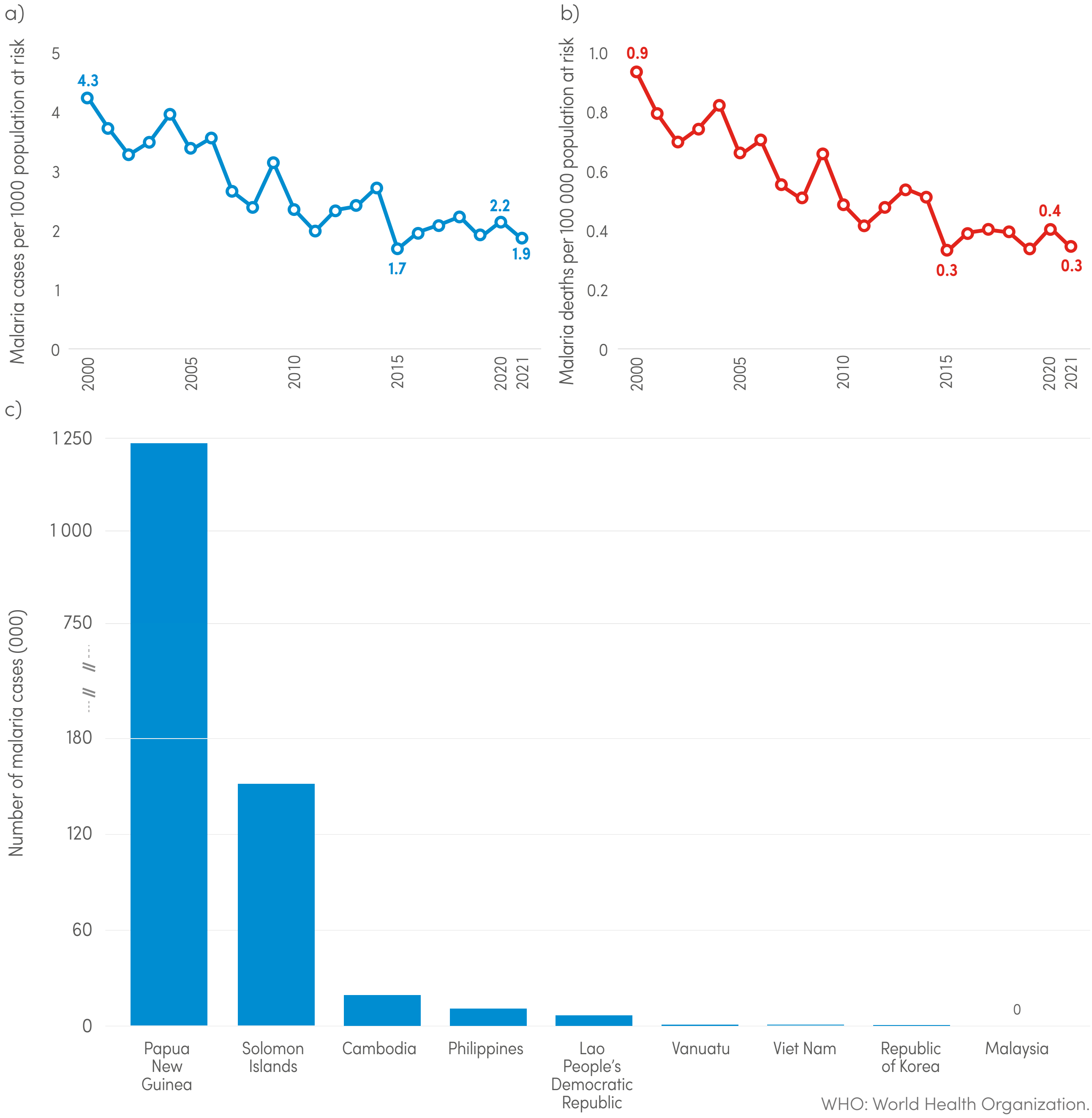
Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**2 805**	1 778	4 049	17.4%	**6 200**	3 400	10 100
2001	**2 477**	1 481	3 653	20.3%	**5 300**	2 800	8 900
2002	**2 192**	1 329	3 223	20.6%	**4 700**	2 500	7 900
2003	**2 359**	1 446	3 501	20.1%	**5 000**	2 700	8 600
2004	**2 702**	1 557	4 067	22.5%	**5 600**	2 900	9 800
2005	**2 301**	1 350	3 499	28.7%	**4 500**	2 300	7 900
2006	**2 463**	1 485	3 650	27.0%	**4 900**	2 600	8 300
2007	**1 847**	981	2 893	21.9%	**3 900**	1 800	7 200
2008	**1 673**	862	2 693	20.5%	**3 600**	1 600	6 600
2009	**2 225**	1 246	3 384	20.5%	**4 700**	2 300	8 800
2010	**1 677**	967	2 517	22.2%	**3 500**	1 700	6 300
2011	**1 422**	847	2 138	21.7%	**3 000**	1 500	5 400
2012	**1 698**	867	3 015	23.2%	**3 500**	1 400	7 200
2013	**1 756**	1 121	2 566	13.6%	**4 000**	1 800	7 200
2014	**2 014**	1 340	2 925	30.9%	**3 800**	1 800	6 700
2015	**1 247**	931	1 622	27.0%	**2 500**	1 300	4 000
2016	**1 472**	1 073	1 921	25.1%	**3 000**	1 400	5 000
2017	**1 576**	1 145	2 101	28.5%	**3 000**	1 500	5 100
2018	**1 693**	1 242	2 239	35.9%	**3 000**	1 500	5 100
2019	**1 434**	1 091	1 811	35.3%	**2 600**	1 300	4 300
2020	**1 650**	1 196	2 150	29.5%	**3 200**	1 400	5 400
2021	**1 426**	1 046	1 839	31.9%	**2 600**	1 200	4 600

P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

In the period 2000–2021, malaria case incidence reduced from 4.3 to 1.9 cases per 1000 population at risk (**Fig. 3.6a**), and the malaria mortality rate reduced from 0.9 to 0.3 deaths per 100 000 population at risk (**Fig. 3.6b**). Papua New Guinea accounted for 87% of all cases in this region in 2021, followed by Solomon Islands, Cambodia and the Philippines (**Fig. 3.6c**). China was certified malaria free in 2021. Malaysia has had no cases due to the four human malaria parasites for 4 consecutive years, but for the past 5 years there has been an increase in the number of zoonotic *P. knowlesi* malaria cases, with 3575 cases reported in 2021. Four countries had fewer than 10 000 estimated cases in 2021: the Lao People's Democratic Republic (6403), the Republic of Korea (274), Vanuatu (576) and Viet Nam (453). Papua New Guinea accounted for 94% of all deaths in the region. There have been zero reported malaria deaths in the Republic of Korea and Vanuatu since 2012, Cambodia since 2018 and Viet Nam since 2019. No deaths due to human malaria have been reported in Malaysia since 2018; however, a small number of *P. knowlesi* malaria deaths have been reported every year since then, with 13 deaths occurring in 2021.

FIG. 3.6.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Western Pacific Region, 2021 *Source: WHO estimates.*



WHO: World Health Organization.

3.6 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO REGION OF THE AMERICAS, 2000–2021

Between 2000 and 2021, in the WHO Region of the Americas, malaria cases and incidence declined by 60% (from 1.5 million to 0.6 million) and 70% (from 14.1 to 4.2 cases per 1000 population at risk), respectively (**Table 3.6**, **Fig. 3.7a**). Over the same period, malaria deaths and the mortality rate reduced by 64% (from 919 to 334) and 73% (from 0.8 to 0.2 deaths per 100 000 population at risk), respectively (**Table 3.6**, **Fig. 3.7b**). The Bolivarian Republic of Venezuela, Brazil and Colombia accounted for 79% of all cases in this region (**Fig. 3.7c**). Most of the cases in this region are due to *P. vivax* (71.5% in 2021).

Progress in this region suffered in recent years because of a major increase in malaria in the Bolivarian Republic of Venezuela, which had about 35 500 cases in 2000, rising to over 482 000 by 2017. In 2020, however, cases reduced by more than half compared with 2019, from 467 000 to 223 000 cases, and then reduced further in 2021, to 205 000 cases.

TABLE 3.6.

Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2021 Estimated cases and deaths are shown with 95% upper and lower confidence intervals. *Source: WHO estimates.*

Year	Number of cases (000)				Number of deaths		
	Point	Lower bound	Upper bound	% *P. vivax*	Point	Lower bound	Upper bound
2000	**1 549**	1 400	1 710	71.6%	**919**	776	1 124
2001	**1 297**	1 169	1 431	67.1%	**832**	699	1 039
2002	**1 183**	1 078	1 297	67.7%	**765**	622	976
2003	**1 159**	1 067	1 262	68.6%	**725**	581	938
2004	**1 147**	1 069	1 235	69.5%	**712**	567	919
2005	**1 273**	1 201	1 359	70.3%	**688**	539	907
2006	**1 097**	1 033	1 175	68.3%	**584**	445	791
2007	**989**	907	1 073	70.2%	**504**	381	696
2008	**696**	643	761	71.1%	**470**	322	699
2009	**688**	635	753	70.5%	**464**	322	686
2010	**818**	746	901	70.9%	**502**	354	728
2011	**615**	568	671	68.9%	**464**	321	674
2012	**585**	545	634	68.9%	**430**	308	607
2013	**576**	530	630	64.1%	**470**	337	647
2014	**475**	444	510	69.4%	**348**	259	449
2015	**573**	531	620	70.1%	**390**	288	505
2016	**688**	637	749	67.3%	**530**	379	693
2017	**946**	878	1 032	73.9%	**665**	452	902
2018	**929**	861	1 014	78.1%	**572**	391	773
2019	**894**	824	979	77.2%	**510**	337	703
2020	**646**	599	700	68.2%	**418**	296	556
2021	**597**	554	646	71.5%	**334**	247	436

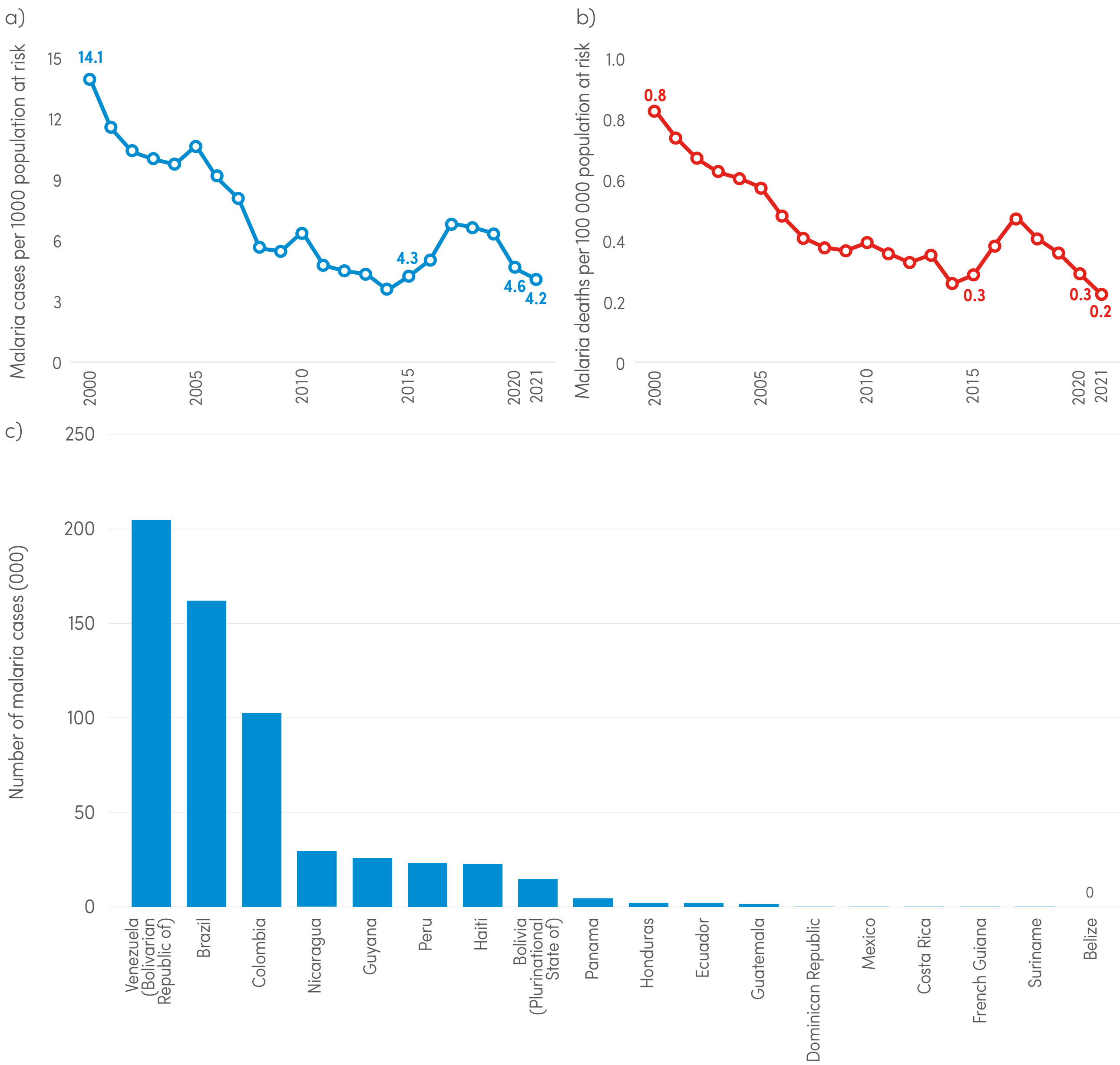
P. vivax: *Plasmodium vivax*; WHO: World Health Organization.

In 2021, the following countries saw substantial reductions in case burden compared with 2019: the Bolivarian Republic of Venezuela (–263 000), Brazil (–17 000), Colombia (–17 000) and Peru (–22 000), with more modest reductions seen in the Dominican Republic, French Guiana, Guatemala, Guyana and Mexico. During the same period, estimated cases increased slightly in Ecuador and the Plurinational State of Bolivia, and more than doubled in Honduras and Panama. Following an increase in estimated cases between 2019 and 2020, Haiti had a considerable reduction in cases in 2021, by about 18 000 compared with 2020; smaller reductions in cases were also seen in Nicaragua and Suriname.

Three countries – Argentina, El Salvador and Paraguay – were certified malaria free in 2019, 2021 and 2018, respectively. Belize reported zero indigenous malaria cases for the third consecutive year. There are few malaria-related deaths in the region; for example, there were an estimated 334 deaths in 2021, most being in adults (78%).

FIG. 3.7.

Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Region of the Americas, 2021 *Source: WHO estimates.*



WHO: World Health Organization.

3.7 ESTIMATED MALARIA CASES AND DEATHS IN THE WHO EUROPEAN REGION, 2000–2021

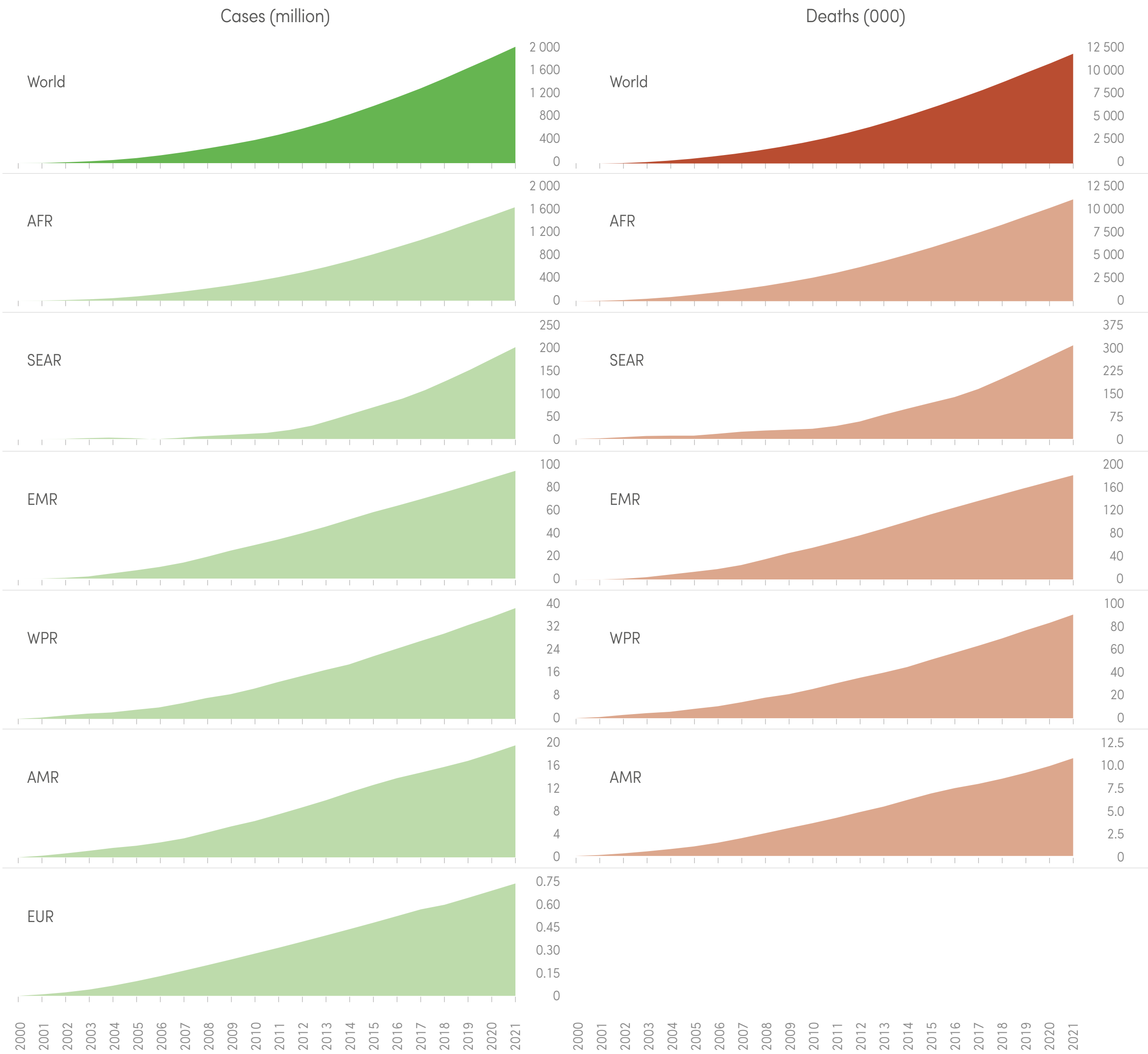
Since 2015, the WHO European Region has been free of malaria. The last country to report an indigenous malaria case was Tajikistan in 2014. Throughout the period 2000–2021, no malaria deaths were reported in the WHO European Region.

3.8 CASES AND DEATHS AVERTED SINCE 2000, GLOBALLY AND BY WHO REGION

Cases and deaths averted over the period 2000–2021 were calculated by comparing the current annual estimated burden of malaria with the malaria case incidence and mortality rates from 2000, assuming that, as a comparison, they remained constant throughout the same period (**Annex 1**). The analysis showed that

FIG. 3.8.

Cumulative number of cases and deaths averted, globally and by WHO region, 2000–2021 *Source: WHO estimates.*



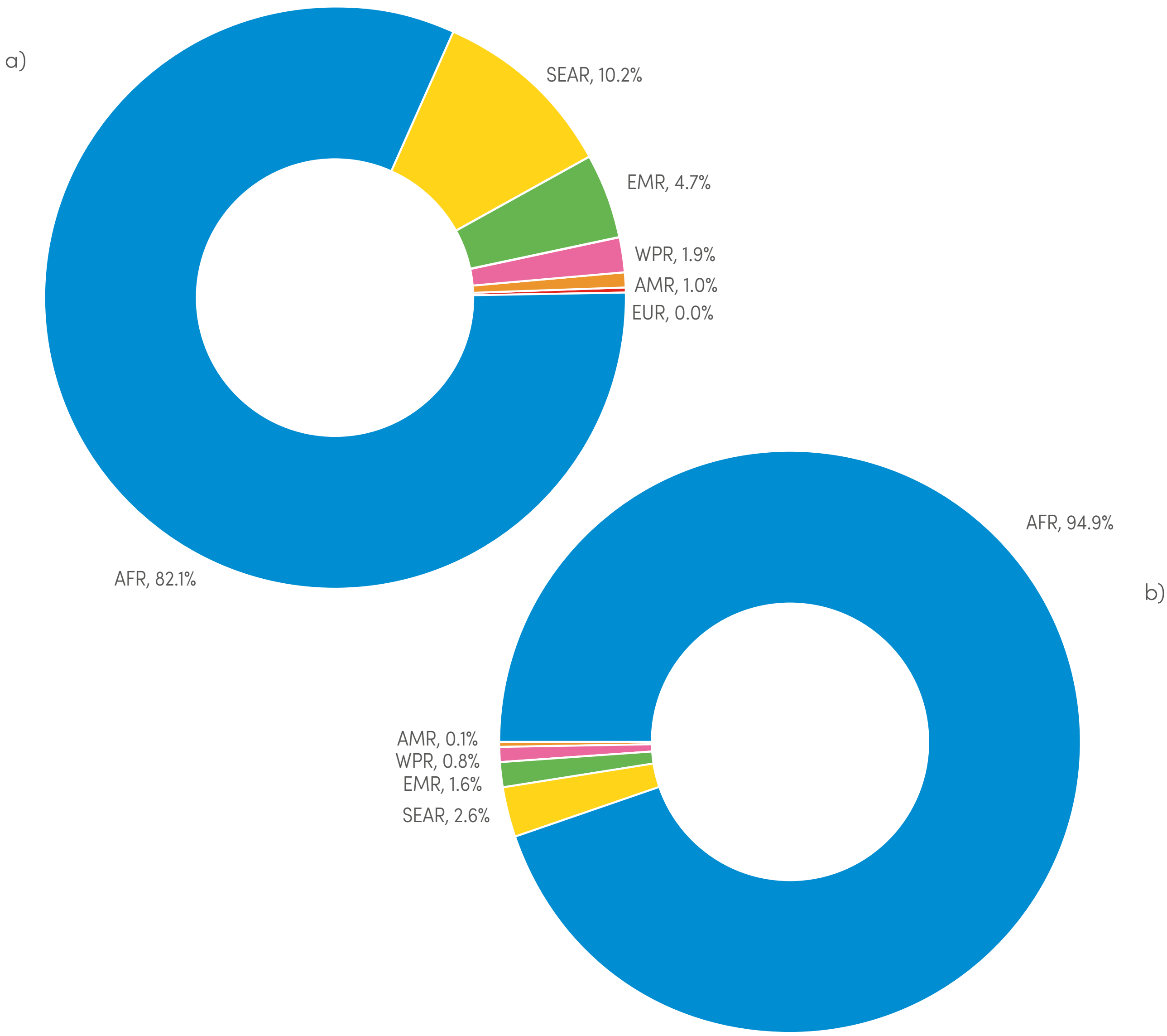
AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

2 billion malaria cases and 11.7 million malaria deaths were averted globally in the period 2000–2021. Most of the cases (82%) and deaths (95%) averted were in the WHO African Region, followed by the South-East Asia Region (cases 10% and deaths averted 3%) (**Fig. 3.8** and **Fig. 3.9**). In addition to malaria interventions, cases and deaths could also have been averted by other factors that modify malaria transmission or disease, such as improvements in socioeconomic status, malnutrition, infrastructure, housing and urbanization.

Despite considerable disruptions to malaria services during the COVID-19 pandemic, it is estimated that 177 million cases and 949 000 deaths were averted in 2020, and a further 185 million cases and 997 000 deaths in 2021, compared with the estimated burden if case incidence and mortality rates had remained at the levels of 2000.

FIG. 3.9.

Percentage of a) cases and b) deaths averted, by WHO region, 2000–2021 *Source: WHO estimates.*



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

3.9 BURDEN OF MALARIA IN PREGNANCY

Malaria infection during pregnancy has substantial risks for the pregnant woman, her fetus and the newborn child. For the pregnant woman, malaria infection can lead to severe disease and death, and placental sequestration of the parasite, which can lead to maternal anaemia; it also puts the mother at increased risk of death before and after childbirth, and is an important contributor to stillbirth and preterm birth. Placental infection can also lead to poor fetal growth and low birthweight, which in turn can lead to retardation of child growth and poor cognitive outcomes; it can also be a major risk factor in perinatal, neonatal and infant mortality (*39–41*). To avert the consequences to women and children of malaria infection, WHO recommends – in combination with vector control, and prompt diagnosis and effective treatment of malaria – the use of IPTp with SP as part of ANC (**Section 7.4**) in malaria endemic areas.

The analysis in this section is restricted to moderate to high transmission countries in the WHO African Region, where the burden of malaria in pregnancy is most pronounced. The analysis of the burden of malaria in pregnancy accounts for the increased levels of malaria risk due to disruptions during the COVID-19 pandemic (**Section 2.6**, **Section 3** and **Section 7.4**).

3.9.1 Prevalence of exposure to malaria infection during pregnancy

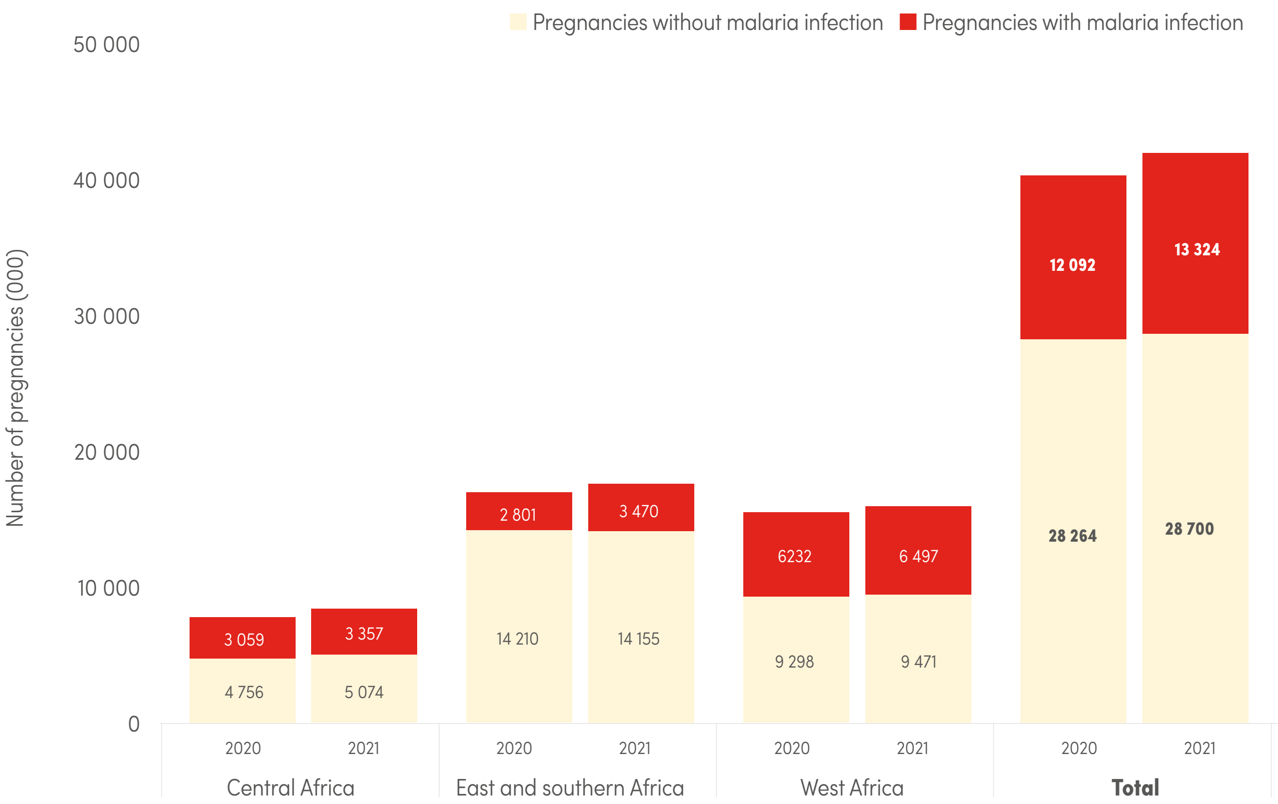
The methods used to estimate country-specific malaria infection exposure during pregnancy (measured as cumulative prevalence over 40 weeks) are presented in **Annex 1**.

In 2021, in 38 moderate to high transmission countries[1] in the WHO African Region, there were an estimated

[1] Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, the Niger, Nigeria, the Republic of the Congo, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, the Sudan, Togo, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.

FIG. 3.10.

Estimated prevalence of exposure to malaria infection during pregnancy, overall and by subregion in 2021, in moderate to high transmission countries in the WHO African Region *Sources: Imperial College and WHO estimates.*



WHO: World Health Organization.

40 million pregnancies (**Annex 1** and **Fig. 7.5**), of which 13.3 million (32%) were exposed to malaria infection (**Fig. 3.10**). This represented an additional 1.2 million women exposed to malaria in 2021 compared with 2020, as malaria risk in several countries increased in this period (**Fig. 3.10**).

By WHO subregion, west Africa had the highest prevalence of exposure to malaria during pregnancy, where about 6.5 million (40.7%) of an estimated 16 million pregnant women had malaria infections. Of the 8.4 million pregnant women in central Africa in 2021, 3.4 million (39.8%) had malaria infection. At 20%, the prevalence of malaria infection in pregnant women was lower in east and southern Africa than in other subregions in 2021 (40% in central Africa and 41% in west Africa); however, the number of women infected was higher in east and southern Africa (3.5 million) than in central Africa (3.4 million).

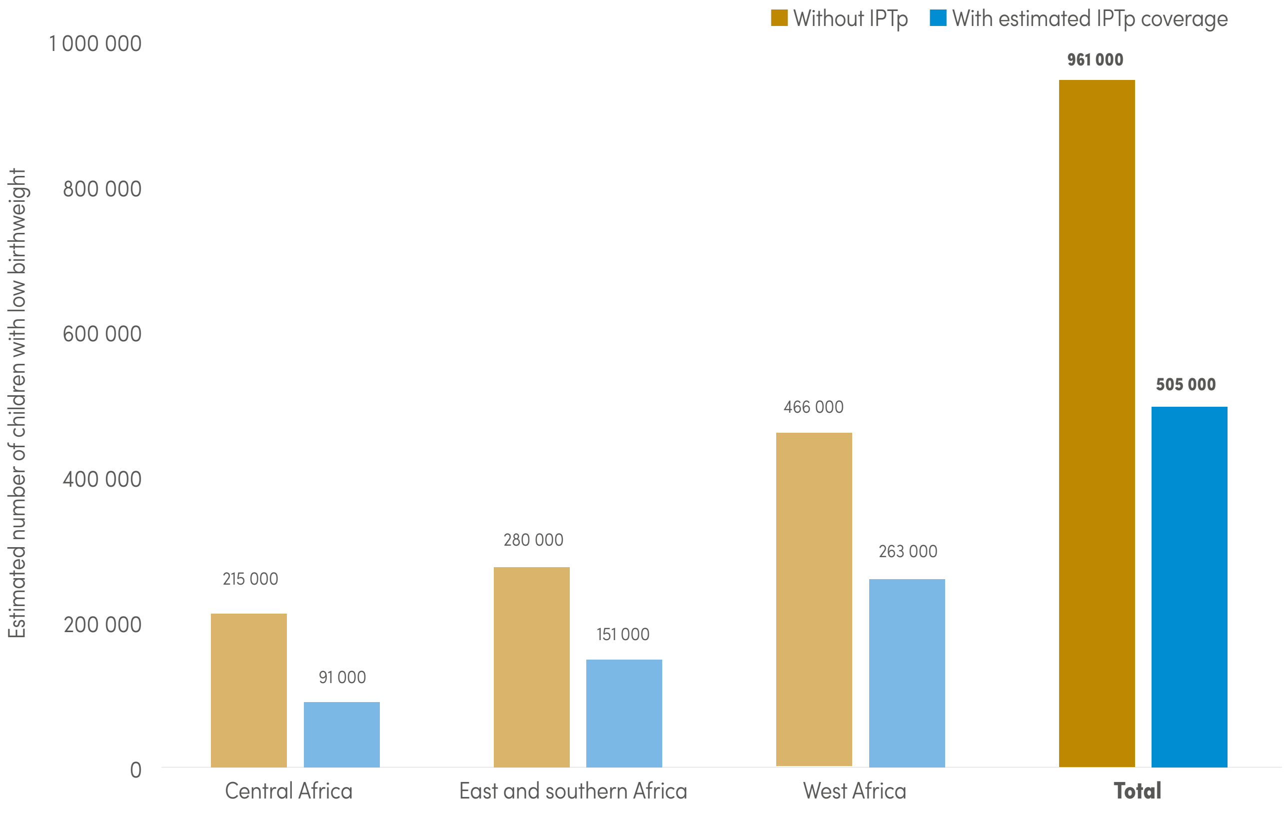
3.9.2 Prevalence of low birthweight in neonates due to malaria infection during pregnancy

There has been an increase in exposure to malaria in pregnancy in the WHO African Region, as outlined in **Section 3.9.1**. Given this increased exposure, without a pregnancy-specific intervention it is estimated that exposure to malaria infection would have resulted in 961 000 neonates with low birthweight compared with an estimated 505 000 neonates with low birthweight in the three subregions in 2020, with 48.5% of the children at risk being in the subregion of west Africa (**Fig. 3.11**).

Low birthweight is a strong risk factor for neonatal and childhood mortality, and averting a substantial number of low birthweights will have a considerable impact on all-cause mortality in children. Of the 38 countries for which the prevalence of malaria infection during

FIG. 3.11.

Estimated number of LBWs due to exposure to malaria infection during pregnancy (without IPTp versus at estimated levels of IPTp coverage), overall and by subregion in 2021, in moderate to high transmission countries in sub-Saharan Africa *Sources: Imperial College and WHO estimates.*



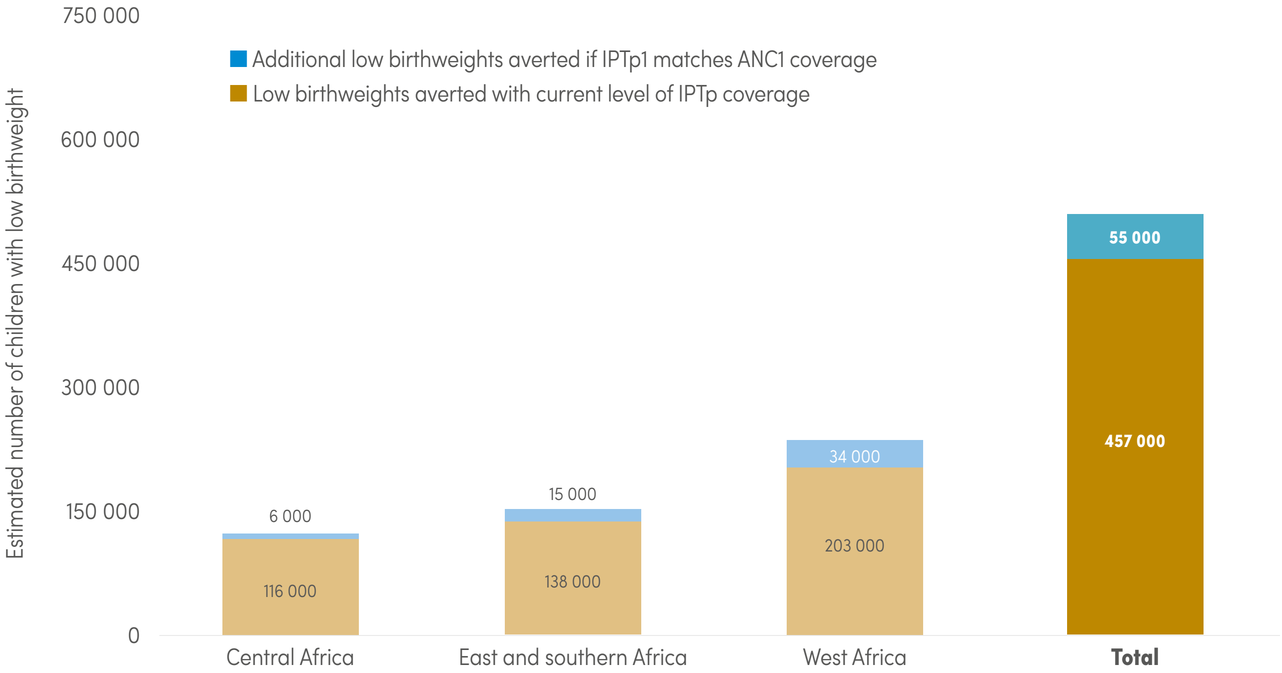
IPTp: intermittent preventive treatment of malaria in pregnancy; LBW: low birthweight; WHO: World Health Organization.

pregnancy was estimated, five countries (Eritrea, Ethiopia, Rwanda, Somalia and the Sudan) had no information on IPTp coverage. This was because the countries were not implementing the intervention, the intervention had been stopped in recent years or the intervention was in use in only a few areas within the country. In the 33 countries in which IPTp was implemented, an estimated 457 000 low birthweights were averted from the 961 000 neonates at risk of low birthweight in 2021, compared with an estimated 408 000 low birthweights averted in 2020. This increase was driven by a combination of increases in neonates at risk of low birthweight and increases in IPTp uptake in 2021.

Accounting for the current impact of IPTp, there are still 505 000 low birthweights that need to be averted across the three subregions. If all of the pregnant women visiting ANC clinics at least once during pregnancy received a single dose of IPTp – assuming they were all eligible, and the levels of IPTp2 and IPTp3 coverage remained the same – an additional 55 000 low birthweights would be averted (**Fig. 3.12**), reducing the remaining residual low birthweight burden of malaria in pregnancy to 450 000. If IPTp3 coverage was raised to the same levels of ANC1 coverage, assuming that subsequent ANC visits were just as high, then an additional 162 000 low birthweights would be averted (**Fig. 3.13**), reducing the remaining residual low birthweight burden of malaria in pregnancy to 343 000. If IPTp3 coverage was optimized to 90% of all pregnant women, an additional 265 000 low birthweights would be averted (**Fig. 3.14**), reducing the remaining residual low birthweight burden of malaria in pregnancy to 240 000.

FIG. 3.12.

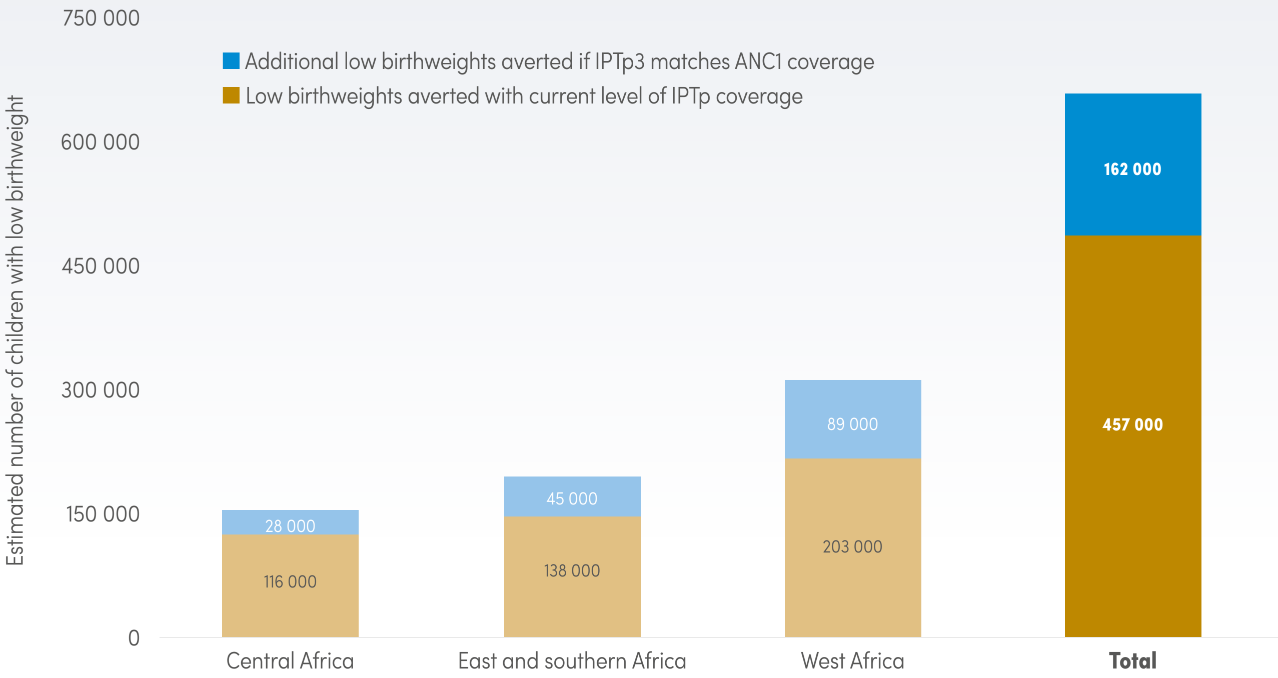
Estimated number of LBWs averted if current levels of IPTp coverage are maintained, and additional number averted if coverage of IPTp1 was optimized to match levels of coverage of ANC1 in 2021 while maintaining IPTp2 and IPTp3 at current levels, in moderate to high transmission countries in the WHO African Region *Sources: Imperial College and WHO estimates.*



ANC: antenatal care; ANC1: first ANC visit; IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp1: first dose of IPTp; IPTp2: second dose of IPTp; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.

FIG. 3.13.

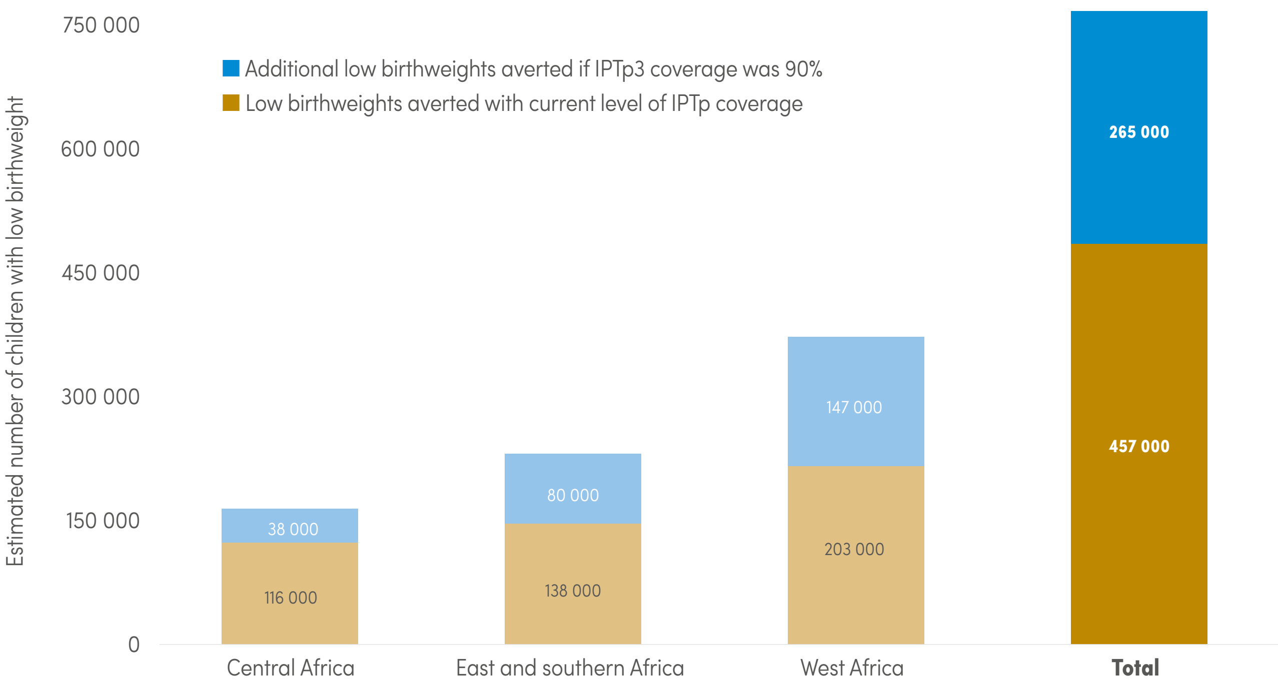
Estimated number of LBWs averted if levels of IPTp3 coverage were optimized to match levels of coverage of ANC1 in 2021, in moderate to high transmission countries in the WHO African Region *Sources: Imperial College and WHO estimates.*



ANC: antenatal care; ANC1: first ANC visit; IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.

FIG. 3.14.

Estimated number of LBWs averted if levels of IPTp3 were optimized to achieve 90% coverage in 2021, in moderate to high transmission countries in the WHO African Region *Sources: Imperial College and WHO estimates.*



IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp3: third dose of IPTp; LBW: low birthweight; WHO: World Health Organization.

4 ELIMINATION AND THE HIGH BURDEN TO HIGH IMPACT APPROACH

This section presents the latest results on progress towards elimination as well as the status of the 11 highest burden countries globally.

4.1 NEARING ELIMINATION

Progress towards malaria elimination is increasing as several countries near the goal of zero indigenous malaria cases. In 2021, there were 84 malaria endemic countries compared with 108 in 2000. The number of malaria endemic countries with fewer than 10 000 indigenous malaria cases increased from 27 in 2000 to 46 in 2021 (**Fig. 4.1**). During the same period, the number of countries that reported fewer than 100 indigenous cases increased from six to 27, and the number of countries that reported fewer than 10 indigenous cases increased from four to 25. Two additional countries – Bhutan and Saudi Arabia – reported fewer than 10 indigenous cases in 2021 compared with 2020.

4.2 MALARIA ELIMINATION CERTIFICATION

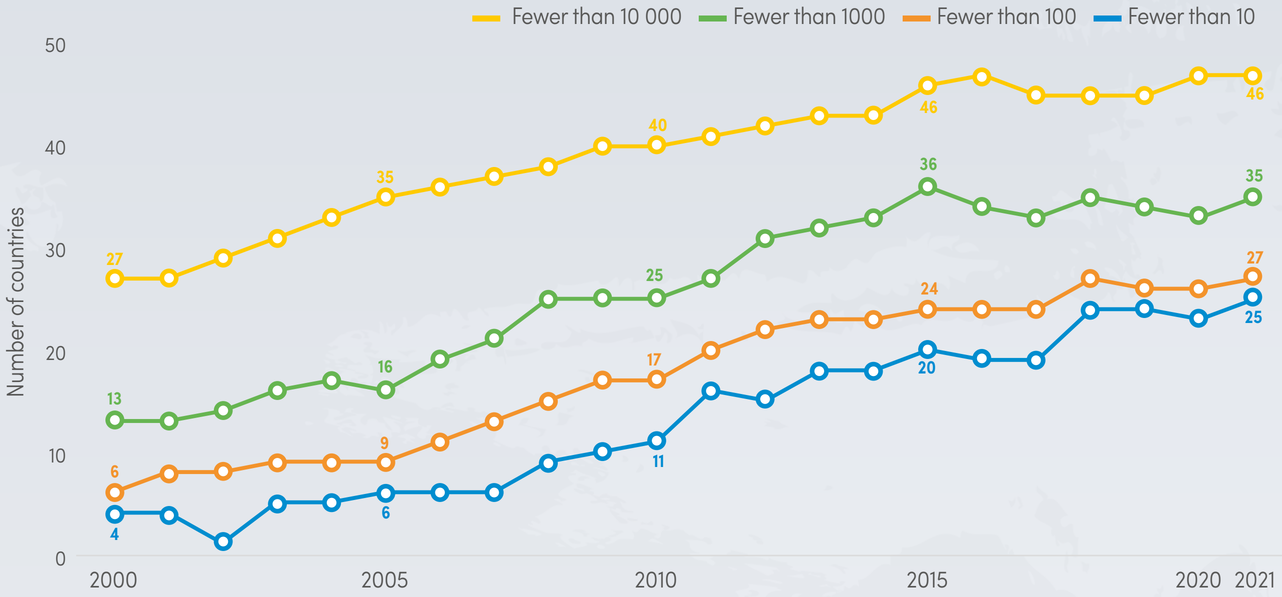
Certification of malaria elimination is granted once a country has proven and shown evidence that local malaria transmission by *Anopheles* mosquitoes has been interrupted in the country, resulting in zero indigenous malaria cases for at least the past 3 consecutive years, and a programme for the prevention of re-establishment of transmission is in place (*42*). In 2017 and 2018, WHO established two malaria elimination advisory committees: the Malaria Elimination Oversight Committee (MEOC) and the Malaria Elimination Certification Panel (MECP), to help countries reach their elimination goals and advise WHO on whether a country could be certified malaria free based on WHO criteria. The preparation for certification starts when countries embark on elimination by achieving zero indigenous transmission and providing supporting documentation of the malaria programme. In 2022, the functions of the MEOC and MECP were merged into one committee and the Technical Advisory Group on Malaria Elimination and Certification (TAG-MEC) was established.

Certification requires the elimination of the four main human parasite species: *P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*. Until now, certification has only been granted to countries where only the four species of *Plasmodium* were transmitted. However, there has been a notable rise in *P. knowlesi* infecting humans in some countries in the WHO South-East Asia Region, especially in Malaysia.

Although there have been no indigenous malaria cases or deaths due to the four human malaria parasites in Malaysia for the past 4 years, since 2017 a total of 17 125 *P. knowlesi* cases and 48 deaths have been reported. In 2021 alone, 3575 cases were reported, resulting in 13 deaths. Over the same period, an additional 435 *P. knowlesi* cases were reported in the WHO South-East Asia Region, in Indonesia, the Philippines and Thailand. WHO has convened two technical consultations on *P. knowlesi* (*43*) and will continue working closely with affected countries to tackle this emerging challenge for malaria elimination. In addition, a careful analysis of currently available data and evidence was discussed by the MECP and subsequently by the Malaria Policy Advisory Group (MPAG) (*43*). Those groups concluded that for countries where the elimination of the four main human malaria species was achieved but human malaria cases of other *Plasmodium* species continue to occur, certification might be granted if the risk of human infection was reduced to the extent that it was negligible.

FIG. 4.1.

Number of countries that were malaria endemic in 2000 and had fewer than 10, 100, 1000 and 10 000 indigenous malaria cases between 2000 and 2021[a] *Sources: NMP reports and WHO estimates.*



NMP: national malaria programme; WHO: World Health Organization.
[a] *Plasmodium knowlesi* and introduced cases are not included.

Based on evidence that indigenous transmission has been interrupted throughout the entire country, 25 countries that were malaria endemic in 2000 have achieved 3 consecutive years of zero indigenous malaria cases; 12 of these countries were certified malaria free by WHO between 2000 and 2021. In 2021, Belize and Cabo Verde reported zero indigenous cases and had achieved this for 3 consecutive years (**Table 4.1**).

TABLE 4.1.

Countries eliminating malaria since 2000 Countries are shown by the year that they attained 3 consecutive years of zero indigenous cases; countries that have been certified malaria free are shown in green (with the year of certification in parentheses). *Sources: Country reports and WHO.*

2000	Egypt	United Arab Emirates (2007)		
2001				
2002				
2003				
2004	Kazakhstan			
2005				
2006				
2007	Morocco (2010)	Syrian Arab Republic	Turkmenistan (2010)	
2008	Armenia (2011)			
2009				
2010				
2011	Iraq			
2012	Georgia	Türkiye		
2013	Argentina (2019)	Kyrgyzstan (2016)	Oman	Uzbekistan (2018)
2014	Paraguay (2018)			
2015	Azerbaijan	Sri Lanka (2016)		
2016	Algeria (2019)			
2017	Tajikistan			
2018				
2019	China (2021)	El Salvador (2021)		
2020	Islamic Republic of Iran	Malaysia		
2021	Cabo Verde	Belize		

WHO: World Health Organization.
Note: Maldives was certified in 2015; however, it was already malaria free before 2000, and thus is not listed here.

Altogether, five countries – Azerbaijan, Belize, Cabo Verde, Iran (Islamic Republic of) and Tajikistan – have submitted an official request for certification.

In 2021, El Salvador became the first central American country to achieve malaria free status. This certification followed more than 50 years of political commitment by the government and the people of El Salvador (*44*).

During the same year, China became the first country in the WHO Western Pacific Region to be certified malaria free in more than 30 years, following 70 years of investment in the fight against malaria (*45*). Algeria, which was certified malaria free in 2019, remains the only country in the WHO African Region to be certified malaria free since 1973 (*46*).

4.3 E-2025 INITIATIVE

In 2021, the E-2025 initiative was launched, building on the foundation and success of the E-2020 initiative. Countries from the E-2020 cohort (i.e. countries identified as having the capacity to eliminate malaria by 2020) that had not yet requested malaria free certification were automatically nominated to participate in the E-2025 initiative. Eight additional countries – the Democratic People's Republic of Korea, the Dominican Republic, Guatemala, Honduras, Panama, Sao Tome and Principe, Thailand and Vanuatu – and one territory, French Guiana, were added based on the following: having a set goal for malaria elimination by 2025 backed by a government-endorsed elimination plan; meeting a defined threshold of malaria case reductions in recent years; meeting the programme requirements; and expert opinions, including from WHO staff (*47*).

In the period 2010–2021, the number of malaria cases in the 25 countries and one territory in the E-2025 decreased by 82.8%. Progress in the reduction of malaria cases by country since 2010 is shown in **Table 4.2**. In 2021, the E-2025 countries reported 33 064 indigenous cases, a 30.4% increase from 2020. Belize and Cabo Verde reported zero malaria cases for the third consecutive year, with Iran (Islamic Republic of) and Malaysia reporting zero indigenous cases for the fourth consecutive year. In 2021, Timor-Leste, following an outbreak in the previous year, reported zero indigenous malaria cases, and Saudi Arabia reported zero indigenous cases for the first time.

Despite the negative impact of the COVID-19 pandemic, 61.5% of E-2025 countries reporting cases continued making progress towards elimination and reduction of the malaria burden. Between 2020 and 2021, case reductions were observed in the following countries: Bhutan (59.1%), Botswana (20.5%), the Dominican Republic (65.6%), Mexico (32.0%), Nepal (56.2%), the Republic of Korea (23.0%), Saudi Arabia (100%), South Africa (33.7%), Suriname (85.9%), Thailand (22.3%), Timor-Leste (100%) and Vanuatu (36.7%) (**Table 4.2**).

Owing to COVID-19 disruptions, South Africa saw a drastic decrease in testing rates. Restrictions to movement because of lockdowns, which occurred during peak malaria transmission periods, resulted in mobile clinics being unable to carry out testing and case investigations at the community level. This, as well as limited human resources, also led to a notable increase over the past 3 years in unclassified cases, with the country reporting one third of its cases as unclassified in 2021.

Nepal continues to report presumed cases, because of treatment of patients based on clinical symptoms despite diagnostic tests being negative, which remains a concern. The country is working to rectify this by updating treatment guidelines and training clinical staff.

With the disruption of the COVID-19 pandemic and pressure on already fragile health systems, there has been a concerning increase in malaria cases in some countries. The following countries, when compared with 2020, have shown increases in malaria cases: the Comoros (56.9%), Costa Rica (52.4%), the Democratic People's Republic of Korea (22.8%), Ecuador (11.1%), Eswatini (53.9%), French Guiana (2.1%), Guatemala (16.9%), Honduras (47.4%), Panama (55.3%) and Sao Tome and Principe (28.9%). Ecuador, for the second consecutive year, reported increases in the number of indigenous cases. Eswatini also saw an increase in local cases, most of which came from areas where malaria had not been reported for years. The Comoros made up 32.0% of all indigenous cases reported in the E-2025 countries, followed by Panama, contributing 13.2%, and Sao Tome and Principe and South Africa, both accounting for 8.0% of the total case burden (**Table 4.2**).

Despite the setbacks, many countries continue to make impressive progress – between 2011 and 2021, the classification rates within the E-2025 countries increased from 7.6% to 90.8%, demonstrating continued efforts by countries in pursuit of their elimination goals. During the same period, there was also an increase in the number of countries that have made private sector malaria reporting mandatory. In 2011, only four countries reported that the private sector was mandated to report; this increased to 18 countries in 2021.

TABLE 4.2.
Number of indigenous malaria cases in E-2020 and E-2025 countries, 2010–2021 *Source: NMP reports.*

Country/ area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Belize	150	72	33	20	19	9	4	7	3	0	0	0
Bhutan	436	194	82	15	19	34	15	11	6	2	22	9
Botswana	1 046	432	193	456	1 346	284	659	1 847	534	169	884	703
Cabo Verde	47	7	1	22	26	7	49	423	2	0	0	0
Comoros	36 538	24 856	49 840	53 156	2 203	1 884	1 467	3 896	15 613	17 599	4 546	10 537
Costa Rica	110	10	6	0	0	0	4	12	70	95	90	189
Democratic People's Republic of Korea[a]	13 520	16 760	21 850	14 407	10 535	7 022	5 033	4 603	3 698	1 869	1 819	2 357
Dominican Republic	2 482	1 616	952	473	459	631	690	341	433	1 291	826	284
Ecuador	1 888	1 219	544	368	242	618	1 191	1 275	1 653	1 803	1 934	2 175
Eswatini	268	379	409	728	389	318	250	440	686	235	233	505
French Guiana	1 632	1 209	900	875	448	374	217	554	546	212	140	143
Guatemala	7 384	6 817	5 346	6 214	4 929	5 538	5 000	4 121	3 018	2 069	1 058	1 273
Honduras	9 745	7 618	6 439	5 364	3 378	3 555	4 094	1 273	632	330	815	1 550
Iran (Islamic Republic of)	1 847	1 632	756	480	358	167	81	57	0	0	0	0
Malaysia	5 194	3 954	3 662	1 028	596	242	266	85	0	0	0	0
Mexico	1 226	1 124	833	495	656	517	551	736	803	618	356	242
Nepal	3 894	2 335	3 230	1 974	832	591	507	623	493	127	73	32
Panama	418	354	844	696	864	546	769	649	684	1 756	1 946	4 354
Republic of Korea	1 267	505	394	383	557	627	602	436	501	485	356	274
Sao Tome and Principe	3 146	8 442	12 550	9 243	1 754	2 056	2 238	2 239	2 937	2 732	1 933	2 719
Saudi Arabia	29	69	82	34	30	83	272	177	61	38	83	0
South Africa	8 060	9 866	6 621	8 645	11 705	4 959	4 323	23 381	9 540	3 096	4 463	2 958
Suriname	1 771	795	569	525	401	81	78	137	37	104	156	22
Thailand	32 480	24 897	46 895	41 602	41 218	14 265	12 076	7 416	51 104	4 065	3 123	2 426
Timor-Leste	48 137	19 739	5 208	1 025	3 424	80	81	16	0	0	3	0
Vanuatu	9 817	6 179	4 532	2 883	1 314	571	2 243	1 227	632	567	493	312
Total	**192 532**	**141 080**	**172 771**	**151 111**	**87 702**	**45 059**	**42 760**	**55 982**	**93 686**	**39 262**	**25 352**	**33 064**

E-2020: malaria eliminating countries for 2020; E-2025: malaria eliminating countries for 2025; NMP: national malaria programme.
Note: When cases in E-2025 countries were higher in 2021 than in 2020, they are shown in red (including countries reporting a continued increase from 2019).

4.4 THE GREATER MEKONG SUBREGION

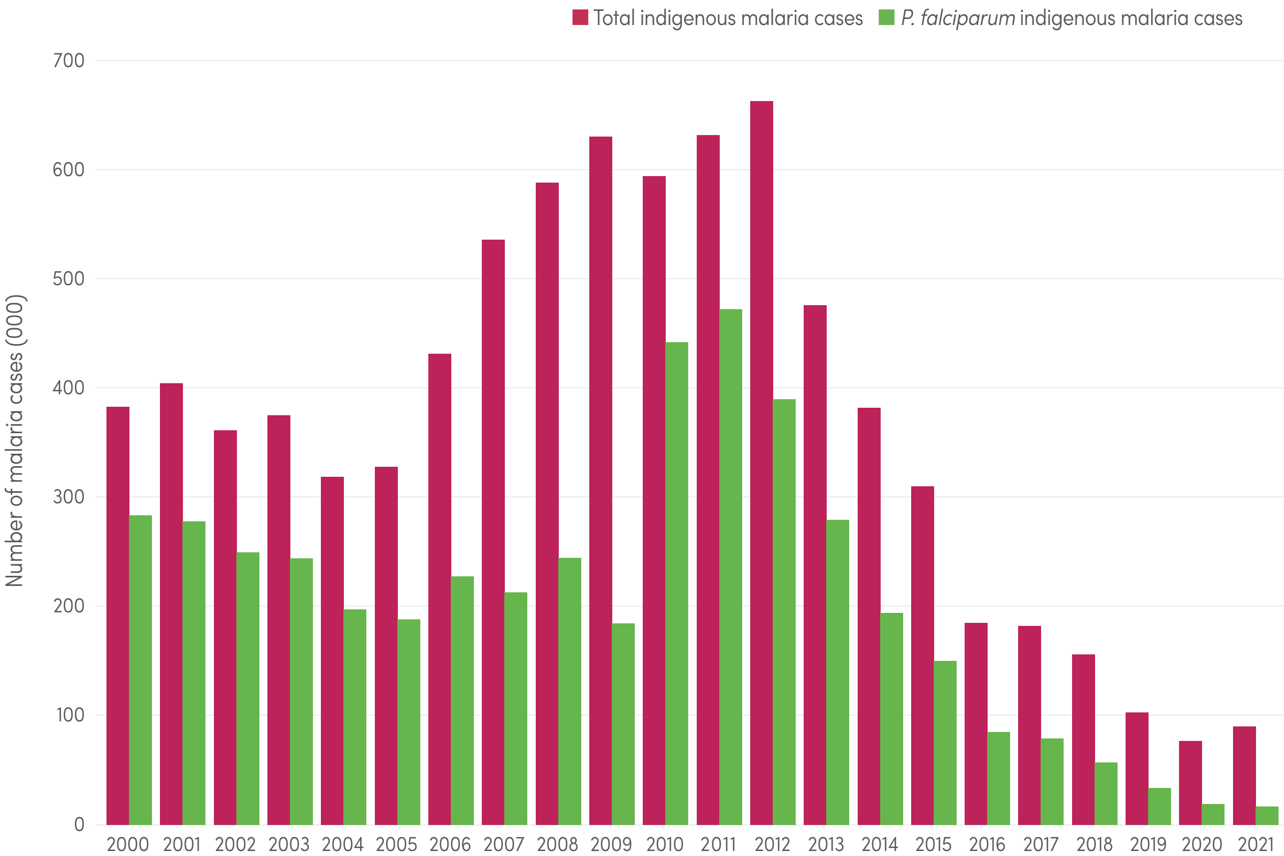
Eliminating *P. falciparum* in the Greater Mekong subregion (GMS) is critical because of the repeated development of drug resistance in *P. falciparum* parasites. Although antimalarial drug resistance remains a concern, countries in the eastern GMS continue to progress towards the elimination of *P. falciparum*, with rapid decline in cases.

Between 2000 and 2021, the GMS countries – Cambodia, China (Yunnan Province), the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam – reported a 76.5% decrease in indigenous malaria cases and a 94.1% decline in indigenous *P. falciparum* malaria cases. China remains the only country within the subregion to consecutively report zero indigenous cases and be certified malaria free.

In 2013 the WHO Emergency Response to Artemisinin Resistance in the GMS initiative was launched, following a peak of malaria cases in the region in 2012 (*48*); in 2017, this transitioned into the Mekong Malaria Elimination Programme (*49*). Between 2012 and 2021, the region saw a staggering decrease in indigenous malaria cases (86.4%) and in indigenous *P. falciparum* malaria cases (95.7%).

FIG. 4.2.

Total indigenous malaria and *P. falciparum* indigenous cases in the GMS, 2000–2021 *Source: WHO database.*



GMS: Greater Mekong subregion; *P. falciparum*: *Plasmodium falciparum*; WHO: World Health Organization.

Notes: Data for *P. falciparum* come from the GMS Malaria Elimination Database for Cambodia 2014, 2015 and 2017, Thailand 2012 and 2013, and Viet Nam 2018.

For the following countries and years, species breakdown does not add up to the total confirmed cases and therefore the numbers of *P. falciparum* cases are likely to be underreported: Cambodia 2000–2006 and 2010–2013; Myanmar 2000–2006 and 2010–2011; Thailand 2005, 2006 and 2010–2011; and Viet Nam 2000 and 2007–2009.

Before the implementation of case investigation and classification in countries, all confirmed cases are considered to be indigenous. This uncertainty should be noted in the interpretation of the trends. The year of implementation of these activities varies by country. For further details of species breakdown from 2010 onwards, see **Annex 4-I**.

In 2021, a total of 90 082 indigenous cases and 16 484 indigenous *P. falciparum* cases were reported, a 17.3% increase in indigenous malaria cases and a 12.2% decline in indigenous *P. falciparum* cases compared with 2020. However, in recent years Myanmar has had some setbacks, with an increase in numbers of both *P. falciparum* and *P. vivax* cases because of the continued political instability in the area. In 2021, Myanmar continued to account for most of the indigenous malaria cases (87.7%) and indigenous *P. falciparum* malaria cases (80.9%) in the subregion, followed by the Lao People's Democratic Republic (accounting for 4.3% of indigenous cases and 8.4% of indigenous *P. falciparum* cases) and Cambodia (accounting for 4.8% of indigenous cases and 5.7% of indigenous *P. falciparum* cases) (**Fig. 4.2**).

As *P. falciparum* cases continue to decline, *P. vivax* has emerged as the dominant species within the subregion. In 2021, Cambodia reported relapses for the first time; the country reported a total of 1978 relapse cases, making up 48% of the country's total indigenous cases. To further accelerate the gains made towards malaria elimination within the region, it is critical to administer primaquine for radical cure for *P. vivax*, in line with WHO guidelines (*50*).

China's malaria free status provides important lessons for the subregion. All GMS countries other than Myanmar have increasingly adopted subnational verification in low-burden settings, in preparation for malaria certification.

FIG. 4.3.

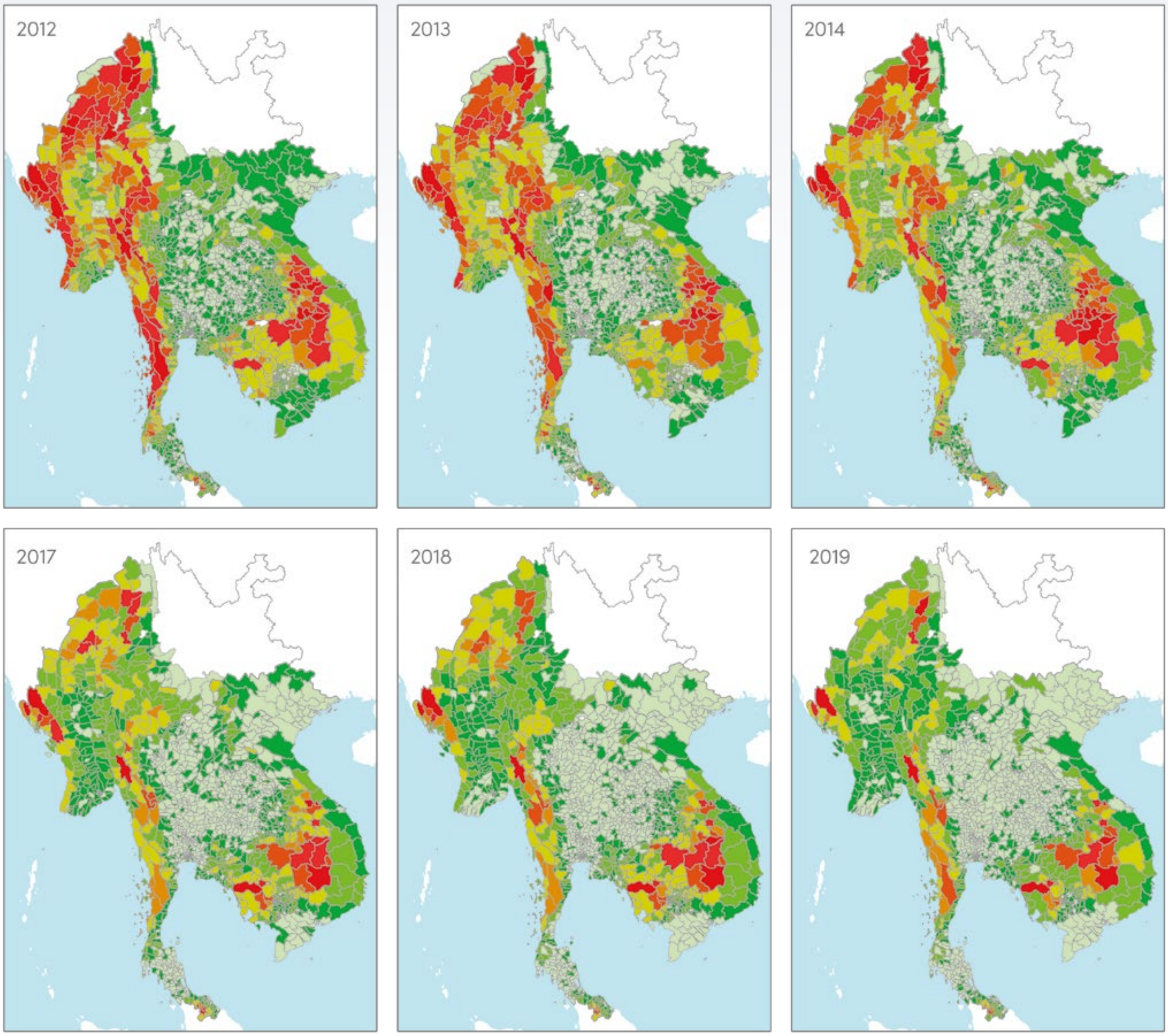
Total indigenous malaria and *P. falciparum* cases in the GMS, by country, 2012–2021 Countries are shown from the highest number of total indigenous malaria cases in 2021 to the lowest. *Source: WHO database.*

GMS: Greater Mekong subregion; *P. falciparum*: *Plasmodium falciparum*; WHO: World Health Organization.

FIG. 4.4.

Regional map of malaria incidence in the GMS, by area, 2012–2021 *Source: NMP reports to GMS MEDB.*

Incidence per 1000 population: 0 | 0–0.1 | 0.1–1 | 1–5 | 5–10 | 10–20 | 20–50 | >50 | Not available

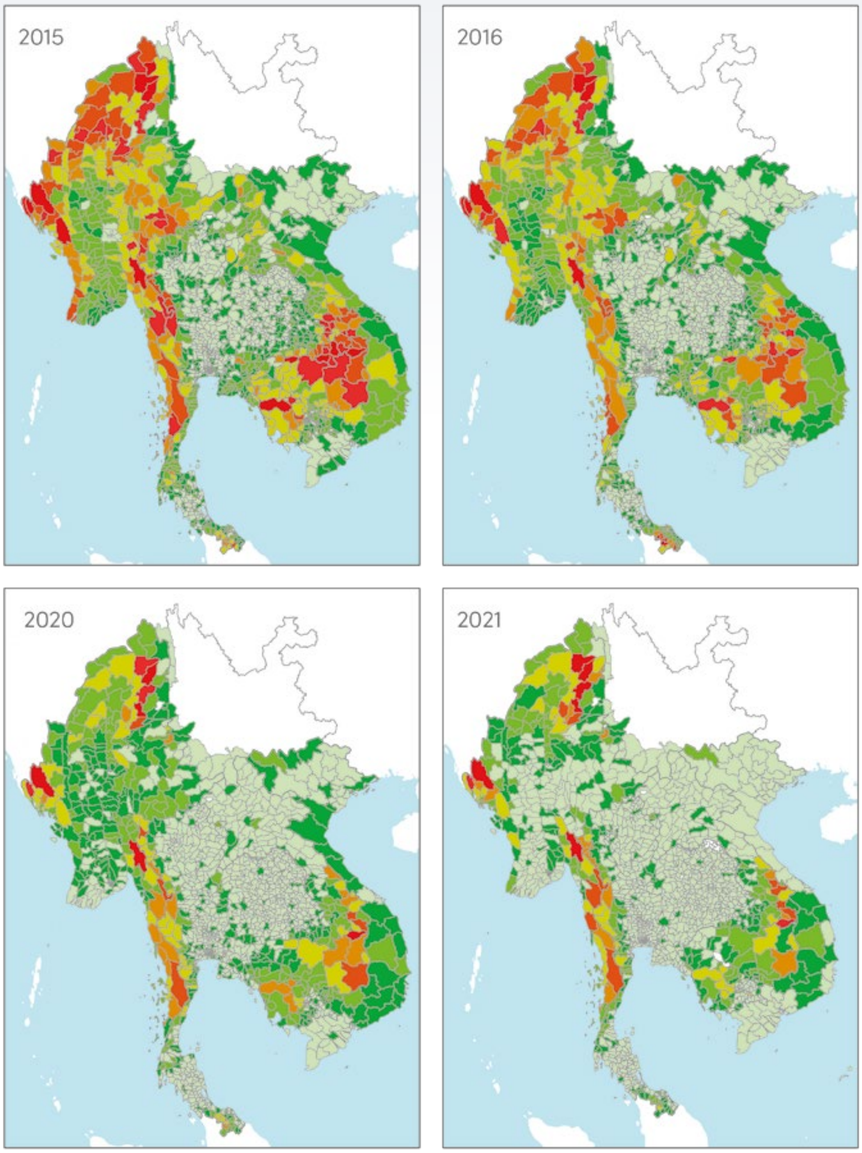


GMS: Greater Mekong subregion; MEDB: Malaria Elimination Database; NMP: national malaria programme.

4.5 PREVENTION OF RE-ESTABLISHMENT

Once countries have eliminated malaria, they should sustain the minimum activities necessary to prevent re-establishment in areas with malariogenic potential (i.e. risk of importation in areas receptive to transmission). All countries that are malaria free should maintain vigilance to rapidly detect imported cases that might occur at any time and anywhere. Detection of introduced or indigenous cases should trigger a rapid response and a thorough investigation, to prevent further transmission.

Given that malaria elimination is often first achieved in parts of the territories within a country, prevention of re-establishment should start at the subnational level while countries are working on full interruption of transmission in all their territories. Subnational verification is a process that is recommended to large countries or countries with a subnational elimination goal. It is a country-owned process and WHO does not verify malaria free status in subnational regions. Subnational verification can help to strengthen



surveillance and response systems and the programme to prevent re-establishment; ultimately, it can prepare the country for national certification, although it is not a prerequisite for national certification (*51*). Countries in the GMS are leveraging the subnational verification exercise to strengthen their programme to prevent re-establishment and to prepare for their country's certification by WHO. China is the first country that has conducted a nationwide subnational verification before being certified malaria free by WHO. The subnational verification process and its results assisted with the final certification.

Transmission of malaria is considered re-established when at least three indigenous cases of malaria of the same species have been found in the same focus of transmission for 3 consecutive years. Between 2000 and 2020, no country that was certified malaria free was found to have malaria transmission re-established.

4.6 THE HIGH BURDEN TO HIGH IMPACT APPROACH

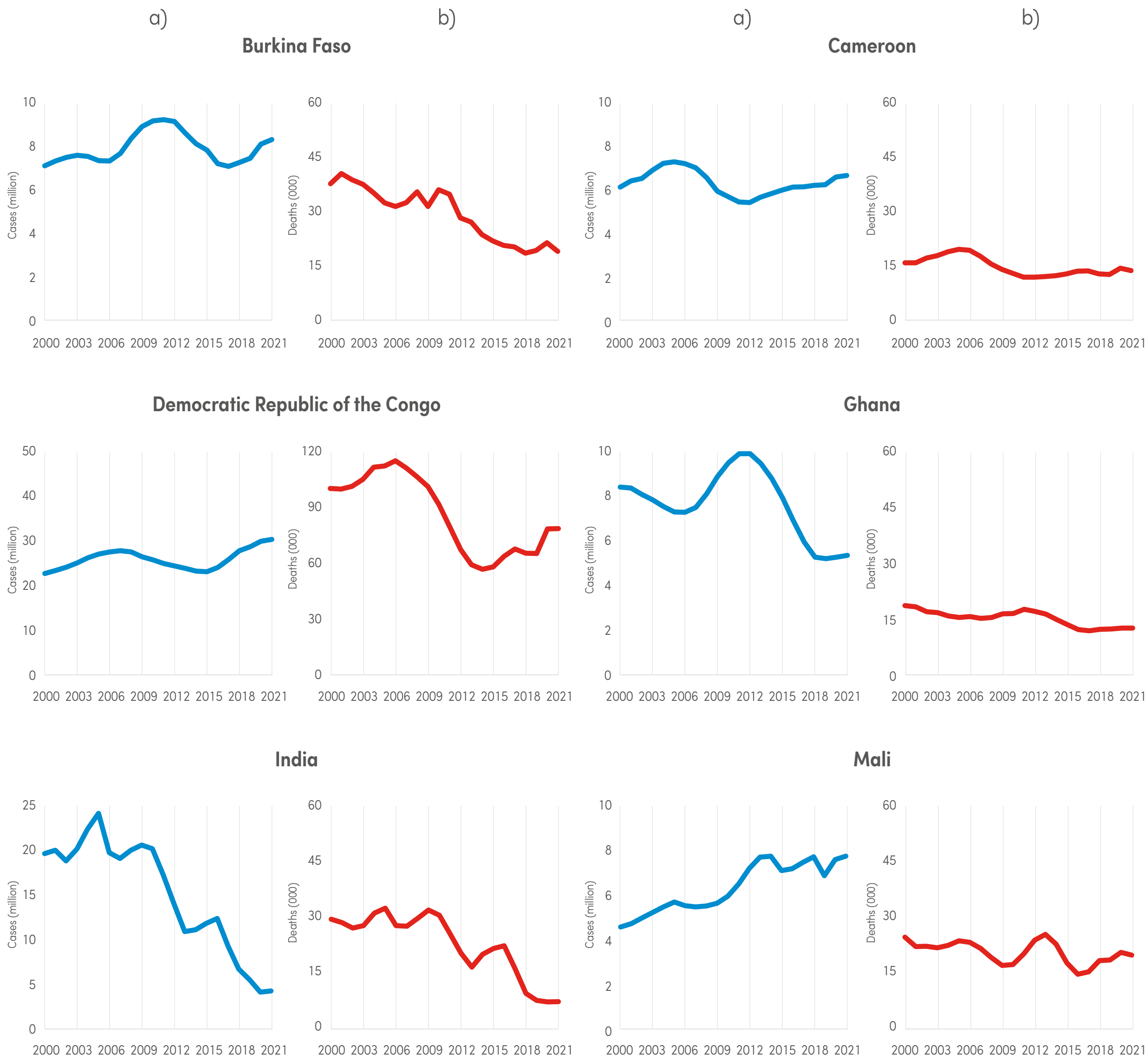
In November 2018, WHO and the RBM Partnership to End Malaria launched the HBHI country-led approach (*52*) as a mechanism to support the 11 highest burden countries to get back on track to achieve the GTS 2025 milestones (*2*). These 11 countries (Burkina Faso, Cameroon, the Democratic Republic of the Congo, Ghana, India, Mali, Mozambique, the Niger, Nigeria, Uganda and the United Republic of Tanzania) accounted for 70% of the global estimated case burden and 71% of global estimated deaths in 2017. Several countries with smaller populations but with high malaria incidence have also adopted the HBHI approach. This section presents the progress made in the burden of malaria and the consequences of disruptions during the COVID-19 pandemic in the HBHI countries.

4.6.1 Malaria burden in HBHI countries

During the period 2000–2015, malaria cases in the HBHI countries reduced from 155 million to 150 million, and deaths from 641 000 to 398 000. However, by

FIG. 4.5.

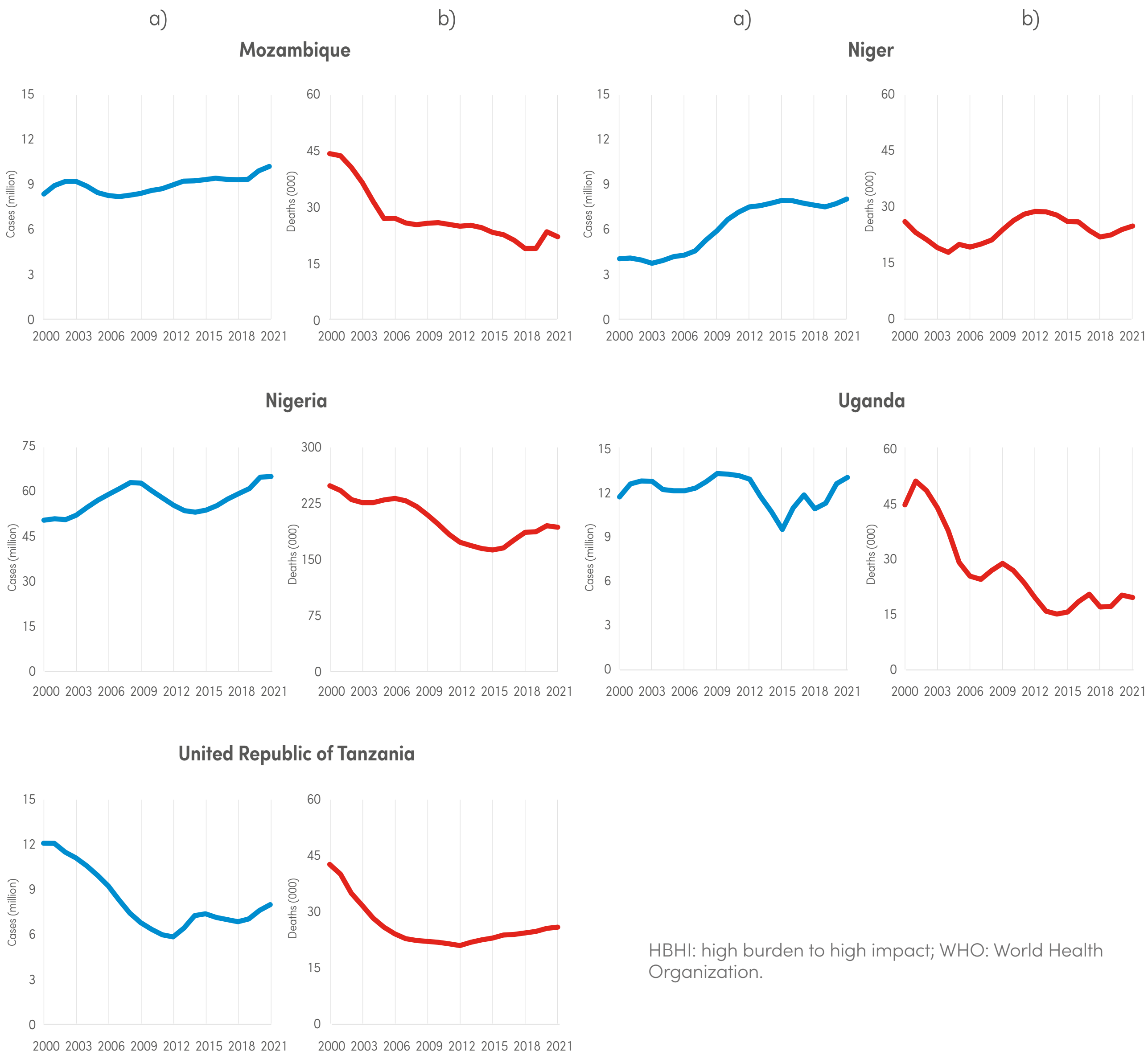
Estimated malaria a) cases and b) deaths in HBHI countries, 2000–2021 *Sources: WHO estimates.*



2020 there had been an increase to 165 million cases and 444 600 deaths, and by 2021 a further increase, to 168 million malaria cases, although deaths declined to 427 854 (**Fig. 4.5**).

In 2021, with the ongoing increase in malaria cases, HBHI countries accounted for 68% of all cases and 70% of deaths globally. When looking at the case contribution within the HBHI countries, the following countries accounted for most of the malaria cases: Nigeria (39.0%), the Democratic Republic of the Congo (18.2%), Uganda (7.8%) and Mozambique (6.1%).

Despite the rise in estimated global cases, global malaria deaths declined for the first time since 2018. Five of the 11 HBHI countries – the Democratic Republic of the Congo, Ghana, India, the Niger and the United Republic of Tanzania – also experienced a decline in deaths, although their contributions to the malaria burden within HBHI countries is still substantial. The following countries account for most malaria deaths within HBHI countries: Nigeria (45.3%), the Democratic Republic of the Congo (18.5%), the United Republic of Tanzania (5.9%) and Uganda (4.6%). Trends in malaria cases and deaths from 2000 to 2021 in HBHI countries are presented in **Fig. 4.5**.



HBHI: high burden to high impact; WHO: World Health Organization.

5 SURVEILLANCE

Accelerating the elimination of malaria, and eventually interrupting its transmission, requires data and information from surveillance systems, to inform decisions on the optimal deployment and impact of interventions. Effective surveillance of malaria cases and deaths, and of key entomological and efficacy indicators, is essential for identifying which areas or population groups are at risk of malaria or are vulnerable to reducing the efficacy of interventions. In turn, this allows for effective programmatic planning, including response to epidemics and intensification of control when necessary.

To systematically track national progress towards achieving Pillar 3 of the GTS (*2*), which is to transform malaria surveillance into a core intervention, WHO recommends the regular monitoring and evaluation of surveillance systems (*53*). This involves assessing the structure, core and support functions and the quality of the data across both passive and active case detection systems – information that is critical to the continuous improvement of surveillance systems. Such information is also useful for better understanding the data captured through these systems, which in turn makes it possible to make well-informed decisions about programmes. A key component of these assessments is a review of the quality of data, including case detection, recording and reporting.

Cases and deaths detected through the surveillance system reported by countries are often from the public health sector, predominantly from passive case detection systems. In elimination settings, data on cases may also be recorded during active case detection. Often, data from the private sector remain sparse and, in countries with moderate to high transmission, it is possible that a substantial percentage of patients who do not seek care remain undocumented by the surveillance system. Hence, a strong surveillance system requires high levels of access to information on care and case detection, and complete reporting by all health sectors.

WHO/GMP, in collaboration with partners, has developed several digital solutions and other types of tools to support the strengthening of country surveillance systems. This section provides a summary of these tools and presents country case studies on surveillance system assessment.

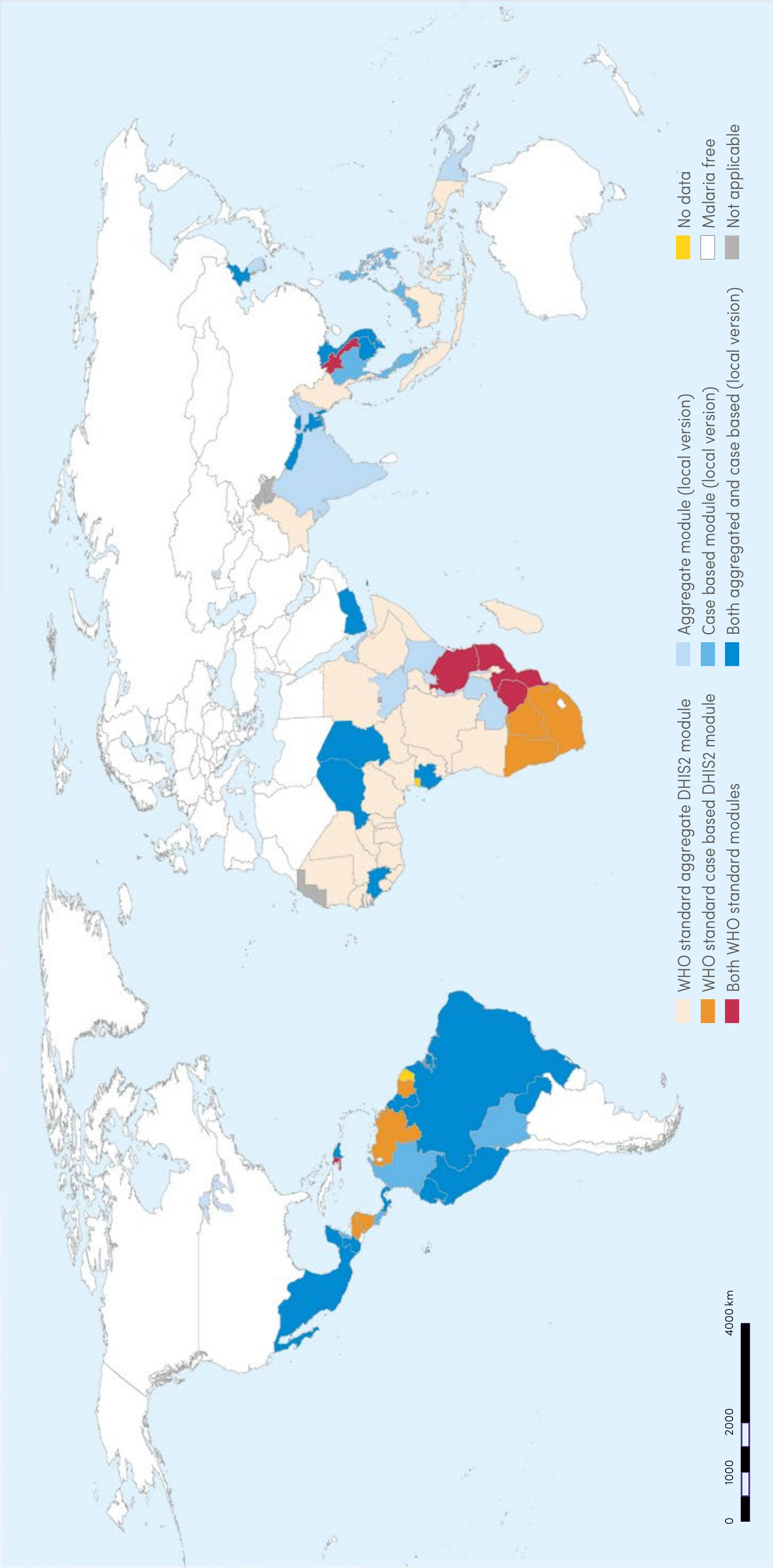
5.1 COUNTRY IMPLEMENTATION OF DIGITAL MALARIA MODULES

Over 40 countries are using malaria surveillance packages designed for the District Health Information System 2 (DHIS2) (*54*), the world's largest Health Management Information System (HMIS). The malaria surveillance packages support Pillar 3 of the GTS (*2*) to transform surveillance into a core intervention; they also help countries to implement the recommendations for surveillance strengthening outlined in the WHO guidance materials (*53*). Each package includes standardized metadata, defining data elements, indicators, visualizations and curriculum materials that have been developed to help countries to strengthen national routine surveillance. The packages are readily available for download and installation in countries that use DHIS2 as their HMIS (*55*).

Since its initial release 4 years ago, 34 countries have adopted the DHIS2 malaria module that is designed for countries whose routine information system focuses on collecting aggregate data (**Fig. 5.1**).

FIG. 5.1.

Implementation status of routine malaria surveillance modules *Source: WHO/GMP as of 20 October 2022.*



DHIS2: District Health Information System 2; GMP: Global Malaria Programme; WHO: World Health Organization.

The most recent version of this module includes additional malaria dashboards for routine monitoring of data quality, stock management and district-level surveillance.

Standard modules specific for entomology and vector control have also been developed to support countries to improve the collection and use of entomological and vector control intervention data. The entomological and vector control modules are integrated with epidemiological modules and other malaria-related modules to form malaria repositories, which have been installed in a few countries.

5.1.1 Malaria case-based reporting and foci investigation module

As more countries progress towards malaria elimination, a robust case-based surveillance system becomes essential, and it becomes necessary to shift from monthly aggregate reporting to timely individual case reporting. The aim of surveillance in low-burden settings is to rapidly detect and treat all malaria infections, investigate every malaria case and identify the likely source of an infection, to then appropriately direct public health action to prevent transmission. This calls for effective surveillance strategies and rapid response from NMPs.

A suite of tools has been developed or enhanced to support malaria elimination surveillance using the DHIS2 web platform (*54*) and DHIS2 capture application (app) for Android (*55*). These tools can be used for case notification, investigation and response, and for focus investigation and response (**Fig. 5.2**).

The various tools make it easy for health workers to enter data on new malaria cases, and to register and monitor foci. As the data are captured, investigative teams are notified – they can also use the module to record case data and investigation data during their surveillance activities. Simultaneously, the quality of the data can be validated and corrected, with duplicates being detected and removed as data are captured. Data can be visualized in graphs, charts, tables and maps, to guide an effective response.

Designed to be accessed through the free open-source DHIS2 platform (*55*), the case-based and foci investigation modules can be used on a smartphone, tablet or computer, both online and offline in the field. Data can be collected in real time, and historical data can be uploaded retrospectively.

As with all WHO malaria modules, these new additions are fully customizable to each country's context and can be integrated into existing DHIS2 implementation, saving time and minimizing maintenance costs.

5.1.2 Integrated malaria data repositories

The malaria repository is a data warehouse for all malaria-related data; it is built on the DHIS2 routine aggregate module but includes other data that are not collected through the HMIS. It provides NMPs with the comprehensive data required for evidence-based strategic and operational planning. In collaboration with countries and partners, the implementation of the repository is undertaken in five main phases:

- Phase 1 (planning phase): convene a national stakeholders meeting, establish a working group, develop a workplan and assign tasks to various stakeholders. Angola and the Niger are at this stage of the process.
- Phase 2: establish a separate instance of the DHIS2, dedicated to non-routine and routine HMIS malaria-related data.
- Phase 3: establish a live link with the national HMIS instance to extract routine malaria-related data.
- Phase 4: install non-routine modules such as entomology, insecticide resistance, commodity distribution, climate and household surveys. Countries in this phase are Burkina Faso, Cameroon,[1] Ghana,[2] Guinea, Kenya, Uganda and the United Republic of Tanzania.
- Phase 5: create a governance mechanism for the supervision of the development and maintenance of the repository as well as training at all levels. The steering committee members required to establish this process include staff from the NMP, ministries of health and supporting partners. Mozambique and Nigeria have established these structures.

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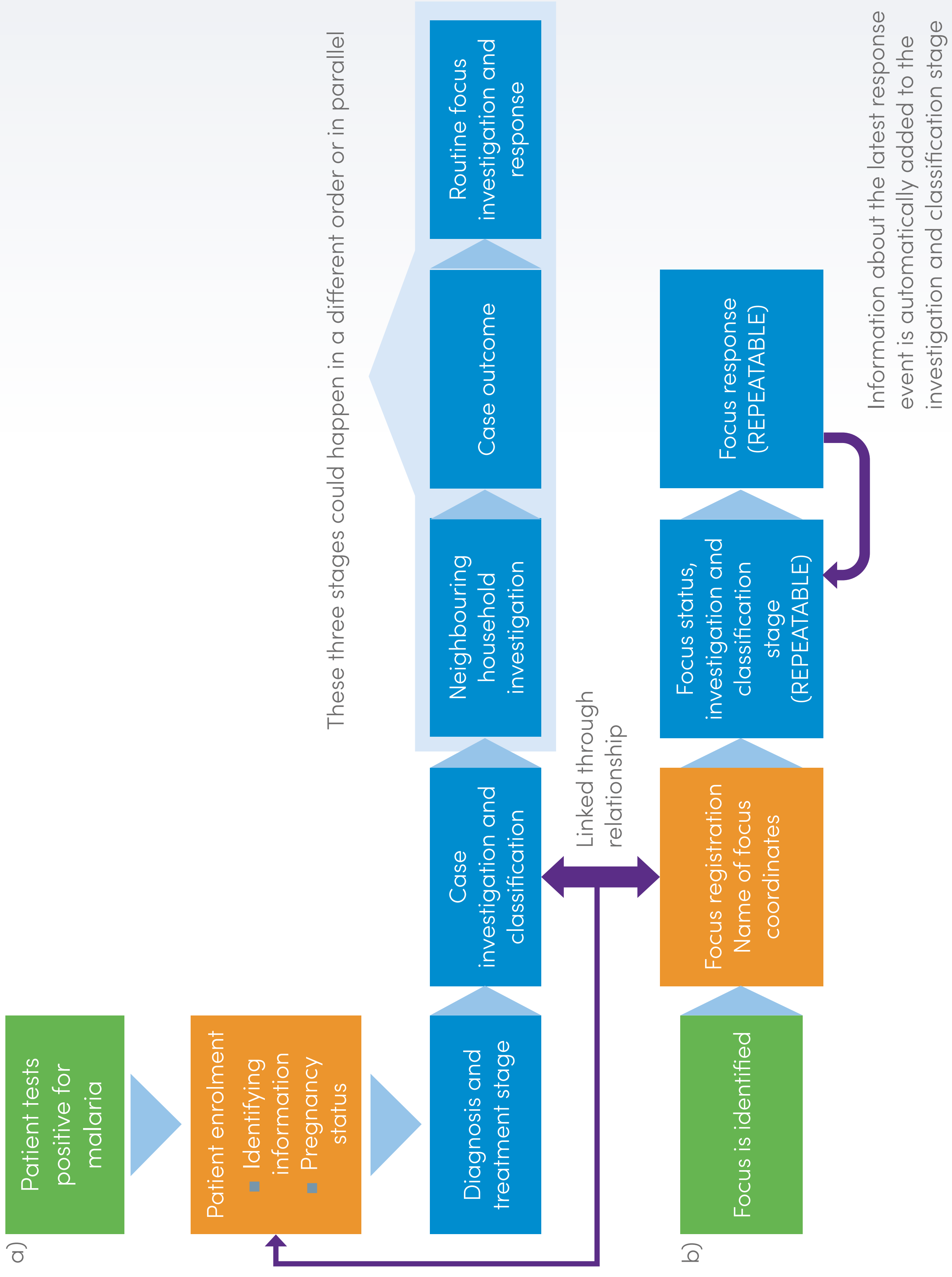
[1] Non-DHIS2 implementation.

[2] Established a separate instance for entomology initially and is now integrating a link to the routine HMIS.

FIG. 5.2.

Overview of WHO case-based malaria elimination surveillance modules: a) malaria case notification, investigation and response, and b) foci investigation and response workflow *Source: Created using DHIS2 (54).*



DHIS2: District Health Information System 2; WHO: World Health Organization.

5.2 MALARIA SURVEILLANCE ASSESSMENTS

Surveillance systems need to be regularly assessed to identify key surveillance gaps and to evaluate the ability of the system to collect complete, timely and accurate data (*53*). The evaluation will enable understanding of the quality of the data generated by the system, how the data can be used to inform decision-making and what bottlenecks are likely to impede the efficiency and effectiveness of the system.

The results of malaria surveillance assessments can be used to provide actionable and prioritized recommendations on how to strengthen surveillance systems; such recommendations can be used to develop national and subnational strategic and operational plans. In elimination settings, a surveillance assessment can help the country to prepare documentation and check the quality of data before certification.

5.2.1 Malaria surveillance assessment toolkit

WHO, in collaboration with partners, has developed a malaria surveillance assessment toolkit (*56*). The toolkit comprises a set of standardized tools to assess the ability of the malaria surveillance system or integrated disease surveillance system to accurately capture malaria cases and deaths across all transmission settings (**Table 5.1**). The assessment framework comprises a minimum set of core indicators that are used to measure the performance of the surveillance

TABLE 5.1.
Contents of the malaria surveillance assessment toolkit

Function	Tools	Description
Define scope	Assessment framework tool	A set of key objectives, sub-objectives and indicators that can be used to quantify and qualify strengths and weaknesses in the surveillance system. This tool should be used as the starting point in an assessment to define the scope of the assessment and the approach.
	Concept note and protocol	A template for the outline of a short concept note for refining the scope, methods, expected outputs and outcomes of an assessment, and a more detailed protocol outline for comprehensive assessments.
	Surveillance assessment planning tool	A budgeting template to assist countries in developing a costed plan to undertake a comprehensive assessment.
Collect and analyse data	Desk review tool	A set of questions, tables, graphs and diagrams used to collect information and summarize what is known about malaria surveillance through document and data review, and optional interviews with surveillance programme staff and other relevant supporting partners.
	Data quality assessment tools	Tools and guidance for collecting and analysing data to specifically assess data quality at national, regional, district and service delivery levels.
	Question bank	A library of questions that can be used to develop survey questionnaires for data collection at service delivery levels.
	Analysis tools	A set of shell tables in Microsoft Excel® that are used to summarize the results of analysis from the survey.
Develop and prioritize recommendations	Technical brief and report outline	A report template for organizing, visualizing and interpreting results from the assessment. A technical brief is used to highlight a subset of priority results, whereas the complete report includes all assessment results.

system by assessing coverage, data quality and data use, and the determinants of the performance. The toolkit has been designed to enable countries to carry out comprehensive assessments, which include a desk review and a survey at all levels of the health system, or a shorter rapid assessment that includes only an assessment of priority indicators, primarily at the national level. Further details on the toolkit and a step-by-step guide on how to carry out a malaria surveillance assessment are shown in the implementation reference guide (*57*).

5.2.2 Country case studies: results from malaria surveillance assessments using the WHO toolkit

To date, four countries have completed assessments using a pilot version of the WHO malaria surveillance assessment toolkit (*56*): Burkina Faso (2020), Cameroon (2021), the Democratic Republic of the Congo (2021) and Ghana (2021). The assessment had two main components:

- a desk review of national documents and a data quality assessment on data extracted from HMIS or the national malaria surveillance system; and
- a quantitative survey and a service delivery level data quality assessment on a randomly selected sample of health facilities across the country.

Results from the assessment of indicators for data quality and use are presented for Burkina Faso, the Democratic Republic of the Congo and Ghana (**Table 5.2**). These data are not yet in the public domain, but the countries have agreed to the publication of summary information in this report.

TABLE 5.2.
Results from the assessment of indicators for data quality and use (>80%=met [green], 50–80%=partially met [orange] and <50=not met [red])

Indicator	Burkina Faso	Democratic Republic of the Congo	Ghana
Completeness of reporting	91%	91%	98%
Timeliness of reporting	85%	66%	94%
Consistency between core variables	85%	68%	60%
Completeness of core variables within registers	64%	74%	40%
Concordance of core variables between registers and aggregated reports	32%	38%	30%
Data used for strategic, policy and operational processes	83%	64%	72%
Users with access to data	58%	96%	73%

Burkina Faso

Burkina Faso does not have an integrated national electronic information system that combines data on malaria cases, interventions, commodities and entomology. Instead, malaria data are collected and recorded in nine systems: the monthly routine HMIS (ENDOS DHIS2), the weekly Integrated Disease Surveillance and Response (IDSR), the Logistics Management Information System (LMIS), the Electronic Consultation Register, the mHealth community platform, the databases for each of the three specific interventions – LLINs, SMC and IRS – and the entomological surveillance database.

The desk-level data quality assessment showed that, between 2016 and 2020, completeness and timeliness of reporting to ENDOS DHIS2 were both high, at 91% and 85%, respectively; it also showed that 85% of reports passed data consistency checks (**Table 5.2**). The data quality assessment carried out at service delivery level (which included 171 public and private health facilities across 13 regions), found that 64% of registers had core variables complete, but that concordance between registers and aggregate reports was low, at 32%. Reasons given by staff for the poor completeness of variables included the high workload of staff (37%), the lack of staff (35%) and data not being available in the register (32%).

The quantitative survey revealed that 66% of the district surveillance agents reported problems with internet connection, which made it difficult to enter the data into the ENDOS platform. Community health workers also expressed difficulties in reporting data owing to the lack of transport to bring the reports back to the health facility. Most district surveillance officers (83%) organize quarterly data validation meetings and 90% of supervisory visits included data verification, but only 55% of the health facilities reported participating in these meetings. These findings may help to explain the low concordance between variables in the register and in ENDOS DHIS2.

Although 83% of regions and districts reported using data for strategic, policy and operational processes, almost half of the health facilities and community workers were not using data to guide decision-making, despite 92% reporting that they routinely analyse their data. The ENDOS platform provides direct access to case surveillance data to users at central, regional and district levels, but not to health facility level. Overall, 62% of health facilities do not have access to the ENDOS national database.

Priority recommendations to address current malaria surveillance system deficiencies include:

- continuing to digitize data collection and reporting (supported by the availability of infrastructure and skilled human resources) to improve data collection and quality, and the timeliness of malaria reports;
- integrating malaria data, including case surveillance, entomology and vector control, into a national data repository, and developing a dashboard to visualize and analyse the data for evidence-based decision-making; and
- strengthening data validation, analysis and use by standardizing training and supervision, and institutionalizing data review meetings at all levels of the system.

Democratic Republic of the Congo

The Democratic Republic of the Congo uses a common DHIS2 platform managed by the HMIS division of the Ministry of Health to report malaria data at the point of service delivery. The HMIS DHIS2 includes data on monthly passive case surveillance, routine intervention data (LLINs and IPTp), the weekly IDSR, the LMIS and mass campaign data (LLINs). Entomological surveillance data are recorded and stored in a separate database.

The desk-level data quality assessment showed that, between 2018 and 2020, completeness of reporting was high, at 91% (**Table 5.2**). Timeliness of reporting posed a challenge, with only 66% of reports being received within the expected time frame.

About 68% of reports received passed all tests for consistency between core variables. This percentage was low owing to inconsistency between IPTp data variables; if these variables were removed, 91% of reports passed consistency checks between core malaria variables (e.g. RDT tested should not be less than RDT positive cases). The service delivery level data quality assessment was carried out in the provinces of Haut-Uele, Kinshasa, Kwilu and Tshopo at 239 health facilities for the period October to December 2020. Completeness of core variables within registers could be improved (74%) and concordance between registers and aggregate reports was low (38%).

A quantitative survey was carried out in the same provinces and included health zone offices (n=80), health facilities – hospitals and reference centres (n=50), health centres and health posts (n=150) and private health facilities (n=50) – and community health workers (n=86). Results from this survey revealed that in the prior 3 months, 83% of all facility types held one to three data review meetings; nevertheless, 84% of facilities and 100% of health zones cited challenges with validating malaria data. Lack of financial motivation was the most common reason for this (cited by 48% of respondents at both levels), followed by time constraints as a result of insufficient staff, high workload and competing priorities. In addition, only 54% of interviewed health providers had received any kind of surveillance training. At the health zone level, 94% of surveillance staff expressed difficulties with reporting owing to lack of equipment and services, lack of time and insufficient training. Only 10% of health facilities had monitoring and evaluation guidelines for malaria surveillance available, and only 30% of respondents were able to correctly define all three key malaria variables (suspected, presumed and confirmed malaria cases). These findings explain the poor concordance between source documents and national data as well as delayed reporting.

Despite 91% of health facilities reporting that data were routinely analysed, only 64% of respondents said that they had used data for strategic, policy and operational processes. Data were mainly used to inform product distribution. Only 5% of facilities reported using some form of automated analysis tool; the others used manual calculations, primarily for preparing reports. A high proportion of health facilities (96%) had access to data, but this was mainly to paper copies of facility HMIS reports. The HMIS DHIS2 platform provides direct access to case surveillance data to users at central, provincial and health zone level, but not to users delivering malaria case management.

Priority recommendations to address current malaria surveillance system deficiencies include:

- ensuring availability of adequate resources such as equipment, guidelines and malaria supplies (e.g. RDTs and ACTs) to facilitate surveillance activities;
- strengthening the integration of malaria surveillance data from different information systems, particularly entomological and survey data, into DHIS2 to allow for easy and adequate visualization of data;
- strengthening the validation, access and use of data by strengthening the capacities of surveillance agents, the use of dashboards and the dissemination of data analysis reports such as the malaria epidemiological bulletins; and
- improving data quality by applying validation rules at the data recording level, by setting up regular data review workshops at the different levels of the system and by conducting routine data quality audits.

Ghana

In Ghana, the primary HMIS for malaria epidemiological surveillance is the District Health Information Management System, an integrated disease surveillance platform developed in DHIS2. Malaria is reported into Ghana's DHIS2 by public sector facilities, including hospitals, clinics, health centres and community health post compounds, and by formal private sector facilities. The country has several different information systems for collecting data on interventions; however, these systems have not been integrated into DHIS2 and a data repository has not yet been established. Most health facilities (95.6%) still use paper forms for data recording and only 21.7% use the DHIS2 e-Tracker directly.

The desk-level data quality assessment showed that, between 2018 and 2020, completeness and timeliness of reporting were high, at 98% and 94%, respectively (**Table 5.2**). Consistency between the core variables was 60% within reports received. The service delivery level data quality assessment was carried out at 203 health facilities, in 24 districts, across six regions (Ashanti, Central, Greater Accra, Oti, Upper West and Western North). There was poor completeness of core variables within reporting registers and poor concordance between data recorded in these registers and aggregate reports (≤40%). A quantitative survey carried out at the same facilities revealed that facilities cited staffing issues (64.5%), lack of availability of source documents (activity sheets, forms and registers) (31.5%), poorly designed and developed tools (21.2%), too high a workload (65.0%), not knowing how to fill out the form (19.7%) and data from community health post compounds not being received (5.4%) as reasons for missing data. Monthly data validation meetings occurred in half of the facilities surveyed but 67% of respondents indicated that their facility had never had an external data quality audit. Furthermore, 55% felt that they had not been adequately trained on malaria surveillance.

More than 70% of users had used data for strategic, policy and operational processes, with nearly 100% of health facilities analysing malaria data and 88% doing so monthly. Most respondents (80%) had received training on data analysis and use, and 72% said that actions were triggered as a result of analysis of the surveillance system data.

Some 73% of users had access to data, but only 51.2% could access DHIS2 directly and 32.5% relied on asking the district for malaria data. One major challenge was not having access to the internet (50%).

Priority recommendations to address current malaria surveillance system deficiencies include:

- developing a single malaria data repository that includes data validation rules and dashboards for all thematic areas;
- ensuring that all care seeking points can report into the malaria data repository;
- creating a comprehensive master health facility list for facilities providing malaria services, including private sector providers;
- increasing data use at lower levels through improved access to dashboards, refresher trainings on data analysis and use, and improved standard operating procedures; and
- improving frequency of data validation meetings and adding components for checking variable completeness.

INVESTMENTS IN MALARIA PROGRAMMES AND RESEARCH

In 2015, WHO launched the GTS (*2*). The 2021 GTS update (*58*) includes estimates for the funding required to achieve key milestones in 2025 and 2030. To reach over 80% coverage of currently available interventions, investment in malaria (both international and domestic) needs to increase substantially above the current annual spending (about US$ 3.1 billion per year for the past 5 years). Total annual resources needed were estimated at US$ 6.8 billion in 2020, increasing by US$ 0.5 billion per year to achieve the estimated US$ 9.3 billion required by 2025 and then by US$ 0.2 billion per year to reach US$ 10.3 billion by 2030 (*58*). Additionally, funding of US$ 8.5 billion is projected to be needed for R&D during the period 2021–2030, representing an average annual investment of US$ 851 million (*58*).

In this section on investments towards malaria control, **Section 6.1** presents the most up-to-date funding trends for malaria control and elimination, by source and channel of funding, for the period 2000–2021 or 2010–2021 (where data are available), both globally and for major country groupings, and **Section 6.2** presents investments in malaria-related R&D for the period 2012–2021.

6.1 FUNDING TRENDS FOR MALARIA CONTROL AND ELIMINATION

In 2021, 91 countries were included in the analysis of total funding for malaria control and elimination. This comprised 84 endemic countries and seven non-endemic countries, two of which have been declared malaria-free in the past 2 years. These seven non-endemic countries are included in this report because they contribute to important trends represented in this section, with some continuing to receive support for malaria. Throughout this section, these 91 countries are referred to as the "malaria endemic countries".

Total funding in 2021 was estimated at US$ 3.5 billion, a consistent increase from the US$ 3.3 billion in 2020 and US$ 3.0 billion in 2019. However, the amount invested in 2021 continues to fall short of the estimated US$ 7.3 billion required globally in 2021 to stay on track for the GTS milestones. Moreover, the funding gap between the amount invested and the resources needed has continued to widen significantly, particularly over the past 3 years, increasing from a gap of US$ 2.6 billion in 2019 to US$ 3.5 billion in 2020 and US$ 3.8 billion in 2021. Each year, the world malaria report describes funding that has been adjusted for inflation as well as potential changes to data in cases where countries or donors provide updates for previous years. Therefore, the figures presented in this chapter reflect 2021 constant dollar values and potential updates, which may vary from figures reported in previous years. The sources of funding for malaria control and elimination are summarized in **Table 6.1**.

TABLE 6.1.
Sources of funding data

International funding		Domestic funding
Multilateral	**Bilateral**	
Donor contributions to the Global Fund 2010–2021 sourced from the Global Fund and WHO/GMP estimates Global Fund disbursements to malaria endemic countries 2003–2021, sourced from the Global Fund	United Kingdom final aid spend 2017–2020 from the Foreign, Commonwealth and Development Office and WHO/GMP estimates for 2021 based on 2020 United Kingdom final aid spend data	NMP reported domestic budget or expenditures when available, or estimates from WHO/GMP 2000–2021
Donor disbursements to multilateral funders 2011–2020 sourced from OECD members' total use of the multilateral system, and WHO/GMP estimates for 2010 and 2021	United States funding for malaria, by agency & recipient country sourced from the Kaiser Family Foundation	Patient care delivery estimates, 2010–2021 from WHO/GMP
	Donor disbursement to malaria endemic countries from OECD CRS (2002–2021, except for United Kingdom 2007–2016) and WHO/GMP estimates for 2021	

CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO/GMP: World Health Organization Global Malaria Programme.

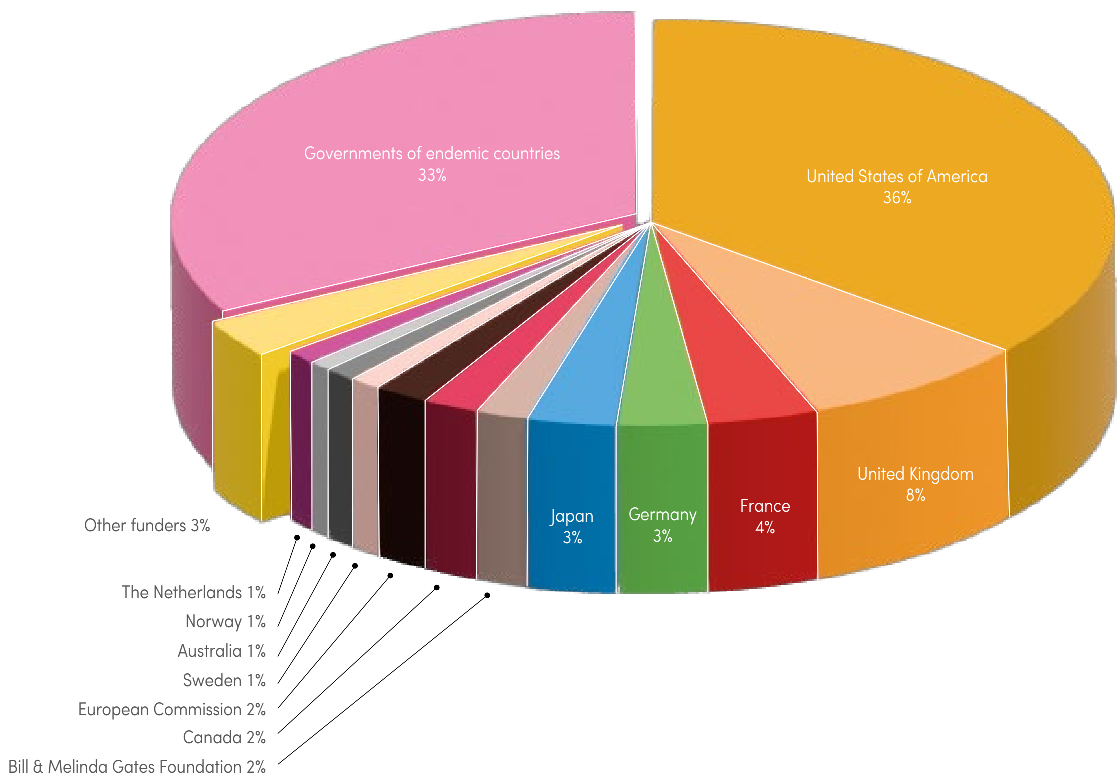
Note: The estimate of 2021 funding from the United Kingdom has been assumed to be the same as that of 2020 because 2021 data were not available at the time of publication of this report.

To assess the share of international funding by source of funds, malaria-related annual funding through multilateral agencies was estimated from donors' contributions to the Global Fund for 2010–2021, and from contributions from the Organisation for Economic Co-operation and Development (OECD) creditor reporting system (CRS) for 2011–2020. Annual OECD CRS funding data for 2010 and 2021 were estimated using 2011 and 2020 reported estimates, respectively. In addition, contributions from malaria endemic countries to multilateral agencies were allocated to governments of endemic countries for the years 2010–2021. From 2010 through 2021, the share of international funding (67%) and domestic funding (33%) revealed an increasing trend in domestic funding compared with 2010 through 2020 (31%). In 2021, the share of international funding also corresponded to 67% of total funding, with governments of malaria endemic countries contributing 33% and domestic funding increasing slightly compared with 2020 (32%). The highest share of contributions since 2010 from international sources stemmed from the USA, the United Kingdom of Great Britain and Northern Ireland (United Kingdom), France, Germany and Japan, followed by other donors (**Fig. 6.1**).

Fig. 6.2 shows the breakdown of total funding for each donor per year from 2010 through 2021. Most of the US$ 3.5 billion invested in 2021 (almost US$ 2.4 billion) came from international funders. The highest contribution stemmed from the government of the USA – over US$ 1.3 billion through planned bilateral funding and malaria-adjusted share of multilateral contributions. This was followed by bilateral and multilateral disbursements of about US$ 0.2 billion each from Germany and the United Kingdom, contributions of about US$ 0.1 billion from Canada, France and Japan, and a combined US$ 0.4 billion from other

FIG. 6.1.

Funding for malaria control and elimination, 2010–2021 (% of total funding), by source of funds (constant 2021 US$) *Sources: ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Foreign, Commonwealth and Development Office, WHO estimates and World Bank DataBank.*



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

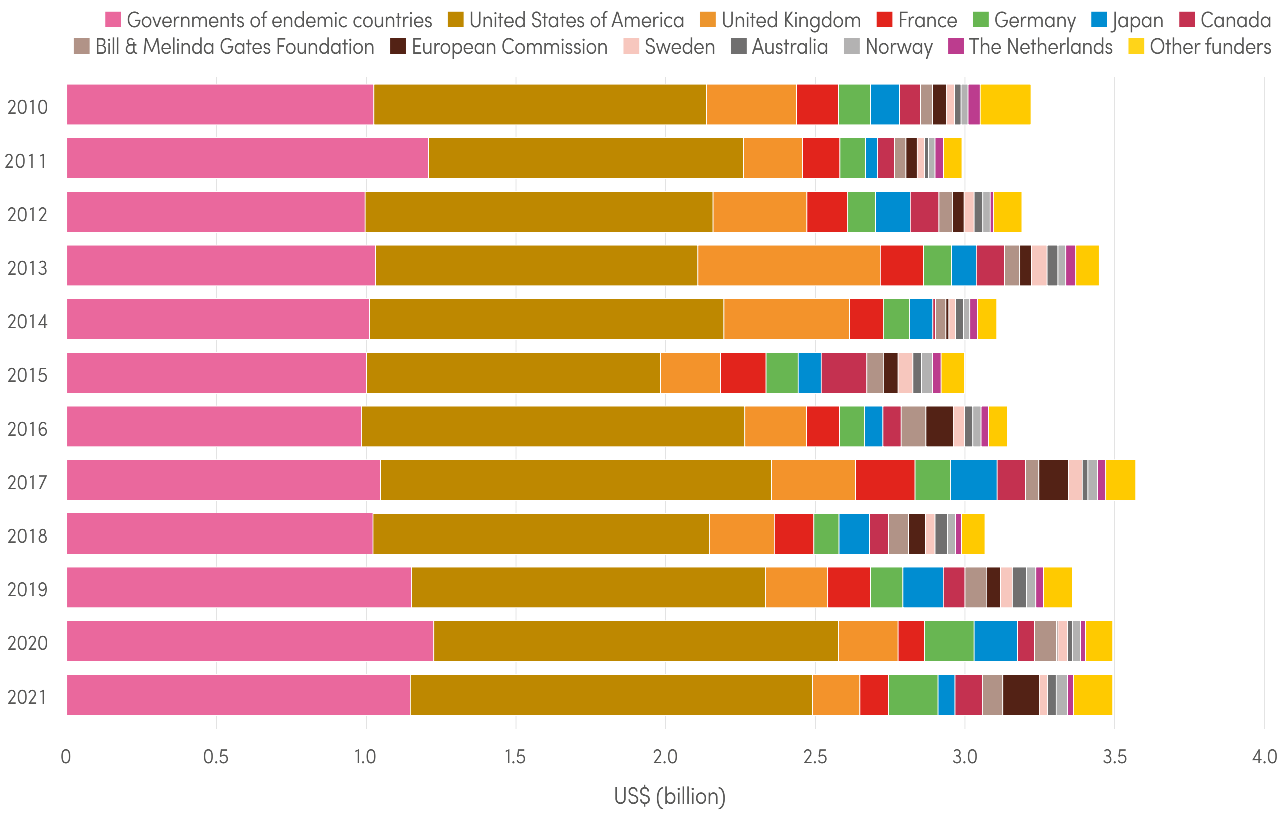
Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

countries that are members of the Development Assistance Committee (DAC) and from private sector contributors. Governments of malaria endemic countries contributed more than a third of total funding in 2021, with investments of over US$ 1.1 billion, of which over US$ 0.3 billion was spent on malaria case management in the public sector and US$ 0.8 billion on other malaria control activities, a US$ 0.1 billion increase from 2020.

To analyse malaria investment since 2000, international bilateral funding data were obtained from several sources, although the availability of historical data varied, depending on the donor. From the USA, data on total annual planned funding from the US Centers for Disease Control and Prevention (US CDC), Department of Defense and United States Agency for International Development (USAID) are available from 2001 to 2021; planned country-level USAID data are available starting in 2006. Data on annual disbursements by the Global Fund to malaria endemic countries are available from 2003 to 2021. For the government of the United Kingdom, disbursement data were obtained through the OECD CRS on aid activity from 2007 to 2016; however, from 2017 to 2020, disbursement data were sourced from *Statistics on international development: final UK aid spend 2020* (*59*) (2021 data were not yet finalized at the time of publishing this report, so disbursement data for 2021 were estimated using 2020 reported figures). The United Kingdom supports malaria control and elimination through a broad range of interventions that are not recorded as malaria-specific spend (e.g. support to overall health systems in malaria endemic countries and R&D), and are therefore not included in this estimate.

FIG. 6.2.

Funding for malaria control and elimination, 2010–2021, by source of funds (constant 2021 US$) *Sources: ForeignAssistance.gov, United Kingdom Foreign, Commonwealth and Development Office, Global Fund, NMP reports, OECD CRS database, the World Bank DataBank and WHO estimates.*



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

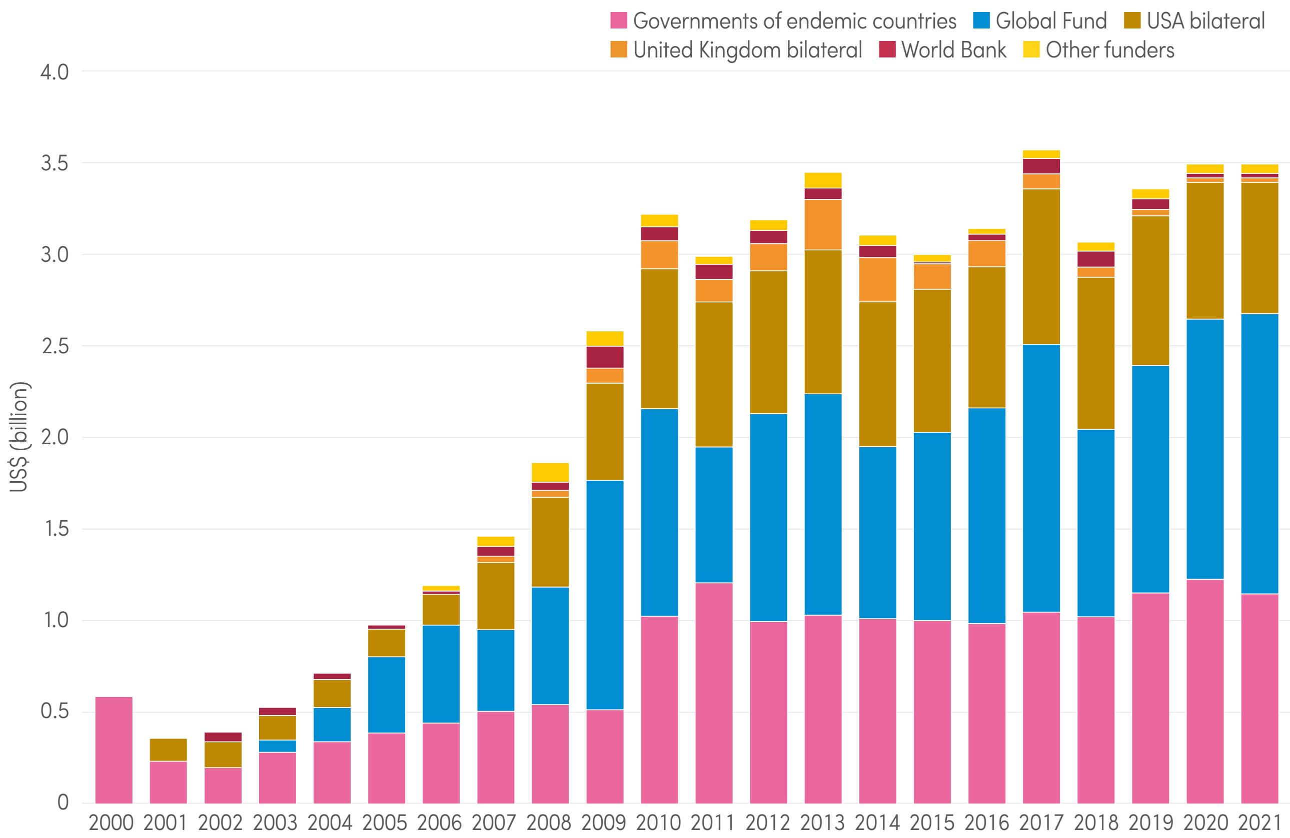
For all other donors, disbursement data were also obtained from the OECD CRS database for the period 2002–2020, with 2021 estimates being derived from 2020 figures. For all international bilateral funding data, the country recipient has been labelled as "unspecified" for all years where country-specific data are not available. For years where no data are available for a particular funder, no imputation was conducted; hence, the trends presented in **Figs. 6.3–6.6** should be interpreted carefully, particularly for the years preceding 2010.

Contributions from governments of endemic countries were estimated as the sum of contributions reported by NMPs for the relevant year plus the estimated costs of patient care delivery services at public health facilities. From 2000 to 2021, where available, government expenditures were used for their contributions (if such expenditures were unavailable, then government budgets or estimates were used). Patient care delivery costs were derived using unit cost estimates from WHO CHOosing Interventions that are Cost-Effective (WHO-CHOICE) (*60*). Where possible, patient care delivery costs per country were included for the years 2010 to 2021, because no unit cost estimates are available for the years before 2010.

Of the US$ 3.5 billion invested in 2021, over US$ 1.1 billion (33%) was contributed from governments of endemic countries. Of the total investments, over US$ 1.5 billion (44%) was channelled through the Global Fund. Compared with previous years, the Global Fund's disbursements to malaria endemic countries increased by about US$ 0.1 billion since 2020 and US$ 0.3 billion since 2019. Planned funding from the USA was

FIG. 6.3.

Funding for malaria control and elimination, 2000–2021, by channel (constant 2021 US$) *Sources: ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Foreign, Commonwealth and Development Office, WHO estimates and World Bank DataBank.*



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; USA: United States of America; WHO: World Health Organization.

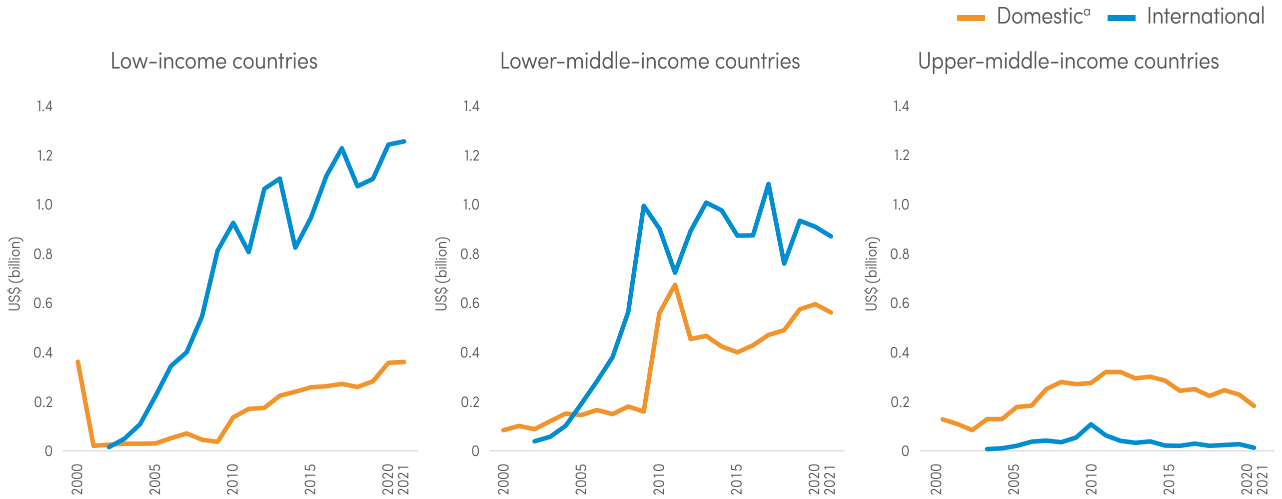
Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

US$ 0.8 billion in 2021, essentially matching the 2017–2020 levels (**Fig. 6.3**).

Fig. 6.4 shows the substantial variation across country income groups (as defined by the World Bank classifications published in July 2022) (*61*) in the share of funding received from domestic and international sources. The World Bank's classifications by income group vary from year to year. In 2021, the low-income group category comprised 27 countries representing over 90% of global malaria cases and deaths. The low-income countries, which accounted for 47% of total malaria funding in 2021, experienced an overall increase in funding since 2000. These countries have received an increase in funding of over 50% since 2010, from both international and domestic sources. In this low-income group, 78% of the funding stemmed from international sources and 22% from domestic sources. The 39 low- and middle-income countries (LMIC) accounted for 41% of total funding in 2021, with international sources accounting for 61% of funding and domestic 39%. This figure continues to reflect an increase in domestic funding; in 2020, international sources accounted for 66% of funding and domestic 34%. In contrast, the upper-middle-income group, comprising 19 countries and accounting for 5% of total funding in 2021, received 4% of their malaria funding from international sources and 96% from domestic public funding (8% and 92% in 2020, respectively). Finally, the three high-income countries accounted for 1% of total malaria funding, with 100% stemming from domestic sources. Malaria funding to regions with no geographical information on recipients and one country that was not classified into an income group this year represent the remaining 6% of malaria funding in 2021.

FIG. 6.4.

Funding for malaria control and elimination, 2000–2021, by World Bank 2021 income group and source of funding (constant 2021 US$) *Sources: ForeignAssistance.gov, Global Fund, NMP reports, OECD CRS database, United Kingdom Foreign, Commonwealth and Development Office, WHO estimates and World Bank DataBank.*



CRS: creditor reporting system; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization.

[a] Excludes out-of-pocket spending by households.

Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

The assessment of funding for malaria control and elimination per capita by domestic and international sources highlights the variation in funding per person at risk, on average, within each WHO region. The calculation for the population at risk is further explained in **Annex 1**. The five graphs in **Fig. 6.5** depict the trends across the different regions in funding per person at risk.

The WHO African Region has the highest funding per person at risk, with international expenditure per capita nearing US$ 2 and domestic expenditure per capita nearing US$ 1, having doubled from US$ 0.50 in 2010. The domestic funding trends should be interpreted with caution because the more cases a country has, the greater the estimated patient costs. However, the trends presented across the other WHO regions show sizeable changes in funding per person at risk over the past decade, with many regions either falling to levels seen in 2010 or decreasing significantly over time. The WHO African Region and the Eastern Mediterranean Region have experienced variations in funding per person at risk by domestic and international sources, with international funding being twice that of domestic funding in 2021. However, the WHO Eastern Mediterranean Region has seen overall funding per person at risk return to the same level in 2021 as it was in 2010, averaging US$ 0.50 per person.

FIG. 6.5.

Funding for malaria control and elimination per person at risk, 2010–2021, by WHO region (constant 2021 US$) *Sources: ForeignAssistance.gov, United Kingdom Foreign, Commonwealth and Development Office, Global Fund, NMP reports, OECD CRS database, World Bank DataBank and WHO estimates.*

AFR: WHO African Region; AMR: WHO Region of the Americas; CRS: creditor reporting system; EMR: WHO Eastern Mediterranean Region; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; SEAR: WHO South-East Asia Region; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization; WPR: Western Pacific Region.

[a] Excludes out-of-pocket spending by households.

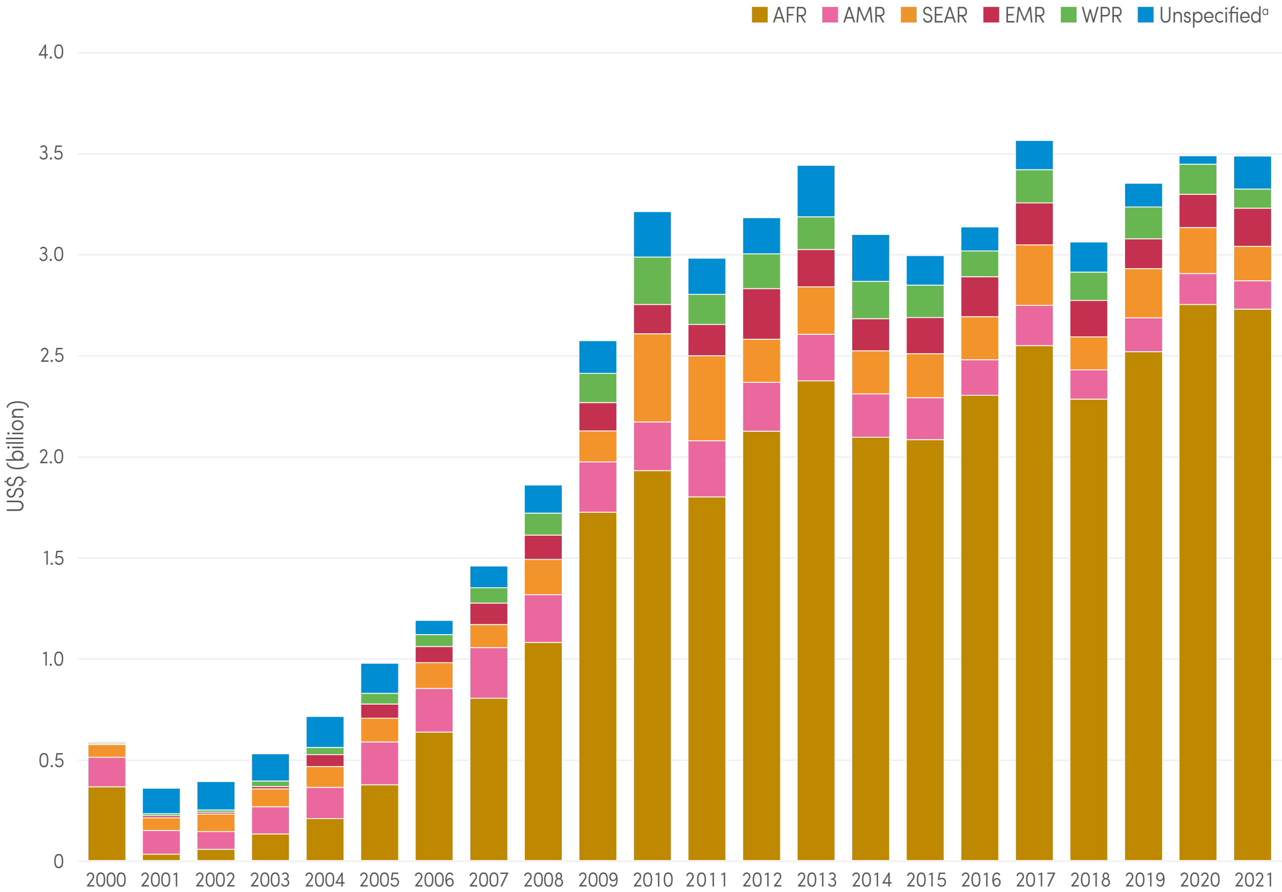
Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

In the WHO Region of the Americas, domestic funding in 2021 per person at risk was four times greater than international funding; however, the overall trend showed a nearly 50% decrease in total funding since 2010. This trend was more apparent in the WHO South-East Asia Region and Western Pacific Region, where funding per person at risk dropped to one third of the reported funding in 2010 – in both cases, from about US$ 0.30 to US$ 0.10 per person at risk, with domestic contributions being significantly higher than international contributions. In recent years, the WHO Western Pacific Region funding from domestic and international sources had converged and had been relatively stable since 2011; however, from 2020 to 2021 there was a 40% decline in total funding per person at risk. Most of the WHO regions, apart from the WHO African Region, have shown volatility in overall funding over the past decade and experienced lower total funding per person at risk in 2021 than in 2010.

In the assessment of funding for malaria control and elimination by WHO region, more than three quarters (78%) of the US$ 3.5 billion invested in 2021 benefited the WHO African Region. Of the remaining funding, 5% each went to the WHO South-East Asia Region and Eastern Mediterranean Region, 4% to the Region of the Americas and 3% to the Western Pacific Region. The remaining 5% of total funding in 2021 was allocated to unspecified regions where no geographical information on recipients was available (**Fig. 6.6**).

FIG. 6.6.

Funding for malaria control and elimination, 2000–2021, by WHO region (constant 2021 US$) *Sources: ForeignAssistance.gov, United Kingdom Foreign, Commonwealth and Development Office, Global Fund, NMP reports, OECD CRS database, World Bank DataBank and WHO estimates.*



AFR: WHO African Region; AMR: WHO Region of the Americas; CRS: creditor reporting system; EMR: WHO Eastern Mediterranean Region; Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; OECD: Organisation for Economic Co-operation and Development; SEAR: WHO South-East Asia Region; United Kingdom: United Kingdom of Great Britain and Northern Ireland; WHO: World Health Organization; WPR: Western Pacific Region.

[a] "Unspecified" refers to funding flows, with no information on the geographical localization of their recipients.

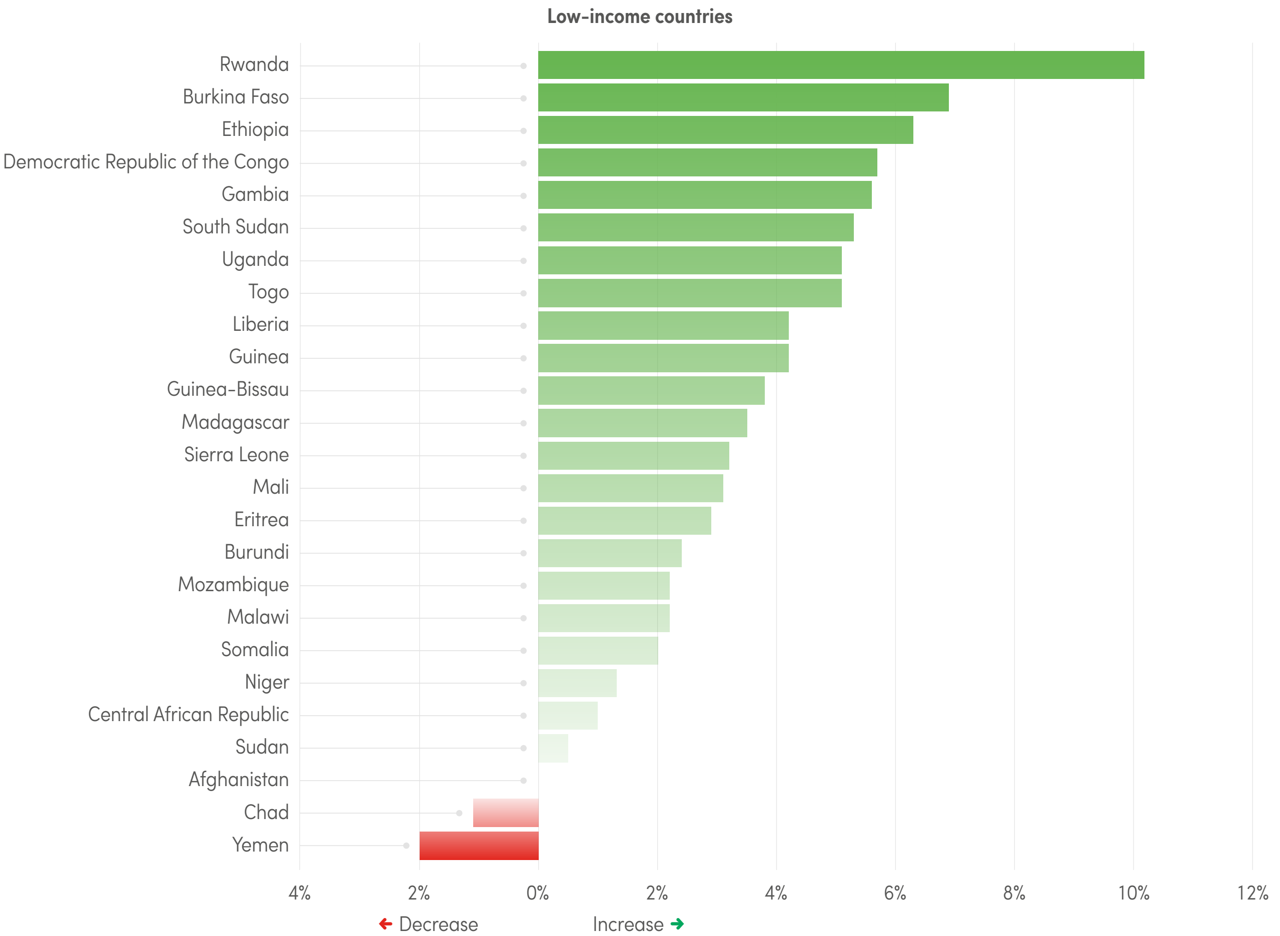
Note: The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Many countries have experienced shocks in their real gross domestic product (GDP) because of the COVID-19 pandemic and other global crises, such as the increasing frequency of infectious diseases (e.g. monkeypox), climate events and conflict. This is reflected in the variation in real GDP across countries since the beginning of the pandemic. The UN predicted in 2021 that the global economy could shrink by about 0.9% during the pandemic (*61–64*). The 2022 World Economic Situation and Prospects (WESP) report by the UN Department of Economic and Social Affairs (*65*) stated that the global economy gained momentum in 2021, with an expansion of 5.5% (the highest growth rate in more than 4 decades), after a global contraction of 3.4% in 2020 (*65*). However, projections suggest that the economy will grow at a slower rate in the coming years. It is important to note that these are global outcomes and projections; therefore, they do not capture the differences across countries. In 2020, 70% of the malaria endemic countries categorized as lower income countries and LMIC experienced a shock in their annual real GDP (*66*). Of these countries, 34 shrunk by more than 1%, with half of these coming from the WHO African Region, as defined in the International Monetary Fund (IMF) data mapper on real GDP annual growth percentage (*66*).

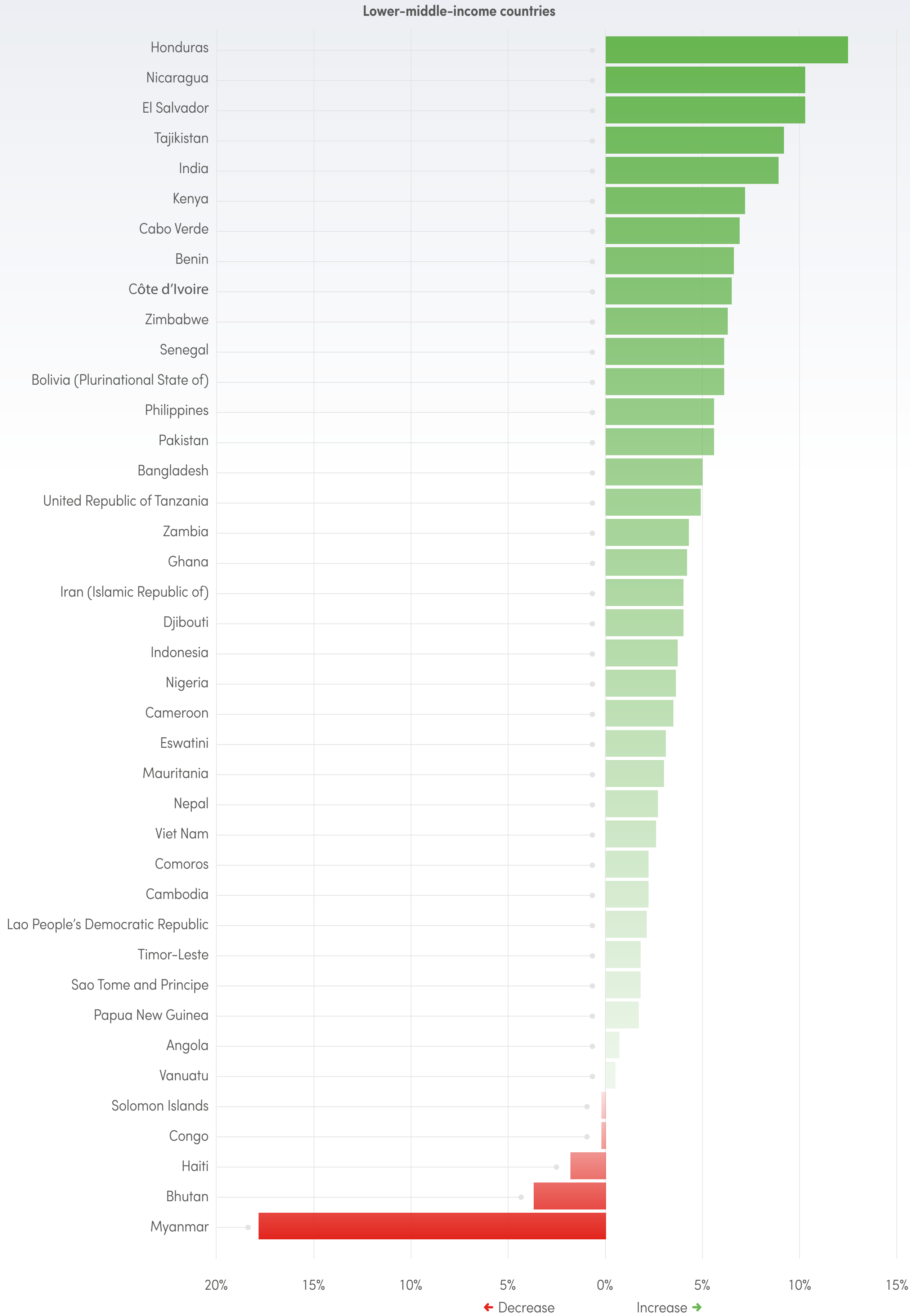
For 2021, the IMF data mapper and World Bank income classification categories show that, among the 65 countries defined as lower income countries and LMIC, only seven countries (11%) experienced a shock (*66*). Of those seven countries, five shrunk by more than 1%, with only one country experiencing a significant decline (of nearly 20%). Most of the 65 lower income countries and LMIC (as well as the upper-middle-income countries) experienced growth in their annual real GDP, ranging from 0.5% to 12.5% (and up to 19.9% for upper-middle-income countries) in 2021 (**Fig. 6.7**); however, a full recovery of GDP per capita since the pandemic will remain a challenge for many developing countries (*65*).

FIG. 6.7.

Real GDP growth annual per cent change, 2021, by World Bank income classification (constant 2021 US$)
Source: IMF data mapper (*66*) *and World Bank Data Bank.*



GDP: gross domestic product; IMF: International Monetary Fund.


Lower-middle-income countries
Honduras
Nicaragua
El Salvador
Tajikistan
India
Kenya
Cabo Verde
Benin
Côte d'Ivoire
Zimbabwe
Senegal
Bolivia (Plurinational State of)
Philippines
Pakistan
Bangladesh
United Republic of Tanzania
Zambia
Ghana
Iran (Islamic Republic of)
Djibouti
Indonesia
Nigeria
Cameroon
Eswatini
Mauritania
Nepal
Viet Nam
Comoros
Cambodia
Lao People's Democratic Republic
Timor-Leste
Sao Tome and Principe
Papua New Guinea
Angola
Vanuatu
Solomon Islands
Congo
Haiti
Bhutan
Myanmar
20%
15%
10%
5%
0%
5%
10%
15%
Decrease
Increase

6.2 INVESTMENTS IN MALARIA-RELATED R&D

6.2.1 Overarching trends

Global funding for malaria basic research and product development was US$ 626 million in 2021, a reduction of US$ 54 million (–7.9%) from 2020. This falls short of the estimated US$ 851 million projected to be required to stay on track towards the GTS milestones (*2*). This drop represented the third consecutive year of funding decline since its 2018 peak, taking headline investment to its lowest level since 2013 or, adjusting for long-term growth in survey participation, the lowest since 2007 when the G-FINDER survey began.

The decrease was driven by large reductions in funding from industry (down US$ 18 million, –14%) and the United Kingdom's Foreign, Commonwealth and Development Office (FCDO) (down US$ 18 million, –51%); it fell most heavily on R&D targeting multiple and "other" malaria strains, which dropped by US$ 70 million to US$ 289 million (46% of total funding). In contrast, funding specifically targeting *P. falciparum* malaria rose slightly to US$ 282 million (45% of total funding) and funding for *P. vivax* malaria remained unchanged at US$ 55 million (8.8%).

Malaria R&D funding declined across most product categories. Vaccine funding continued its downward trajectory for the fourth consecutive year, falling to US$ 118 million (down US$ 17 million, –13%), leaving it only slightly above its lowest recorded level. However, in a reversal of a trend seen over the past 2 years, this decrease was largely caused by a fall in funding for early-stage vaccine research, rather than clinical development. In particular, the Bill & Melinda Gates Foundation reduced its investment into early-stage research by almost three quarters (down US$ 10 million, –74%). Despite this, it remained the third-largest overall funder of malaria vaccine R&D, behind only the US National Institutes of Health (NIH) and industry.

While continuing to receive more than a quarter of malaria funding (US$ 166 million), basic research appeared to experience the largest absolute decline in funding in 2021 (down US$ 22 million, –12%). However, this was largely due to the absence of 2021 funding data from the Indian Council of Medical Research, which had been the second largest funder in 2020, with contributions of more than US$ 16 million. Adjusting for differences in survey participation, malaria basic research still fell substantially – by US$ 12 million (–7.2%) – attributable mostly to reduced funding from the Australian National Health and Medical Research Council and tapered disbursements from Open Philanthropy, which had made frontloaded payments under its 2- and 3-year grants in 2020.

After receiving a record 10% share of funding in 2020 (US$ 68 million), vector control product (VCP) R&D fell by just under a fifth to US$ 55 million in 2021. The Bill & Melinda Gates Foundation and the FCDO, which collectively accounted for 80% of VCP funding in 2020, saw their funding decrease by US$ 12 million (–27%) and US$ 3.6 million (–33%), respectively. However, this decrease was partially offset by a rise in funding from Open Philanthropy, which disbursed US$ 10 million to the University of California, Davis to progress a gene drive application designed to reduce or inhibit the ability of mosquitoes to transmit malaria.

Diagnostics funding received only 2.5% of total malaria funding in 2021, its lowest share since 2013. Since its sustained peak at over US$ 30 million a year between 2017 and 2019, diagnostics funding has now declined by close to half, to US$ 16 million. The rate of decline slowed in 2021, thanks to a doubling of the Bill & Melinda Gates Foundation funding (up US$ 3.5 million, 110%) and a slight increase from the US NIH (up US$ 1.2 million, 21%). This was offset by a US$ 6.2 million fall in funding from the United Kingdom's Department of Health and Social Care and FCDO, with the latter concluding 4 years of funding to PATH, amid substantial declines more broadly in its funding to a wide range of neglected diseases.

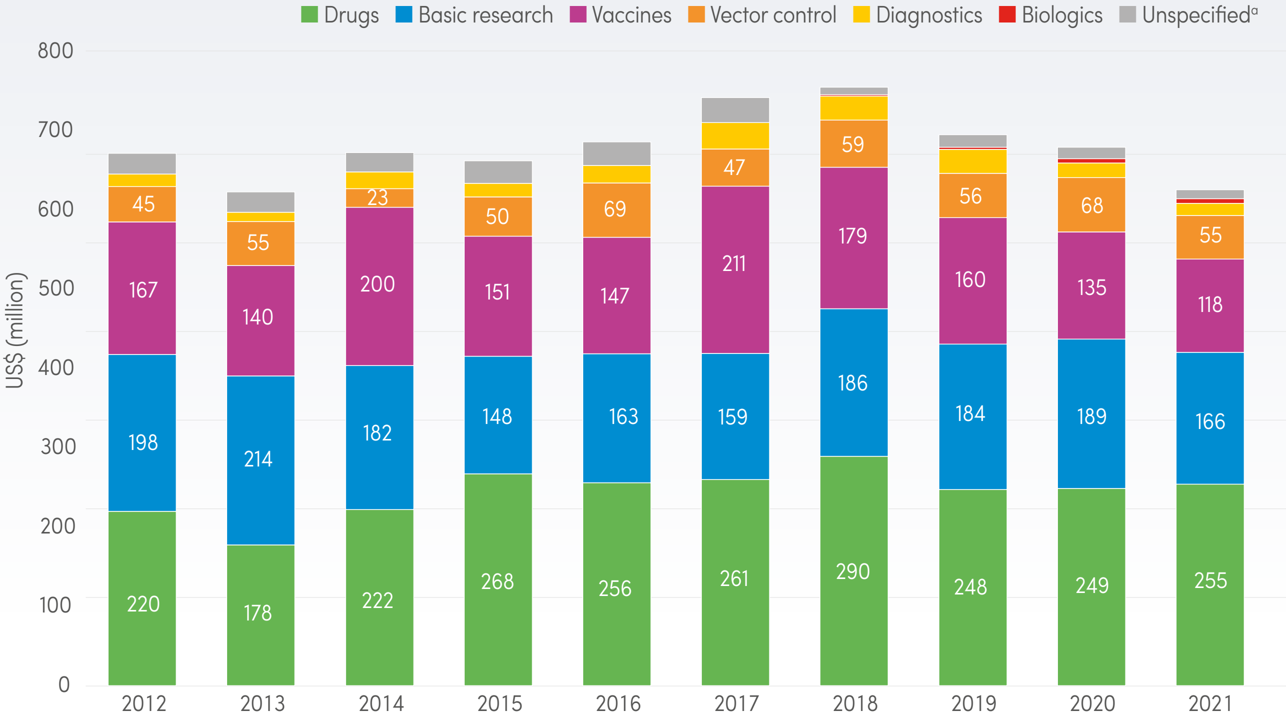
Only R&D for therapeutics bucked the overall downward trend, with drug R&D rising by US$ 5.7 million (2.3%) and biologics by US$ 0.4 million (7.0%), leaving both with their largest share of overall malaria funding in the past decade. The increase in drug funding was mostly thanks to Unitaid, which more than doubled last year's record contributions to reach a new peak of US$ 23 million (up US$ 13 million, 132%).

In contrast to other product areas, industry remained the top funder of drug R&D, having contributed 38% (US$ 927 million) of all drug R&D funding over the past 10 years. However, its contributions fell slightly in 2021, to US$ 75 million (29% of total drug R&D funding). The largest decreases were in industry's funding for clinical development, which trended downwards from a peak of US$ 85 million in 2018 to US$ 31 million in 2021.

Despite a US$ 30 million drop in contributions from the public sector in high-income countries, they continued to provide 52% of global malaria R&D funding in 2021. This was largely thanks to the US NIH – the top funder of malaria R&D – whose funding remained stable at US$ 189 million. Philanthropic funding fell slightly, due to reduced funding from the Bill & Melinda Gates Foundation – still the second largest overall funder – followed by a US$ 18 million drop in aggregate industry funding, leaving it as the third largest. Record funding from Unitaid drove multilaterals' share of funding to nearly 4%, its highest level ever, while – after adjusting for the absence of Indian funding data – LMIC public funding rose slightly.

FIG. 6.8.

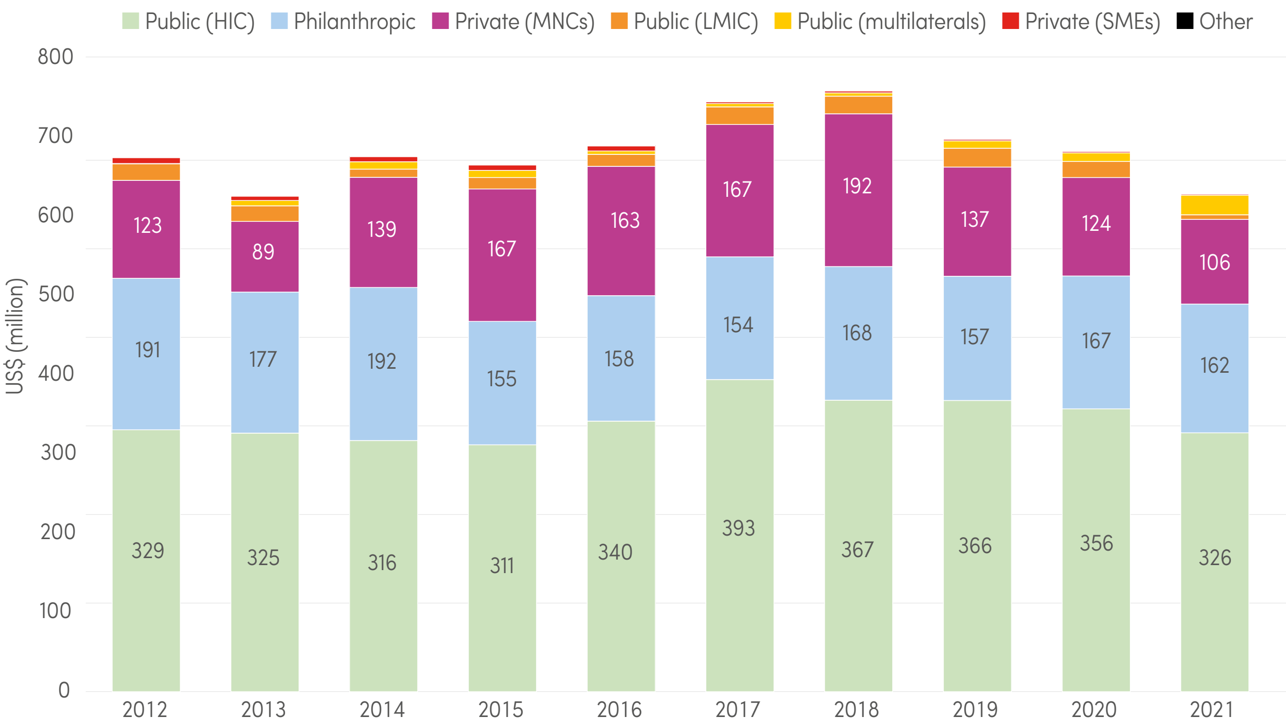
Funding for malaria-related R&D, 2012–2021, by product type (constant 2021 US$) *Sources: Policy Cures Research G-FINDER data portal (67).*



R&D: research and development.
[a] "Unspecified" refers to funding flows, with no information on the product type.

FIG. 6.9.

Funding for malaria-related R&D, 2012–2021, by sector (constant 2021 US$) *Sources: Policy Cures Research, G-FINDER data portal (67).*



HIC: high-income countries; LMIC: low- and middle-income countries; MNC: multinational corporation; R&D: research and development; SME: small and medium enterprise.

7

DISTRIBUTION AND COVERAGE OF MALARIA PREVENTION, DIAGNOSIS AND TREATMENT

This section summarizes data from manufacturers and NMPs on the distribution of malaria interventions. It also presents modelled estimates of access to and coverage of ITNs.

7.1 DISTRIBUTION AND COVERAGE OF ITNs

Manufacturers delivered about 220 million ITNs to malaria endemic countries in 2021, 10 million fewer than in 2020 and 34 million fewer than in 2019 (**Fig. 7.1**). About 94% of all ITNs delivered by manufacturers went to countries in sub-Saharan Africa. Of these, 46% were pyrethroid–piperonyl butoxide (PBO)[1] nets and 9% were dual active ingredient ITNs. About 56% of the ITNs delivered in sub-Saharan Africa were received in Nigeria (37 million), the Democratic Republic of the Congo (31.6 million), the United Republic of Tanzania (11.9 million), Kenya (11.8 million), Burkina Faso (11.5 million) and the Niger (10.0 million). Data from 2010–2021 are presented here; however, manufacturers' delivery data show that, between 2004 and 2021, more than 2.5 billion ITNs were supplied globally, of which 2.2 billion (87%) were supplied to sub-Saharan Africa.

In 2021, a total of 200 million ITNs were distributed globally by NMPs in malaria endemic countries. Of these ITNs, 176 million were distributed in sub-Saharan Africa. More than half of the total number of nets distributed in sub-Saharan Africa were distributed in five countries: the Democratic Republic of the Congo (22.6 million), Côte d'Ivoire (21.7 million), Kenya (17.9 million), Ghana (17.8 million) and Nigeria (16.4 million). Of the 25.1 million nets distributed outside sub-Saharan Africa, 90% were distributed in six countries: India (16.2 million), Yemen (1.8 million), Papua New Guinea (1.6 million), Viet Nam (1.5 million), Bangladesh (0.9 million) and Cambodia (0.6 million).

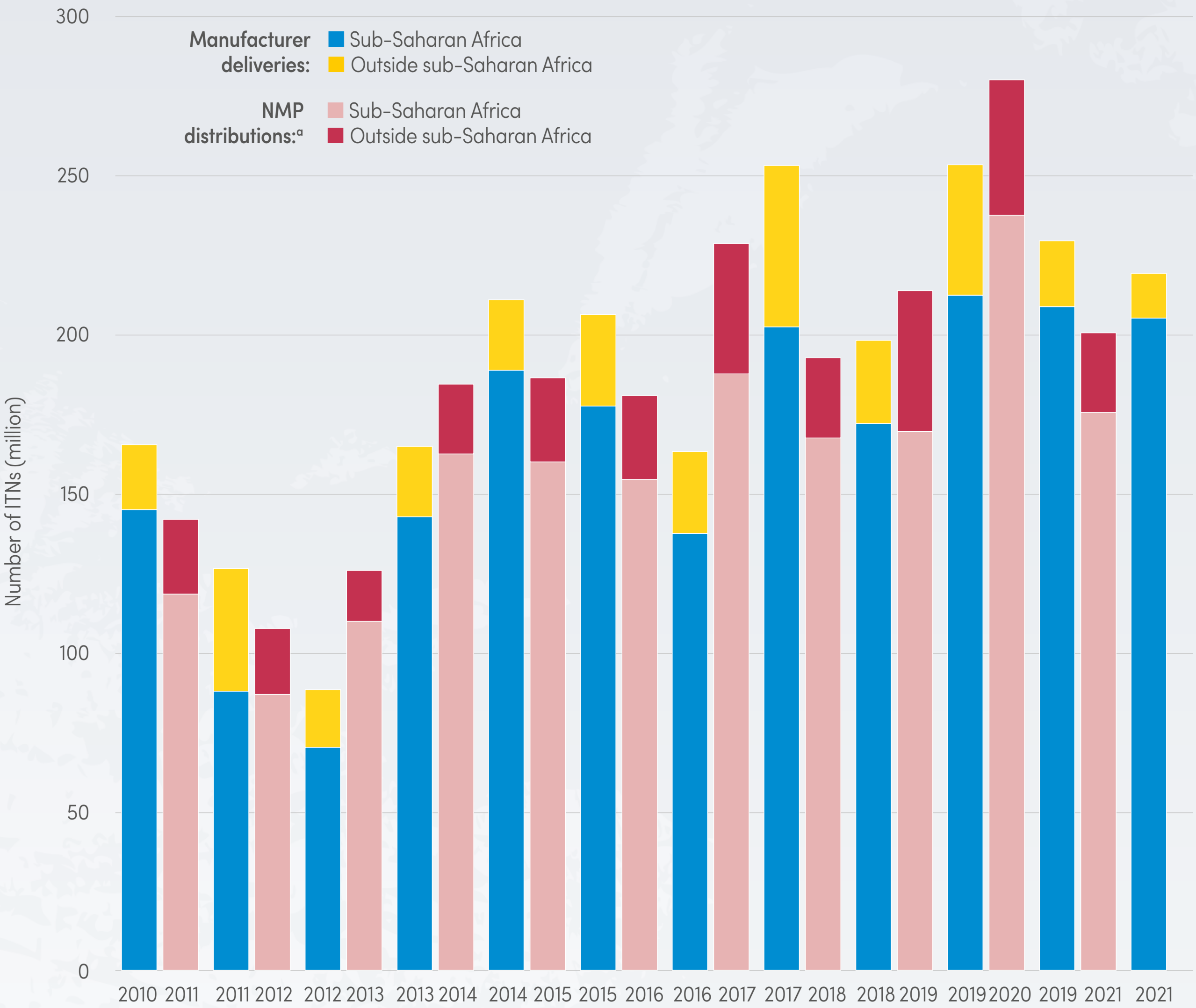
Indicators of population-level coverage of ITNs were estimated for sub-Saharan African countries in which ITNs are the main method of vector control. Household surveys were used, together with manufacturer deliveries and NMP distributions, to estimate the following indicators:

- ITN use (i.e. percentage of a given population group that slept under an ITN the night before the survey);
- ITN ownership (i.e. percentage of households that owned at least one ITN);
- percentage of households with at least one ITN for every two people; and
- percentage of the population with access to an ITN within their household (i.e. percentage of the population that could be protected by an ITN, if each ITN in a household could be used by two people).

[1] PBO is a synergist that disrupts the functions of the enzyme in the mosquito that makes them resistant to pyrethroids.

FIG. 7.1.

Number of ITNs delivered by manufacturers and distributed[a] by NMPs, 2010–2021 *Sources: Milliner Global Associates and NMP reports to AMP and WHO.*



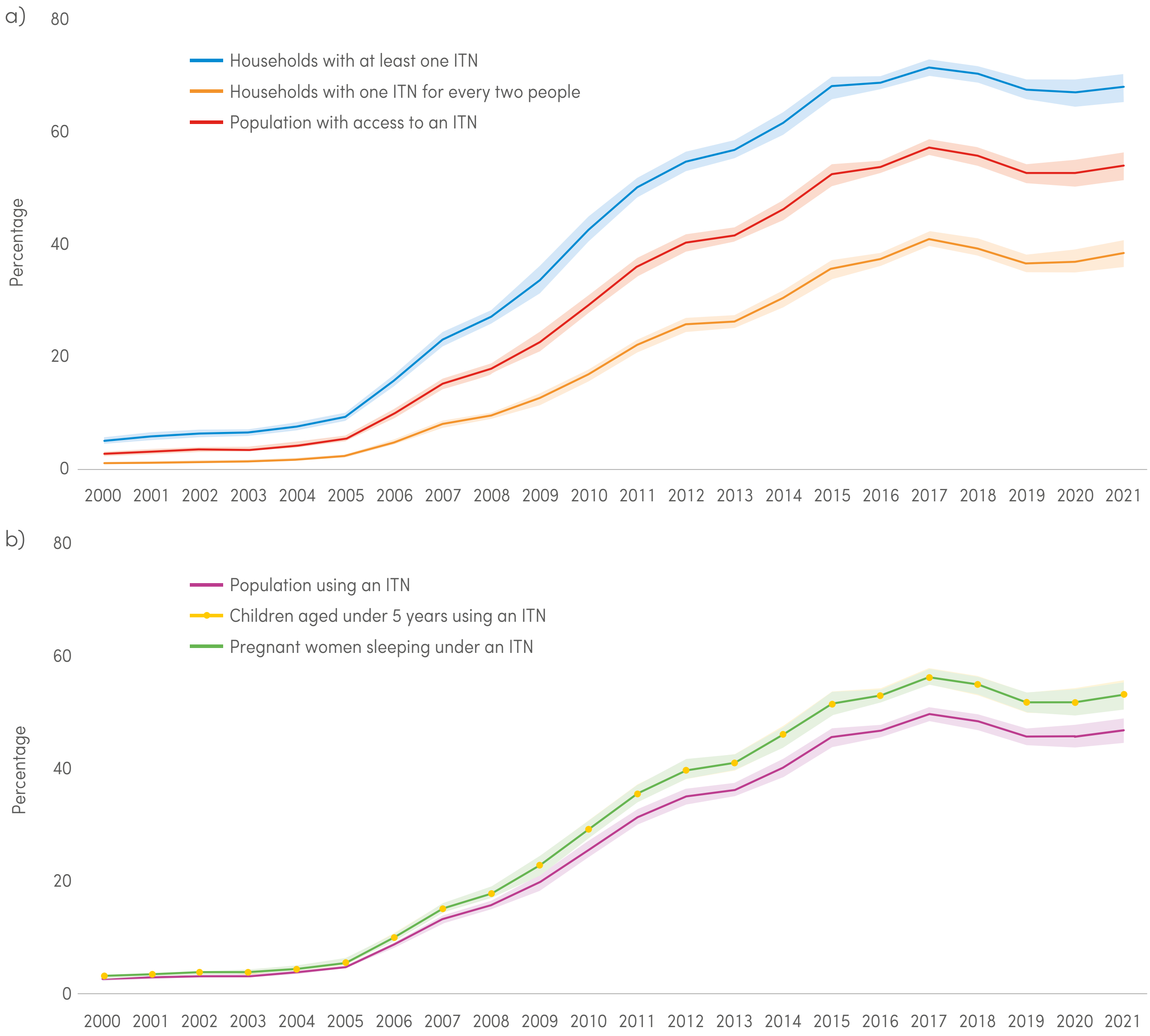
AMP: Alliance for Malaria Prevention; ITN: insecticide-treated mosquito net; NMP: national malaria programme; WHO: World Health Organization.

[a] A lag between manufacturer deliveries to countries and NMP distributions of about 6–12 months is expected; thus, deliveries by manufacturers in a given year are often not reflected in distributions by NMPs in that year. Also, distributions of ITNs reported by NMPs do not always reflect all the nets that have been distributed to communities, depending on completeness of reporting. These issues should be considered when interpreting the relationship between manufacturer deliveries, NMP distributions and likely population coverage. Additional considerations include nets that are in storage in-country but have not yet been distributed by NMPs and those sold through the private sector that are not reported by programmes.

By 2021, 68% of households in sub-Saharan Africa had at least one ITN, an increase from about 5% in 2000. The percentage of households owning at least one ITN for every two people increased from 1% in 2000 to 38% in 2021. In the same period, the percentage of the population with access to an ITN within their household increased from 3% to 54%. The percentage of the population sleeping under an ITN also increased considerably between 2000 and 2021 for the whole population (from 2% to 47%), for children aged under 5 years (from 3% to 53%) and for pregnant women (from 3% to 53%). Overall, access to and use of ITNs remains below the levels observed in 2017 (**Fig. 7.2**). Survey results on key ITN coverage indicators, by country, are shown in **Annex 4-Ea**.

FIG. 7.2.

a) Indicators of population-level access to ITNs, sub-Saharan Africa, 2000–2021 and b) indicators of population-level use of ITNs, sub-Saharan Africa, 2000–2021 *Sources: ITN coverage model by Malaria Atlas Project* (*68, 69*).



ITN: insecticide-treated mosquito net.

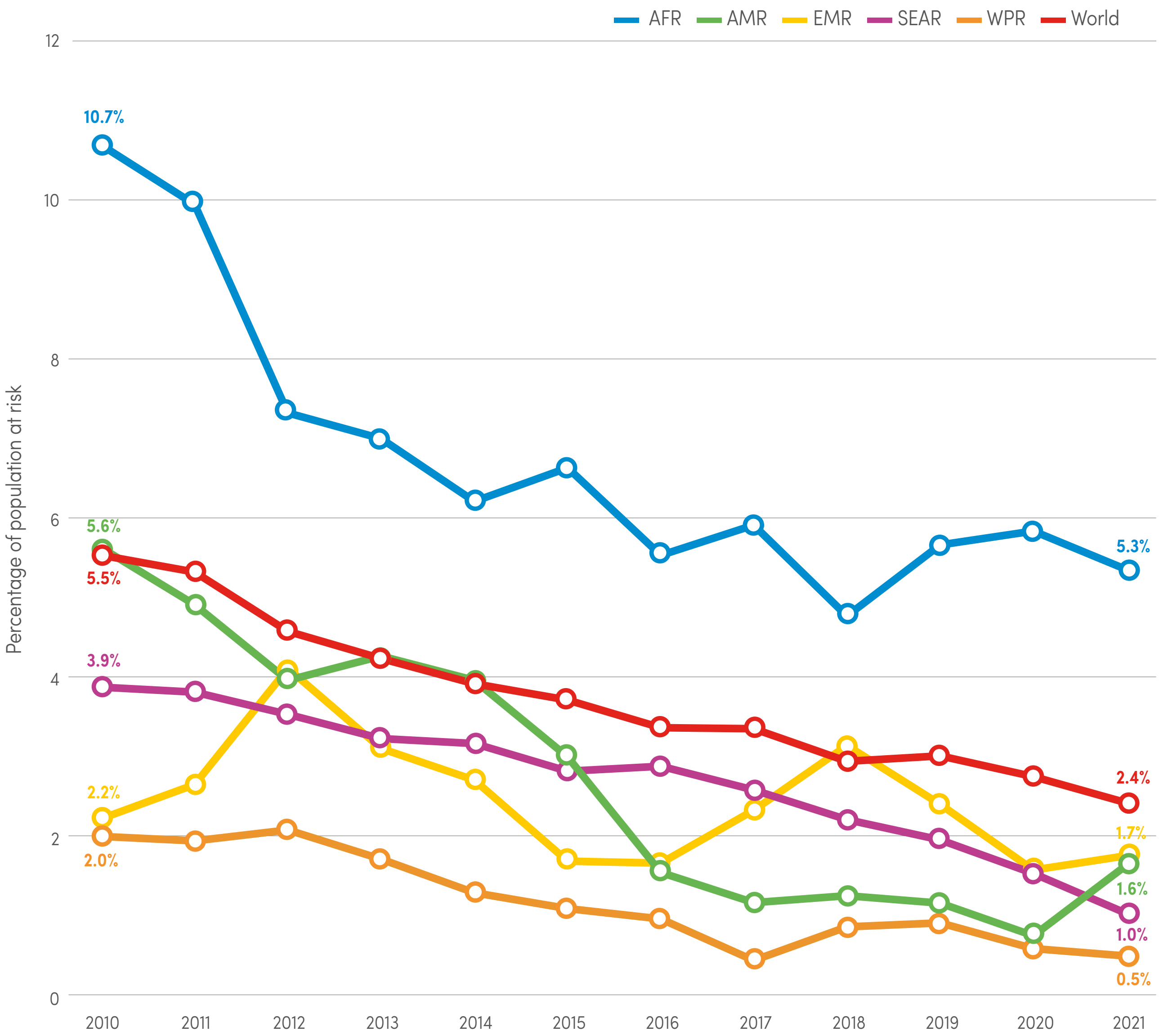
7.2 POPULATION PROTECTED WITH IRS

In 2021, 53 countries[1] implemented IRS to prevent malaria. Globally, the percentage of the population at risk protected by IRS in countries that are currently malaria endemic continued to decline, from 5.5% in 2010 to 2.4% in 2021. The percentage of the population at risk protected by IRS has remained stable since 2016, with less than 6% of the population protected in each WHO region (**Fig. 7.3**). The number of people protected by IRS globally fell from 153 million in 2010 to 112 million in 2015, and further declined to 80 million in 2021. Between 2020 and 2021, the number of people protected by IRS decreased in India, Zambia and Chad, by 7.8 million, 1.7 million and 1.0 million, respectively.

[1] The 53 countries that implemented IRS in 2021 are Angola, Benin, Bhutan, Botswana, Brazil, Burkina Faso, Burundi, Chad, Colombia, the Comoros, Costa Rica, Djibouti, the Dominican Republic, Ecuador, Eritrea, Eswatini, Ethiopia, the Gambia, Ghana, Guatemala, Honduras, India, Indonesia, Kenya, the Lao People's Democratic Republic, Madagascar, Malawi, Mali, Mexico, Mozambique, Namibia, Nepal, Nicaragua, Pakistan, Panama, the Philippines, Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, the Sudan, Thailand, Timor-Leste, Uganda, the United Republic of Tanzania, Viet Nam, Yemen, Zambia and Zimbabwe.

FIG. 7.3.

Percentage of the population at risk protected by IRS, by WHO region, 2010–2021[a] *Source: IVCC data and NMP reports.*



AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; IRS: indoor residual spraying; IVCC: Innovative Vector Control Consortium; NMP: national malaria programme; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

[a] Among malaria endemic countries, 2021.

7.3 SCALE-UP OF SMC

SMC has been implemented in 15 countries in sub-Saharan Africa. In 2021, Uganda and Mozambique implemented SMC for the first time. The average number of children treated per cycle of SMC steadily increased from about 0.2 million in 2012 to almost 45 million in 2021 (**Table 7.1**). Between 2020 and 2021, there were an additional 11.6 million children treated with SMC per cycle. Nigeria contributed to 92% of this

TABLE 7.1.
Average number of children treated with SMC per cycle, by year, in countries implementing SMC, 2012–2021 *Sources: LSHTM and MMV.*

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Benin	0	0	0	0	0	0	0	114 165	236 639	374 560
Burkina Faso	0	0	307 770	954 047	2 647 713	2 970 117	3 298 397	3 298 397	4 136 042	4 409 619
Cameroon	0	0	0	0	1 071 723	1 581 183	1 636 658	1 681 737	1 780 742	1 908 941
Chad	10 000	263 972	27 307	500 153	824 806	998 595	1 184 706	1 638 158	2 259 851	2 512 920
Gambia	0	0	65 271	76 450	73 710	76 601	112 841	110 870	121 834	76 045
Ghana	0	0	0	115 309	151 509	327 446	329 953	964 956	1 033 812	1 322 251
Guinea	0	0	0	201 283	442 177	575 927	840 120	841 090	1 088 194	1 122 434
Guinea-Bissau[a]	0	0	0	0	42 097	166 162	42 571	86 107	86 107	108 394
Mali	160 000	537 294	524 742	1 999 987	3 980 684	3 990 096	4 299 242	3 767 820	3 767 099	3 357 846
Mozambique	0	0	0	0	0	0	0	0	0	119 254
Niger	0	225 970	528 681	621 173	2 361 924	2 545 885	3 952 400	4 151 103	4 516 729	4 457 575
Nigeria	0	209 451	370 280	787 399	1 696 770	4 122 999	3 508 924	4 110 152	13 236 139	23 922 101
Senegal	0	55 709	595 745	614 581	621 503	631 897	0	879 652	687 959	748 116
Togo	0	119 222	170 165	0	411 811	420 451	434 161	453 907	486 716	475 997
Uganda	0	0	0	0	0	0	0	0	0	81 899
Total	**170 000**	**1 411 618**	**2 589 960**	**5 870 382**	**14 326 425**	**18 407 359**	**19 639 973**	**22 098 113**	**33 437 862**	**44 997 950**

TABLE 7.2.
Number of treatment doses delivered, by year, in countries implementing SMC, 2014–2021 *Sources: LSHTM and MMV.*

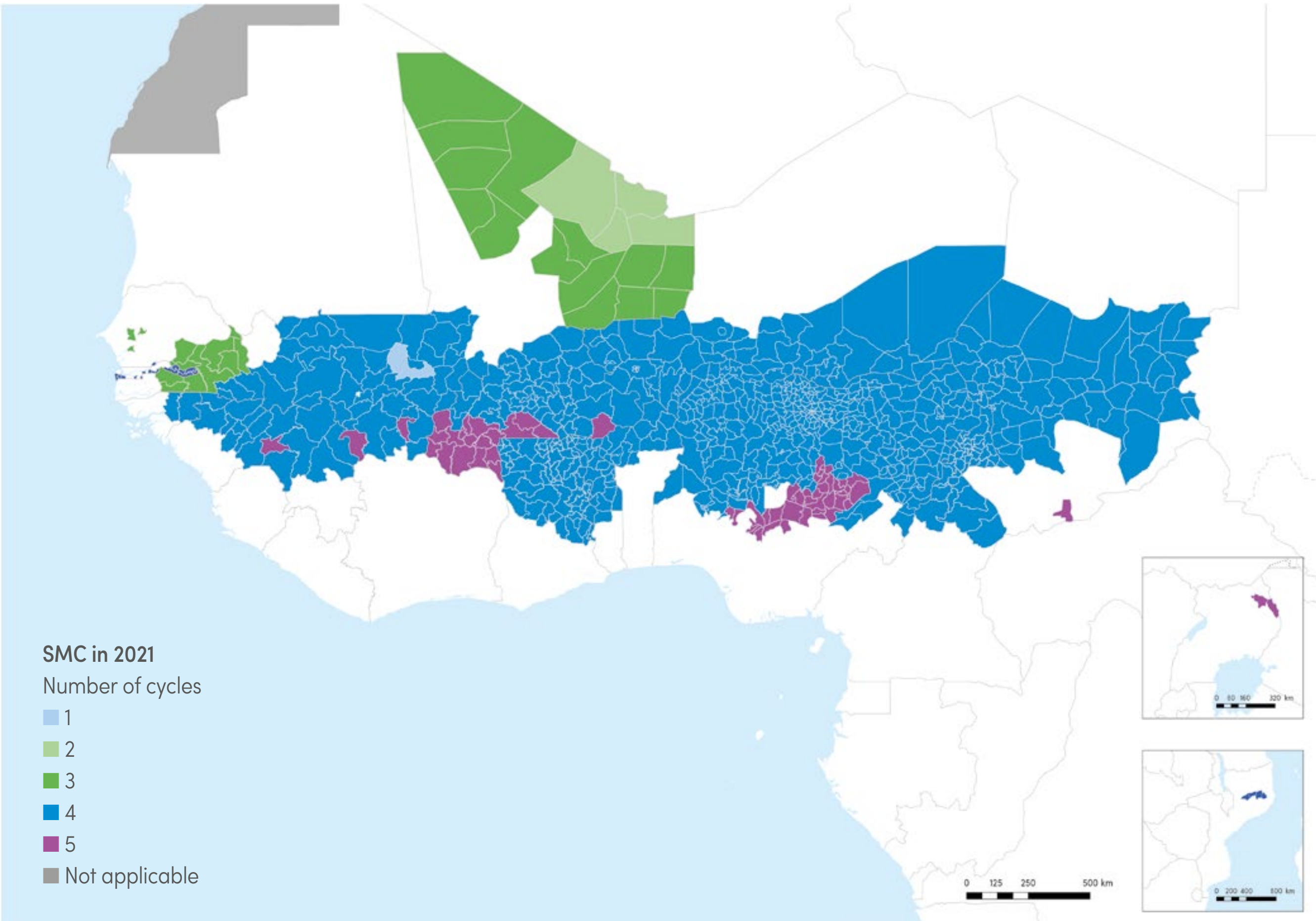
Country	2014	2015	2016	2017	2018	2019	2020	2021
Benin	0	0	0	0	0	456 661	856 491	1 498 240
Burkina Faso	1 231 081	3 816 187	10 590 851	11 799 603	13 193 588	13 193 588	16 544 168	18 603 883
Cameroon	0	0	4 286 893	6 324 731	6 546 632	6 726 947	7 122 967	7 635 762
Chad	109 226	1 850 623	3 299 222	3 658 347	4 738 823	5 967 618	9 039 406	10 142 392
Gambia	195 812	305 800	294 839	306 405	406 044	443 478	487 334	304 180
Ghana	0	461 236	606 037	1 309 782	1 319 813	3 859 822	4 135 249	4 803 223
Guinea	0	805 131	1 768 708	2 303 709	3 360 479	3 003 612	4 352 774	4 533 292
Guinea-Bissau[a]	0	0	146 718	664 647	170 284	344 429	344 429	433 574
Mali	2 098 969	7 999 948	15 398 687	15 960 382	17 113 604	15 068 821	14 956 952	12 906 775
Mozambique	0	0	0	0	0	0	0	477 016
Niger	2 072 438	2 484 692	7 977 379	10 183 541	15 243 535	16 604 412	18 066 916	17 830 299
Nigeria	1 481 118	3 149 597	6 316 916	9 298 163	13 842 931	16 440 609	52 944 556	96 002 997
Senegal	1 787 236	1 887 211	1 910 656	1 942 868		2 684 527	2 107 303	2 290 288
Togo	510 494	0	1 235 433	1 529 275	1 302 483	1 185 327	1 946 863	1 903 986
Uganda	0	0	0	0	0	0	0	409 495
Total	**9 486 374**	**22 760 425**	**53 832 339**	**65 281 453**	**77 238 216**	**85 979 851**	**132 905 408**	**179 775 402**

LSHTM: London School of Hygiene & Tropical Medicine; MMV: Medicines for Malaria Venture; SMC: seasonal malaria chemoprevention.
[a] Values for 2020 were imputed from 2019.

increase, with 24 million children treated on average per cycle. In four countries, there were fewer children treated per SMC cycle in 2021 than in 2020: the Gambia (46 000), Mali (409 000), the Niger (59 000) and Togo (11 000). The total number of treatment doses delivered among countries implementing SMC in 2021 was about 180 million (**Table 7.2**). Subnational areas in each country where SMC was delivered in 2021, together with the number of cycles in each district, are shown in **Fig. 7.4**.

FIG. 7.4.

Subnational areas where SMC was delivered, and number of treatment cycles per district, in implementing countries in sub-Saharan Africa, 2021 *Source: LSHTM.*



LSHTM: London School of Hygiene & Tropical Medicine; SMC: seasonal malaria chemoprevention.
Note: In one district in Mali where 4 cycles were planned, only 1 cycle was implemented, and in four districts where 3 cycles were planned, 2 cycles were implemented due to delays in receiving financial support.

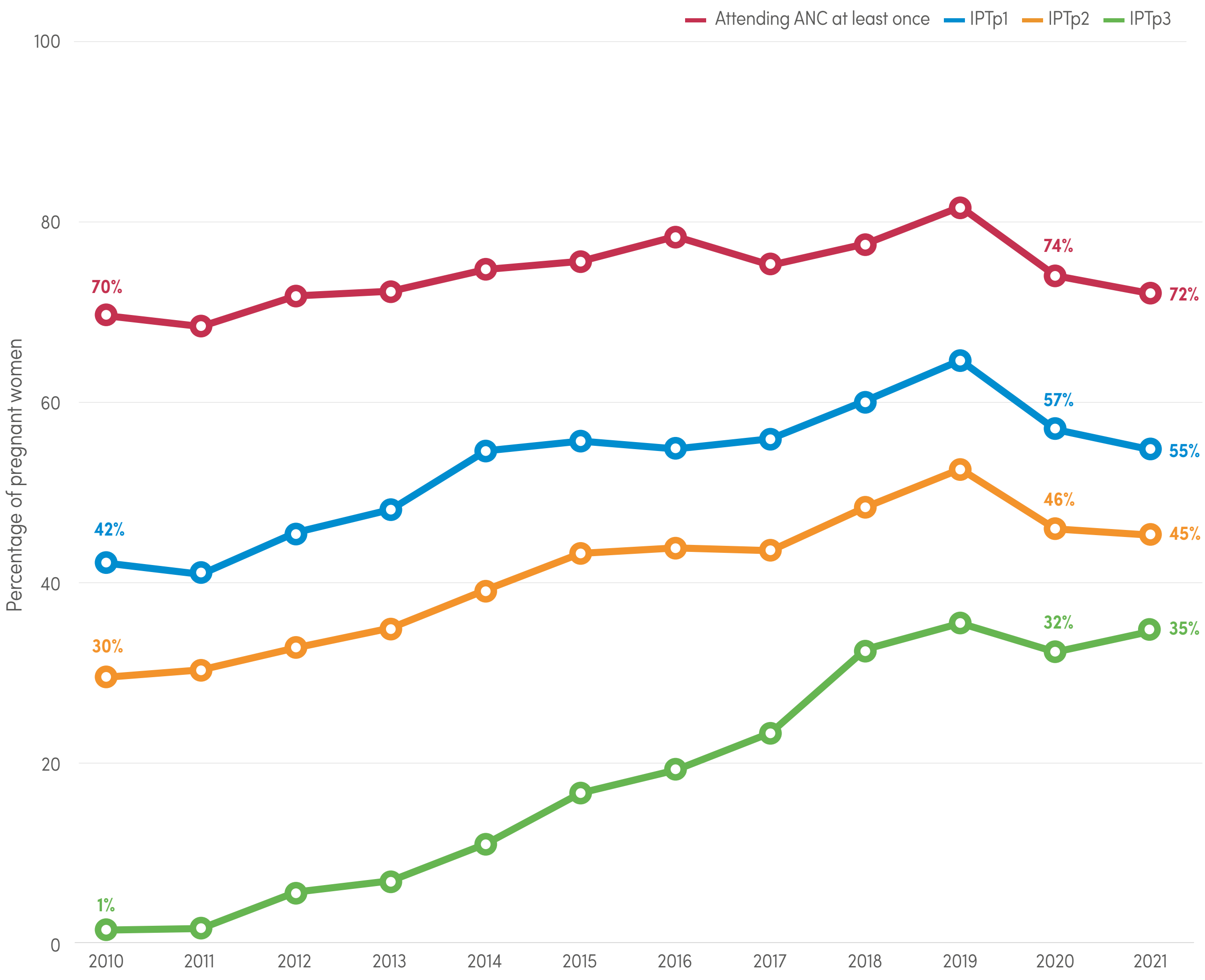
7.4 COVERAGE OF IPTp USE BY DOSE

To date, 35 African countries[1] have adopted IPTp nationally to reduce the burden of malaria during pregnancy. Of these, 33 countries[2] with moderate to high malaria transmission reported routine data from health facilities in the public sector on the number of women visiting antenatal clinics, and the number receiving the first, second, third and fourth doses of IPTp (i.e. IPTp1, IPTp2, IPTp3 and IPTp4). Using annual expected pregnancies as the denominator (adjusted for fetal loss and stillbirths) (**Annex 1**, **Fig. 7.5**), the percentage of IPTp use by dose was computed. ANC and IPTp coverages reported for 2021 were adjusted for disruptions in ANC services, as explained in **Annex 1**. Overall, the coverage of ANC and IPTp1 has decreased from nearly 82% and 65% in 2019, to 72% and 55% in 2021, respectively. Coverage of IPTp3 in 2021, at 35%, remained largely unchanged from 2019 and 2020, and well below the target of at least 80%. This underscores the substantial number of missed opportunities for IPTp, given that 55% of women received IPTp1 in 2021 (**Fig. 7.5**). Between 2020 and 2021, estimated IPTp3 coverage increased in Angola, Benin, Burkina Faso, Cameroon, the Congo, Ghana, Kenya, Liberia, Mali, Mozambique, the Niger, Senegal, Sierra Leone, Togo and Zambia.

[1] The 35 countries that implement IPTp nationally are Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, the Comoros, the Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia,

FIG. 7.5.

Percentage of pregnant women attending an ANC clinic at least once and receiving IPTp, by number of SP doses, sub-Saharan Africa, 2010–2021 *Sources: NMP reports, CDC estimates and WHO estimates.*



ANC: antenatal care; CDC: United States Centers for Disease Control and Prevention; IPTp: intermittent preventive treatment of malaria in pregnancy; IPTp1: first dose of IPTp; IPTp2: second dose of IPTp; IPTp3: third dose of IPTp; NMP: national malaria programme; SP: sulfadoxine-pyrimethamine; WHO: World Health Organization.

7.5 MALARIA DIAGNOSIS AND TREATMENT

This section presents information on manufacturer sales and deliveries and national distribution of RDTs and ACTs, treatment seeking for fever in children aged under 5 years, and population-level coverage of malaria diagnosis and treatment with ACTs. RDT data reflect sales by manufacturers eligible for procurement (i.e. under the Malaria RDT Product Testing Programme) from 2010 to 2017 and for WHO prequalification since 2018, and NMP distributions of RDTs. Manufacturer data on ACTs have been provided by eligible companies for WHO-prequalified products.

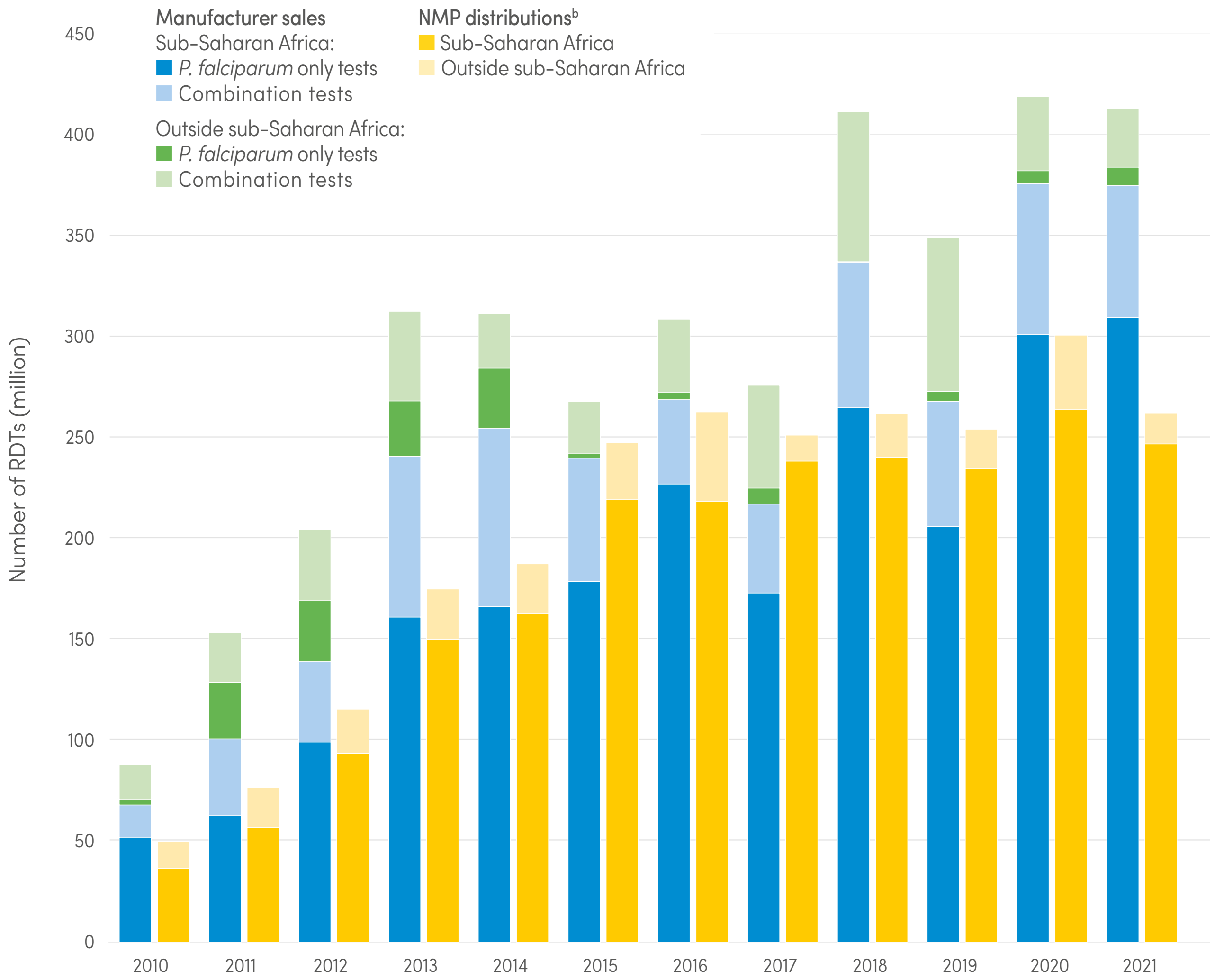
Globally, 3.5 billion RDTs for malaria were sold by manufacturers between 2010 and 2021, with more than 82% of sales being in sub-Saharan African countries. In the same period, NMPs distributed 2.4 billion RDTs, with 88% of these being in sub-Saharan Africa (**Fig. 7.6**). This difference may be due to the lack of reporting of RDTs that are yet to be distributed to health facilities or to inadequate reporting of RDT use from the private sector. In 2021, manufacturers reported about 413 million RDT sales. All 10 eligible manufacturers reported figures for 2021. NMPs distributed 262 million RDTs in 2021, about 39 million fewer than in 2020.

Madagascar, Malawi, Mali, Mauritania, Mozambique, the Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, South Sudan, Togo, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.

[2] The Comoros and Sao Tome and Principe are not included owing to their low malaria burden.

FIG. 7.6.

Number of RDTs sold by manufacturers and distributed by NMPs for use in testing suspected malaria cases, 2010–2021[a] *Sources: NMP reports and delivery data from eligible manufacturers.*



NMP: national malaria programme; *P. falciparum*: *Plasmodium falciparum*; RDT: rapid diagnostic test.

[a] NMP distributions do not reflect those RDTs still in storage that have yet to be delivered to health facilities and to community health workers.

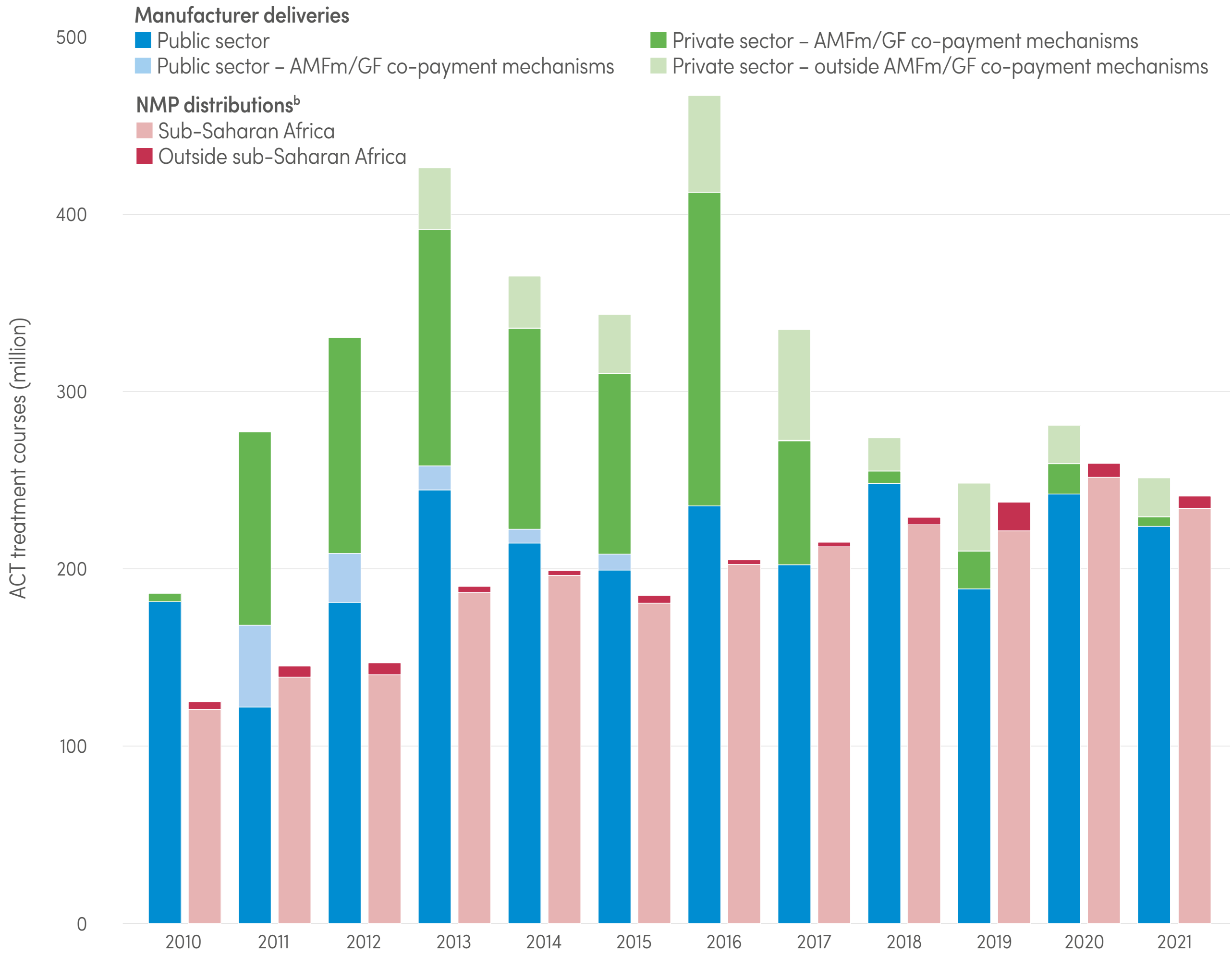
Almost 3.8 billion treatment courses of ACT were delivered globally by manufacturers between 2010 and 2021 (**Fig. 7.7**). About 2.6 billion of these deliveries were to the public sector in malaria endemic countries, and the rest were either public sector or private sector co-payments (or both), or were exclusively through the private retail sector. National data reported by NMPs show that, in the same period, 2.4 billion ACTs were delivered to health service providers to treat malaria patients in the public health sector. In 2021, some 225 million ACTs were delivered by manufacturers to the public health sector. NMPs distributed 242 million ACTs in 2021, of which 97% were in sub-Saharan Africa, where about 113 million ACTs were distributed in four countries: Nigeria (40.3 million), Uganda (31.7 million), Zambia (21.4 million) and the Democratic Republic of the Congo (19.3 million).

Aggregated data from household surveys conducted in sub-Saharan Africa between 2005 and 2021 were used to analyse coverage of treatment seeking, diagnosis and use of ACTs by children aged under 5 years (**Table 7.3**). Data were from 20 countries[1,2], that undertook at least two surveys in this period (baseline,

[1] The 20 countries were Angola (malaria indicator survey [MIS] 2011; demographic and health survey [DHS] 2015), Benin (DHS 2006; DHS 2017), Burkina Faso (DHS 2010; MIS 2017), Burundi (DHS 2010; DHS 2016), Cameroon (DHS 2011; DHS 2018), Ghana (DHS 2008; MIS 2019), Guinea (DHS 2005; MIS 2021), Kenya (DHS 2008; MIS 2020), Liberia (MIS 2011; DHS 2019), Madagascar (MIS 2011; DHS 2021), Malawi (DHS 2010; MIS 2017), Mali (DHS 2006; DHS 2018),

FIG. 7.7.

Number of ACT treatment courses delivered by manufacturers and distributed by NMPs to patients, 2010- 2021[a,b] *Sources: Companies eligible for procurement by WHO/UNICEF and NMP reports.*



ACT: artemisinin-based combination therapy; AMFm: Affordable Medicines Facility–malaria; GF: Global Fund to Fight AIDS, Tuberculosis and Malaria; NMP: national malaria programme; UNICEF: United Nations Children's Fund; WHO: World Health Organization.

[a] NMP deliveries to patients reflect consumption reported in the public health sector.

[b] AMFm/GF indicates that the AMFm operated from 2010 to 2013, with the GF co-payment mechanism operating from 2014.

2005–2011; and most recent, 2015–2021). Comparing the baseline and latest surveys, there was little change in the prevalence of fever within the 2 weeks preceding the survey (median 25% versus 20%) or in treatment seeking for fever (median 65% versus 67%). Comparing the source of treatment between the baseline and latest surveys, the proportion who received care from public health facilities increased from a median of 58% to 69%, and the proportion who received care from the private sector fell from a median of 40% to 28%. Use of community health workers was low in both periods, with medians of 2% and 1%, respectively.

The proportion of children aged under 5 years who received a diagnosis with a finger or heel prick increased from a median of 30% at baseline to 57% in the latest surveys. Use of ACTs among those who sought care also increased, from a median of 14% at baseline to 24% in the latest surveys. In the most recent surveys, among those who received a finger or heel prick, 29% were treated with ACTs, compared with 21% at baseline. ACT use among children for whom care was sought and who were prescribed antimalarial medicine increased to 55% in the recent period, compared with 39% in the baseline period.

Mozambique (DHS 2011; MIS 2018), Nigeria (MIS 2010; DHS 2018), Rwanda (DHS 2010; DHS 2019), Senegal (DHS 2010; DHS 2019), Sierra Leone (DHS 2008; DHS 2019), Uganda (DHS 2011; MIS 2018), the United Republic of Tanzania (DHS 2010; MIS 2017) and Zambia (DHS 2007; DHS 2018).

[2] Although surveys were available from Zimbabwe, data were not included owing to low case numbers. In addition, Ethiopia could not be included here because the interim mini-survey conducted in 2019 did not include questions on care seeking behaviour or fever.

TABLE 7.3.
Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years, from household surveys in sub-Saharan Africa, at baseline (2005–2011) and most recently (2015–2021) *Source: household surveys.*

Children aged under 5 years	Baseline (2005–2011)			Most recent surveys (2015–2021)		
Indicator	**Median estimate**	**Lower bound**	**Upper bound**	**Median estimate**	**Lower bound**	**Upper bound**
Prevalence of fever						
With fever in past 2 weeks	25.0%	19.7%	34.4%	19.9%	16.1%	26.1%
Treatment seeking for fever						
With fever in past 2 weeks for whom treatment was sought	64.8%	58.8%	72.2%	66.5%	57.2%	74.2%
Source of treatment for fever among those who were treated						
Public sector (health facility)	58.0%	48.0%	78.5%	68.8%	46.3%	83.3%
Public sector (community health worker)	2.0%	0.7%	3.4%	1.1%	0.3%	5.0%
Private sector (formal and informal)	39.8%	21.4%	51.0%	27.5%	16.7%	55.0%
Diagnosis among those with fever and for whom care was sought						
Received a finger or heel prick	29.8%	12.2%	38.4%	56.5%	37.8%	64.7%
Use of ACTs among those for whom care was sought						
Received treatment with ACTs	14.3%	7.5%	32.2%	23.9%	11.1%	43.6%
Use of ACTs among those for whom care was sought and received a finger or heel prick						
Received ACTs	20.6%	16.3%	41.7%	28.8%	18.8%	53.2%
Use of ACTs among those for whom care was sought and were treated with an antimalarial						
Received ACTs	38.9%	23.6%	68.2%	55.1%	35.5%	88.5%

ACT: artemisinin-based combination therapy.

Data from the most recent household surveys, conducted between 2015 and 2021, were used to analyse coverage of treatment seeking, diagnosis and use of ACTs by children aged under 5 years, by country (**Table 7.4**). The percentage of children with fever for whom care was sought ranged from 45.4% in Madagascar to 86.9% in Uganda. The percentage of those with fever for whom care was sought and who received a diagnosis ranged from 17.4% in Nigeria to 83.8% in Burundi. Among those for whom care was sought, the percentage who received ACTs ranged from 1.6% in Senegal to 61.8% in Uganda. The proportion receiving ACTs among those for whom care was sought and who received a finger or heel prick ranged from 2.9% in Senegal to 64.9% in Uganda. The percentage of antimalarial medicines prescribed that were ACTs ranged from 12% in Burundi to about 97% in Malawi and Zambia.

TABLE 7.4.

Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years from the most recent household survey for countries in sub-Saharan Africa *Source: household surveys.*

Country	Latest survey	Treatment seeking for fever	Diagnosis among those with fever and for whom care was sought	Use of ACTs among those for whom care was sought	Use of ACTs among those for whom care was sought and who received a finger or heel prick	Use of ACTs among those for whom care was sought and were treated with an antimalarial
		Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)	Median (lower bound–upper bound)
Angola	DHS 2015	55.1 (51.8–58.4)	58.2 (53.9–62.4)	20.8 (17.4–24.7)	27 (22.1–32.4)	75.7 (69.1–81.3)
Benin	DHS 2017	53.9 (50.7–57.0)	29.3 (26.4–32.4)	10.9 (9.1–12.9)	18.7 (14.7–23.4)	38.3 (32.8–44.0)
Burkina Faso	MIS 2017	73.8 (69.8–77.6)	64.7 (59.9–69.2)	54.0 (49.7–58.2)	60.1 (55.2–64.9)	79.9 (75.8–83.5)
Burundi	DHS 2016	69.7 (67.8–71.6)	83.8 (82.1–85.3)	7.6 (6.3–9.1)	8.3 (6.9–10.0)	11.6 (9.7–13.8)
Cameroon	DHS 2018	63.0 (58.7–67.1)	31.0 (26.6–35.9)	10.6 (8.3–13.5)	17.1 (11.5–24.7)	22.4 (17.6–28.2)
Ghana	MIS 2019	69.5 (64.9–73.8)	47.9 (42.8–53.0)	51.4 (45.9–56.9)	58.7 (51.4–65.6)	86.8 (81.2–90.9)
Guinea	MIS 2021	62.2 (57.3–66.9)	43.1 (38.0–48.3)	25.2 (21.3–29.6)	36.6 (29.6–44.2)	53.1 (46.5–59.6)
Kenya	MIS 2020	63.8 (57.6–69.7)	48.8 (41.1–56.6)	–	–	–
Liberia	DHS 2019	81.4 (78.0–84.4)	58.0 (53.3–62.6)	26.1 (22.6–29.9)	30.5 (26.3–35.2)	43.1 (37.4–49.1)
Madagascar	DHS 2021	45.4 (41.8–49.1)	40.0 (35.8–44.4)	15.0 (12.0–18.6)	26.9 (20.9–33.8)	55.1 (46.9–63.0)
Malawi	MIS 2017	54.1 (49.0–59.2)	64.8 (58.2–70.8)	49.0 (42.4–55.7)	61.0 (53.7–67.9)	97.4 (94.2–98.9)
Mali	DHS 2018	57.8 (53.8–61.8)	24.2 (20.2–28.7)	11.2 (8.6–14.6)	24.4 (17.8–32.4)	32.8 (25.9–40.5)
Mozambique	MIS 2018	69.1 (63.5–74.2)	68.3 (63.2–73.1)	46.2 (40.4–52.0)	57.9 (50.2–65.2)	98.4 (96.6–99.3)
Nigeria	DHS 2018	73.8 (72.1–75.4)	17.4 (16.0–19.0)	27.3 (25.6–29.1)	42.0 (37.9–46.2)	51.3 (48.8–53.9)
Rwanda	DHS 2019	62.9 (60.0–65.7)	60.9 (57.2–64.6)	12.2 (9.5–15.7)	18.9 (14.8–23.8)	92.3 (84.7–96.3)
Senegal	DHS 2019	50.3 (45.1–55.5)	27.7 (22.5–33.7)	1.6 (0.6–4.0)	2.9 (1.1–7.3)	43.0 (18.9–70.8)
Sierra Leone	DHS 2019	75.5 (72.7–78.1)	71.9 (68.2–75.3)	22.5 (19.2–26.2)	22.9 (19.2–27)	31.7 (27.4–36.4)
Uganda	MIS 2018	86.9 (84.7–88.8)	58.0 (53.8–62.2)	61.8 (56.9–66.5)	64.9 (59.0–70.3)	87.9 (83.9–91.0)
United Republic of Tanzania	MIS 2017	75.4 (72.2–78.3)	55.0 (50.4–59.5)	36.8 (31.3–42.6)	43.7 (36.6–51.1)	89.0 (82.7–93.2)
Zambia	DHS 2018	77.2 (74.2–79.9)	76.9 (72.5–80.7)	42.7 (38.2–47.4)	51.7 (46.8–56.5)	96.9 (94.8–98.2)

ACT: artemisinin-based combination therapy; DHS: demographic and health survey; MIS: malaria indicator survey.

8 GLOBAL PROGRESS TOWARDS THE GTS MILESTONES

The GTS calls for a reduction in malaria case incidence and mortality rates (compared with a 2015 baseline) of at least 40% by 2020, 75% by 2025 and 90% by 2030 (*2*). The updated estimates for 2020 and 2021 include the effect of disruptions of malaria services during the pandemic. The malaria mortality estimates were based on a new method introduced in 2021 for quantifying the malaria CoD fraction (**Annex 1, Table 3.1**). Projections for beyond 2021 if current malaria trends are sustained were informed by the trends observed between 2012 and 2021.

Trends in estimated malaria cases and deaths were used to make annual projections from 2022 to 2030, to track progress towards the future GTS milestones and targets for 2025 and 2030, as mandated to WHO by the World Health Assembly (*2*). The data and projections presented here have been adjusted for potential disruptions during the COVID-19 pandemic, which – despite commendable global and national efforts to maintain essential malaria services – led to higher malaria morbidity and mortality in 2020 and 2021 (**Section 3.1**).

8.1 GLOBAL PROGRESS

In 2021, the GTS 2020 targets for morbidity and mortality, based on the 2015 baseline, were not achieved globally, despite the considerable progress made since 2000 (**Fig. 8.1**). The GTS and SDG 2025 and 2030 targets for malaria morbidity and mortality will also not be met unless urgent actions are taken (**Fig. 8.1**). A malaria case incidence of 59.2 cases per 1000 population at risk in 2021 (instead of the expected 31 cases per 1000) means that, globally, we are now off track by 48% (i.e. the GTS target is 48% lower than the current case incidence); at the current trajectory, by 2030 the world could be off track by 89% (**Fig. 8.1a**). Malaria deaths per 100 000 population at risk decreased from 15 in 2015 to 14.8 in 2021. Globally, the world is off track by 48% (**Fig. 8.1b**); if this trajectory continues, by 2030 it will be off track by 88%.

Fig. 8.2 and **Fig. 8.3** present progress in all countries considered to be malaria endemic in 2015. Countries were ranked into eight categories to assess progress towards malaria case incidence and the mortality rate milestone in 2020 from the 2015 baseline:

- on track (zero malaria cases);
- on track (decrease by 40% or more);
- decrease by between 25% and less than 40%;
- decrease by less than 25%;
- no increase or decrease since 2015 (less than 5% increase or decrease in case incidence or mortality rate);
- increase by less than 25%;
- increase by between 25% and less than 40%; and
- increase by 40% or more.

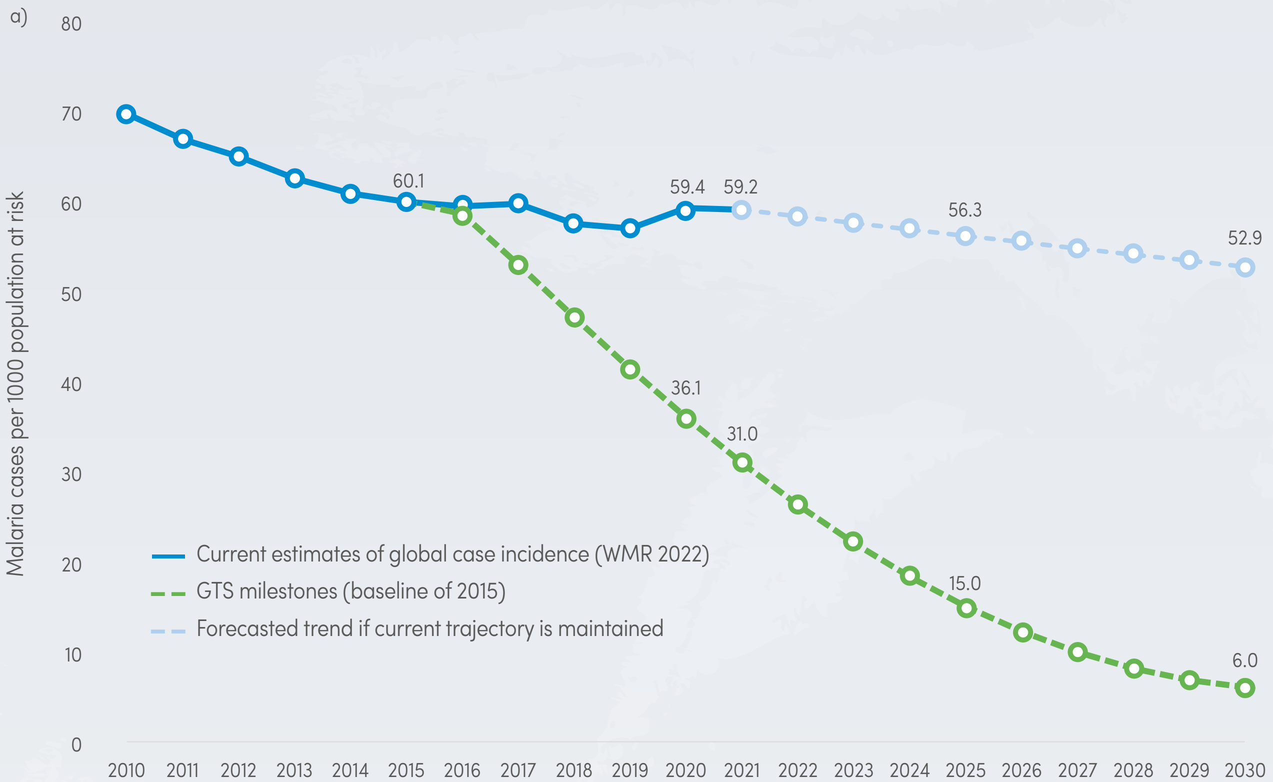
Of the 93 countries that were malaria endemic (including the territory of French Guiana) in 2015, four countries have been certified malaria free since 2015; Algeria, China, El Salvador and Sri Lanka. Thirty-nine countries (42.0%) met the GTS morbidity milestone for 2021, having achieved a reduction of 40% or more in case incidence or reported zero malaria cases. One fifth (19 countries; 20.4%) had made progress in reducing malaria case incidence by less than the expected target. Twenty-seven countries (29.0%) had experienced increased case incidence, with 14 countries (15.0%) experiencing an increase of 40% or more in 2021 compared with 2015. In eight countries (8.6%), malaria case incidence in 2021 was similar to that of 2015.

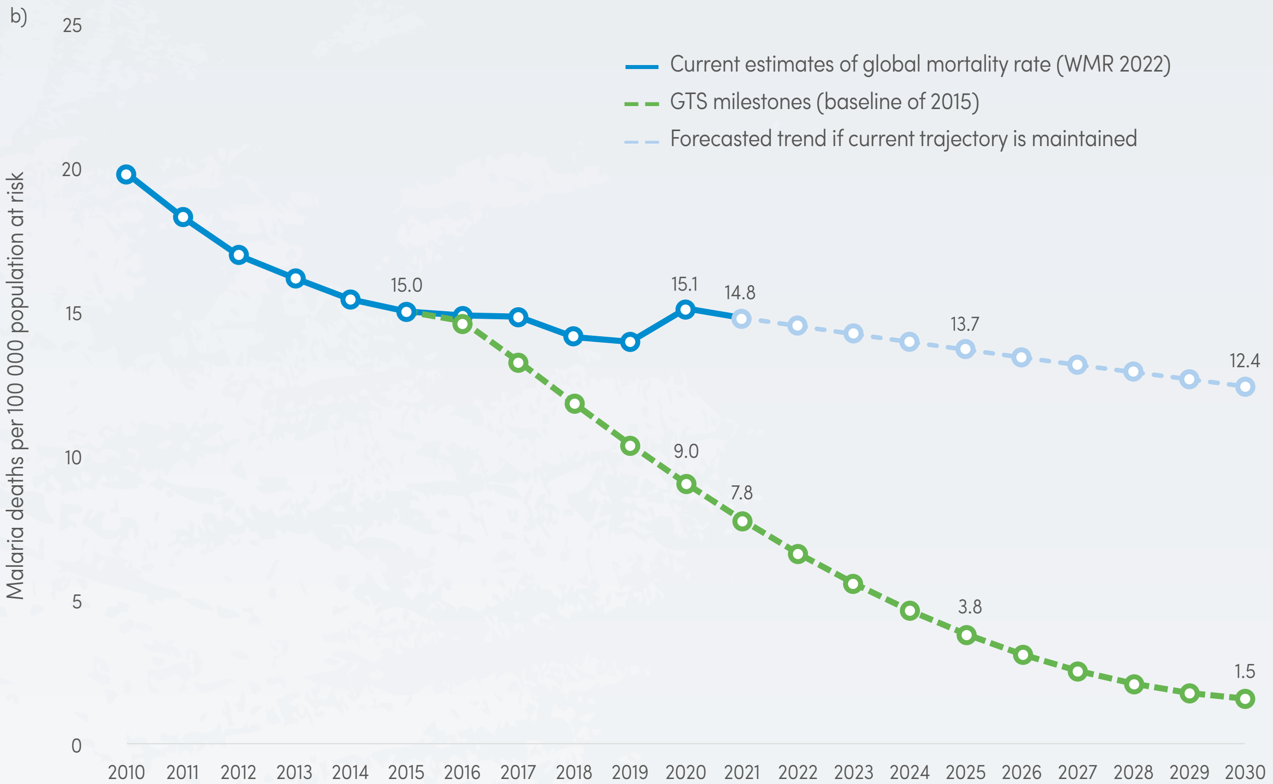
Forty-three countries (46.2%) that were malaria endemic in 2015 met the GTS mortality milestone for

2021, with 28 of them reporting zero malaria deaths. An additional 22 countries (23.7%) achieved reductions in the mortality rate, but progress was below the 40% target. In nine countries, malaria mortality rates remained at the same level in 2021 as in 2015 (9.7%), whereas rates increased in 19 countries (20.4%), among which 11 countries had increases of 40% or more.

FIG. 8.1.

Comparison of global progress in malaria a) case incidence and b) mortality rate, considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) *Source: WHO estimates.*

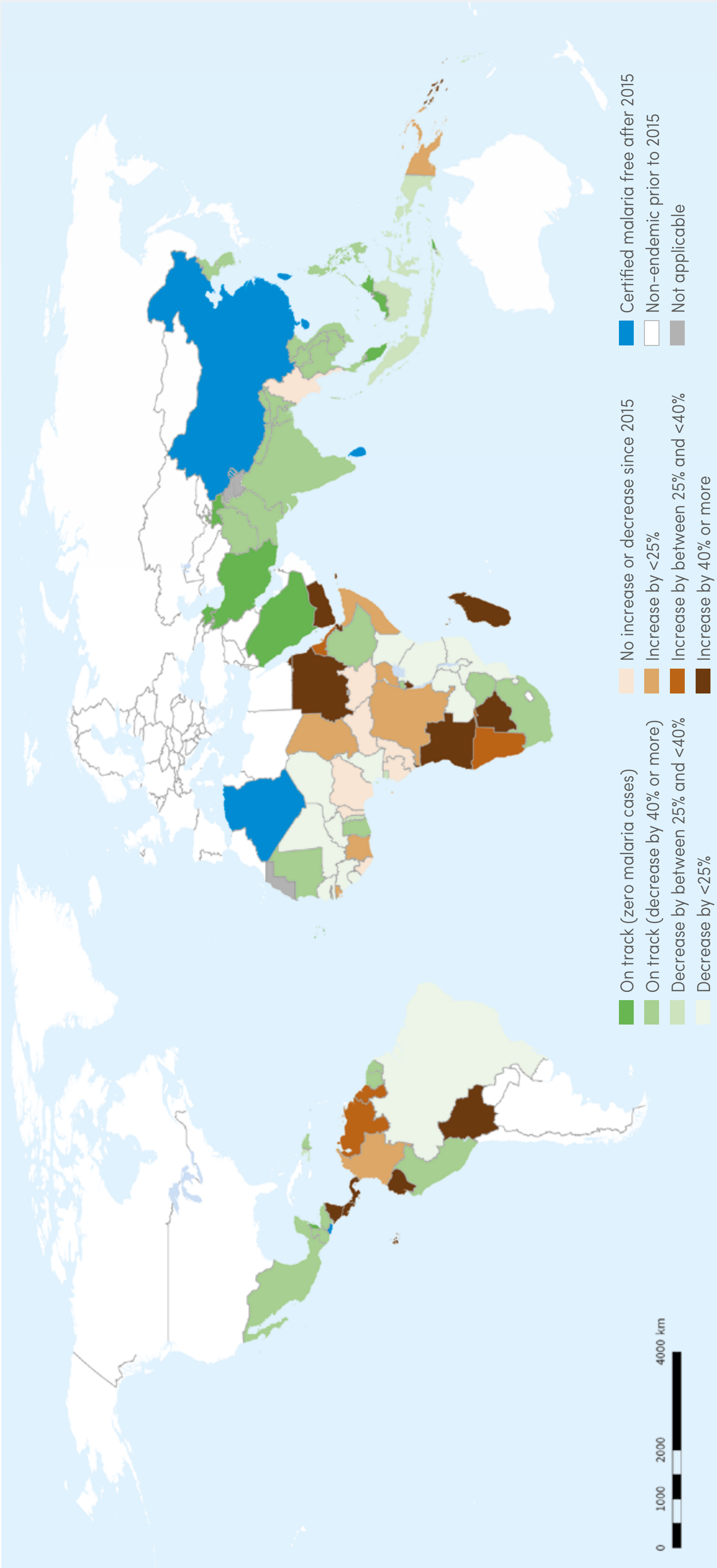




GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

FIG. 8.2.

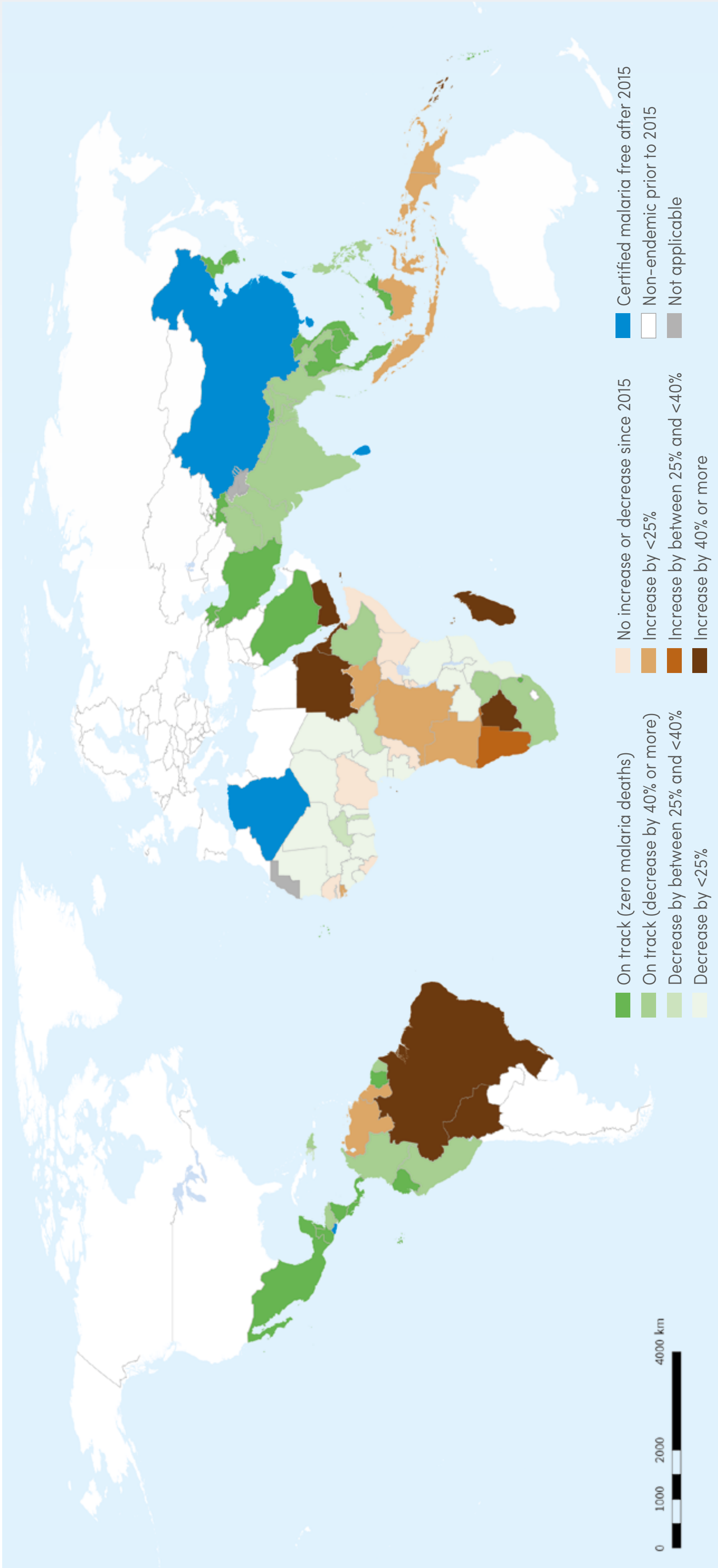
Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2020 malaria case incidence milestone of at least 40% reduction from a 2015 baseline *Source: WHO estimates.*



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization.

FIG. 8.3.

Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2020 malaria mortality rate milestone of at least 40% reduction from a 2015 baseline *Source: WHO estimates.*



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization.

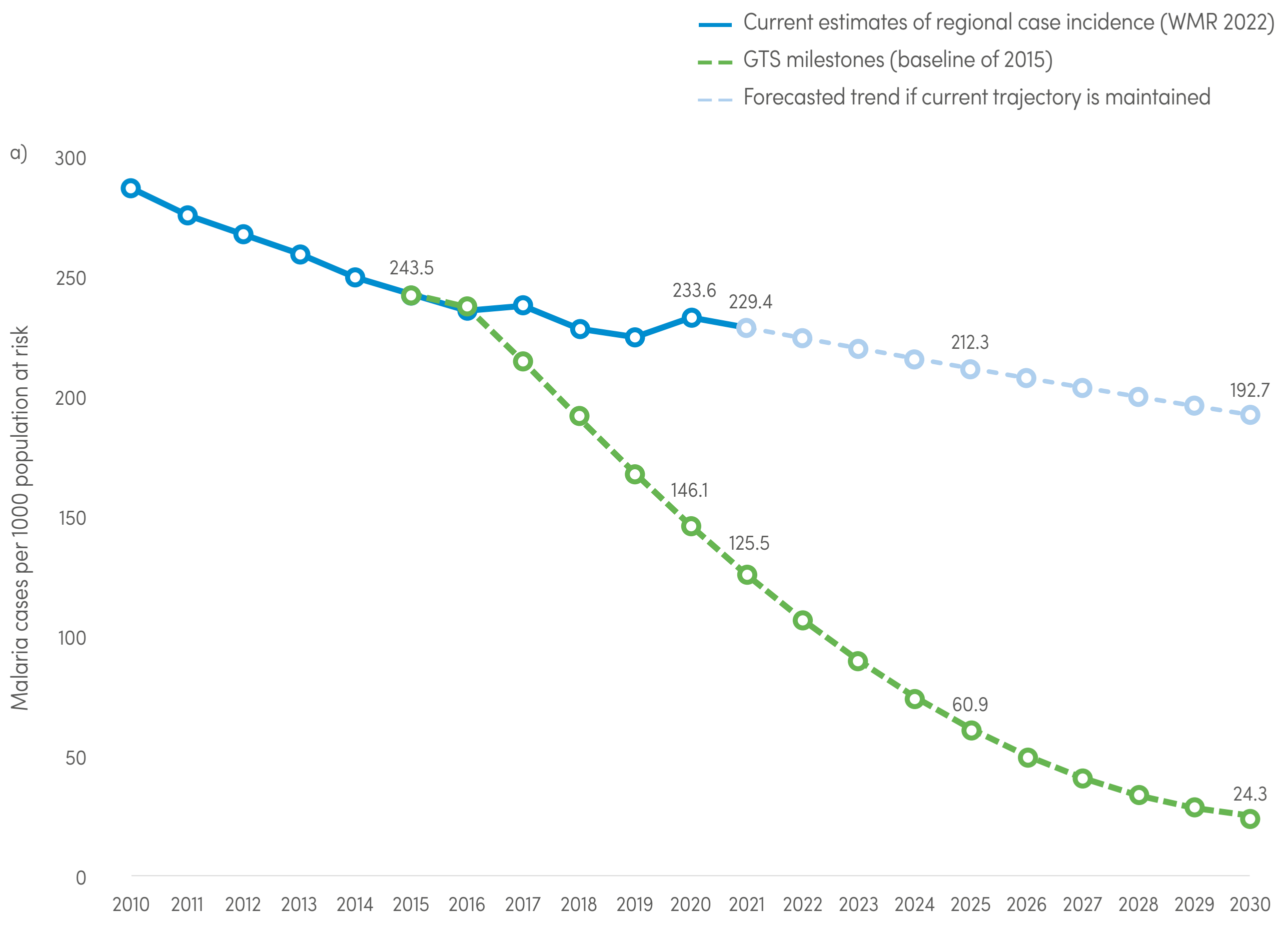
8.2 WHO AFRICAN REGION

Analysis of the trends by region shows that, in 2021, the WHO African Region was off track for both the malaria morbidity and mortality GTS milestones, by 45% and 47%, respectively (**Fig. 8.4**). In 2020, only Cabo Verde, Ethiopia, the Gambia, Ghana and Mauritania met the GTS 2020 target, and in 2021, in addition to those countries, Rwanda, South Africa and Zimbabwe were now on track to meet the GTS 2025 target, with at least a 40% reduction in malaria case incidence. Algeria has already been certified malaria free.

Although not on track, 15 countries (Burkina Faso, Cameroon, Equatorial Guinea, Eswatini, Guinea, Kenya, Malawi, Mali, Mozambique, the Niger, Senegal, Sierra Leone, Togo, the United Republic of Tanzania and Zambia) achieved reductions in malaria case incidence by 2021 compared with 2015 (**Fig. 8.2**). There was no difference (<5% increase or decrease) in case incidence in 2021 compared with 2015 in seven countries (Benin, the Central African Republic, the Congo, Gabon, Liberia, Nigeria and South Sudan). Case incidence was higher in 2021 than in 2015 by less than 25% in Chad, Côte d'Ivoire, the Democratic Republic of the

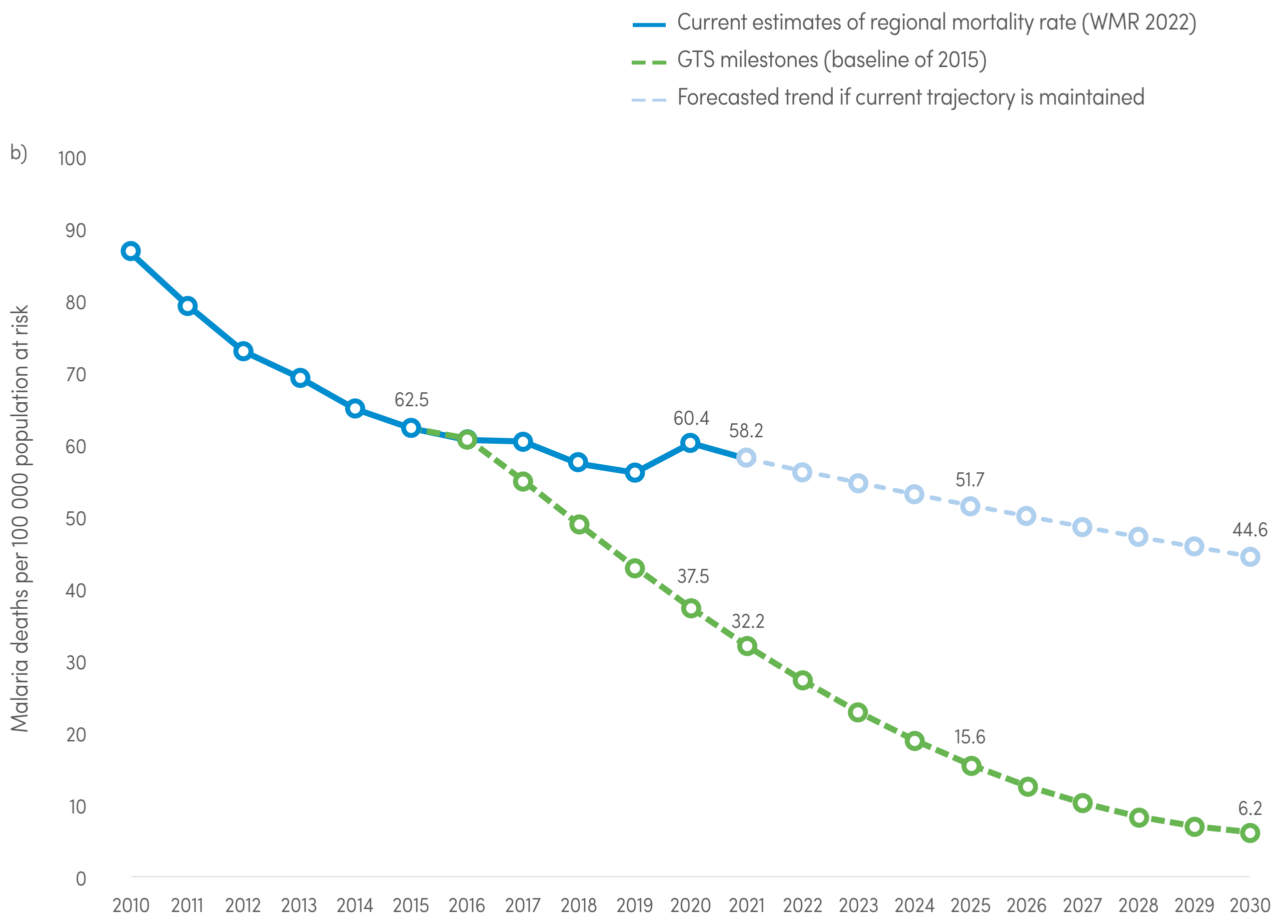
FIG. 8.4.

Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO African Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)
Source: WHO estimates.



Congo, Guinea-Bissau, Sao Tome and Principe and Uganda; increased by 25–40% in Eritrea and Namibia; and increased by 40% or more in Angola, Botswana, Burundi, the Comoros and Madagascar.

Cabo Verde and Eswatini had zero estimated malaria deaths in 2021 (**Fig. 8.3**), and Ethiopia, South Africa and Zimbabwe achieved a reduction in mortality rate of 40% or more. Although 20 countries did not meet the GTS 2021 mortality milestones (Benin, Burkina Faso, Cameroon, the Central African Republic, Chad, Côte d'Ivoire, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Malawi, Mali, Mauritania, Mozambique, the Niger, Sierra Leone, Togo, the United Republic of Tanzania and Zambia), these countries did achieve mortality rate reductions of less than 40%. Eight countries (Burundi, the Congo, Kenya, Liberia, Nigeria, Rwanda, Senegal and Uganda) showed no change (<5% decrease or increase) in mortality rate in 2021 compared with 2015, whereas increases in mortality rate of between 5% and 25% were seen in four countries (Angola, the Democratic Republic of the Congo, Guinea-Bissau and South Sudan); increases of between 25% and 40% were seen in Namibia; and increases of 40% or more were reported in Botswana, the Comoros, Eritrea, Madagascar and Sao Tome and Principe.



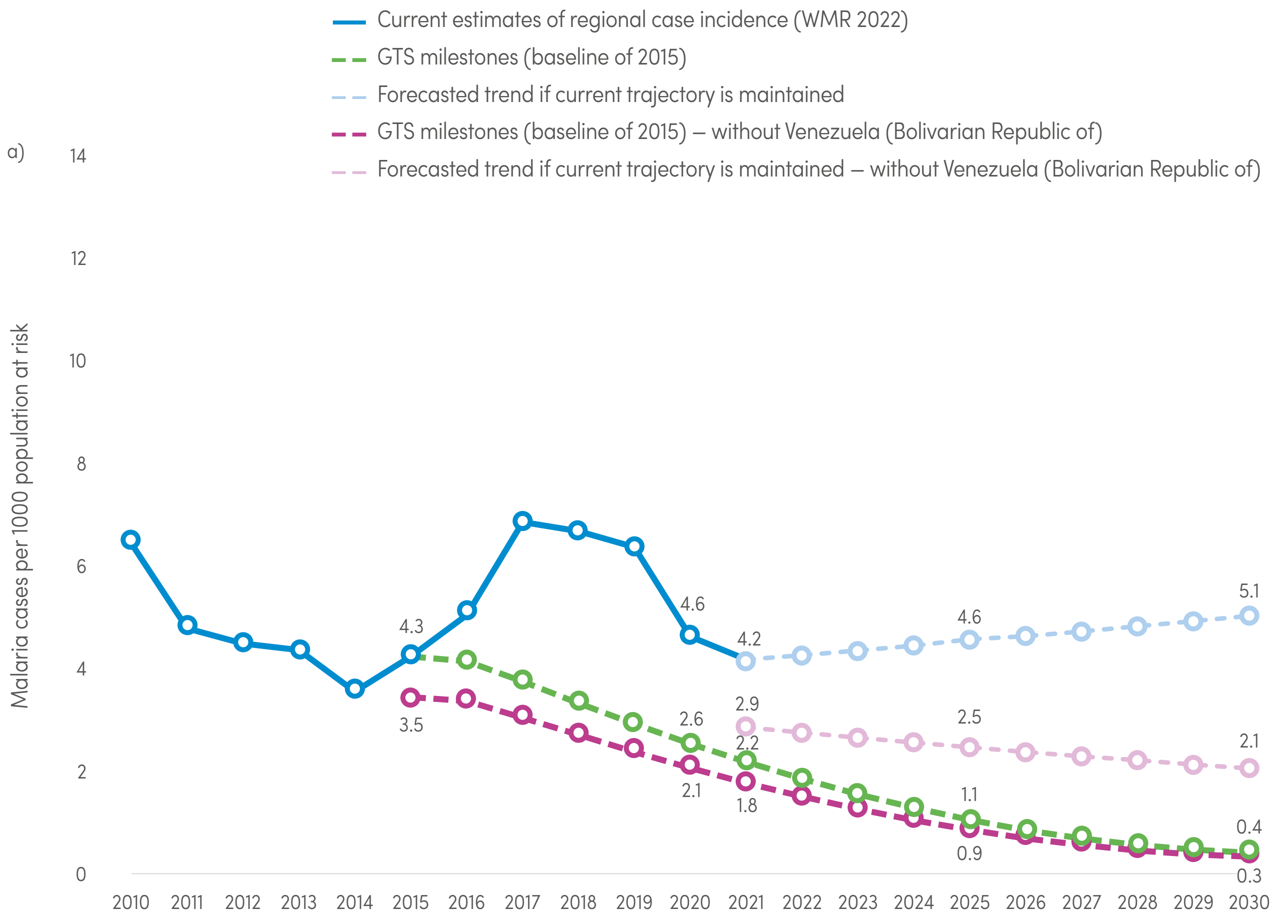
GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

8.3 WHO REGION OF THE AMERICAS

In the WHO Region of the Americas, El Salvador was certified malaria free in 2021 and Belize reported zero malaria cases for the third consecutive year in 2021. The Dominican Republic, French Guiana, Guatemala, Honduras, Mexico, Peru and Suriname all had a reduction of at least 40% in case incidence in 2021 compared with 2015 (**Fig. 8.5**). Over the same period, Haiti was estimated to have reduced malaria case incidence by less than 40% and Brazil by less than 25%. In Colombia, the estimated increase in case incidence was less than 25%, and in the Bolivarian Republic of Venezuela and Guyana, estimated increases were between 25% and 40%. In Costa Rica, Ecuador, Nicaragua, Panama and the Plurinational State of Bolivia, case incidence increased by 40% or more in 2021 compared with 2015. Analysis of progress towards the GTS malaria case incidence milestones in the WHO Region of the Americas shows that the region is currently off track by 48%. On the current trajectory, by 2030 there would be an increase in case incidence of 20%. At the regional level, most of the worsening of the trend is attributable to the epidemic in the Bolivarian Republic of Venezuela. When the estimated cases from the Bolivarian Republic of Venezuela are excluded from the analysis the trend is reversed, resulting in a decline in case incidence of 28% (**Fig. 8.5a**).

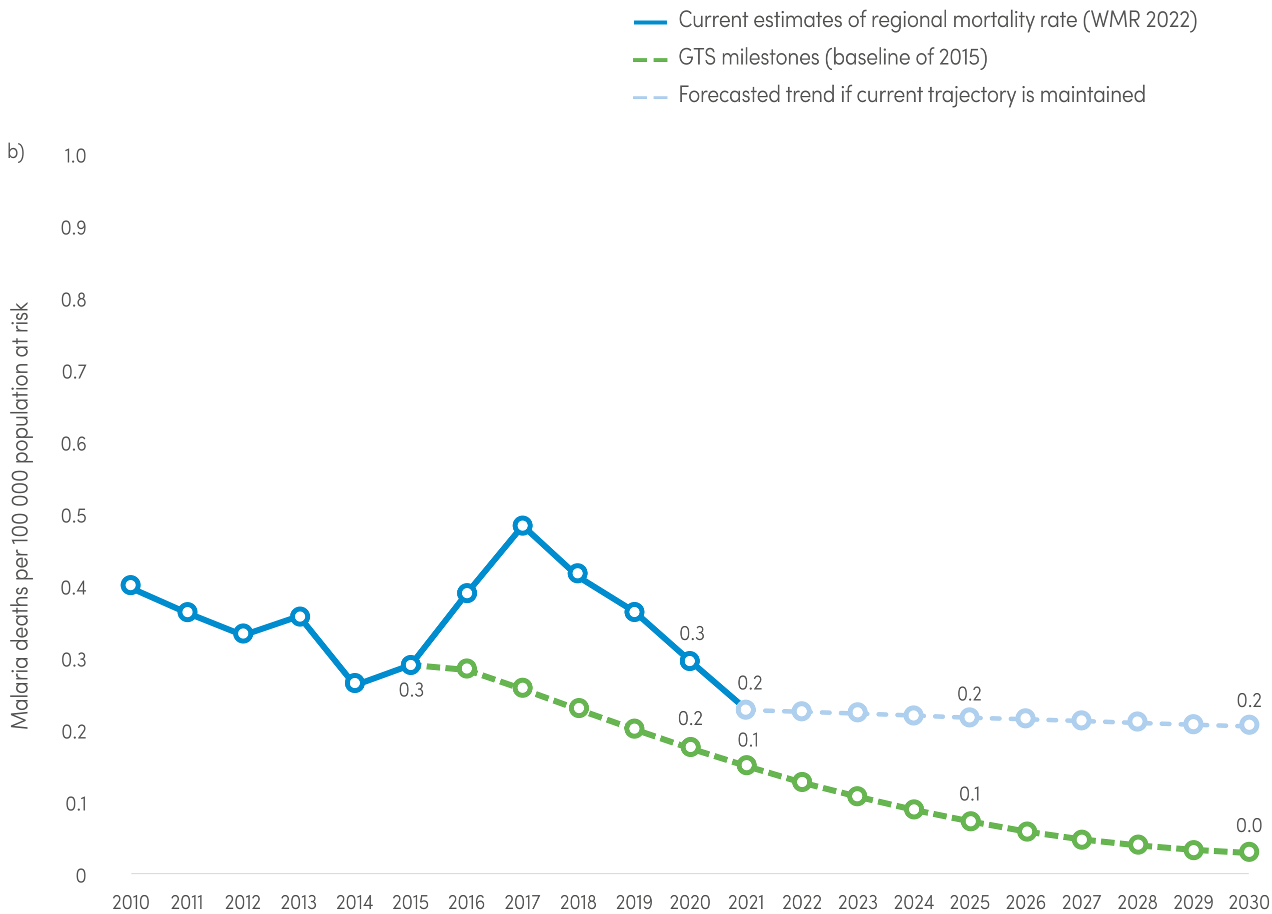
FIG. 8.5.

Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Region of the Americas considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) *Source: WHO estimates.*



The number of cases in the Bolivarian Republic of Venezuela more than halved in 2020 and reduced further in 2021. Control measures must be strengthened in high-risk and migrant and mobile populations in the WHO Region of the Americas. To get the region back on track, the increasing trend in case incidence observed in several countries needs to be reversed.

There were few malaria deaths in the WHO Region of the Americas (**Fig. 8.5b**), and changes in 2021 relative to the GTS 2015 baseline should be interpreted with caution. For example, although the mortality rate in Brazil and the Plurinational State of Bolivia increased by 40% or more (**Fig. 8.3**), it is estimated that the actual number of deaths would be 58 and 5, respectively. An estimated additional 183 deaths were from the Bolivarian Republic of Venezuela and Guyana, where there were increases of 5–25% in the mortality rate. Nevertheless, the region is currently off track for achieving all current and future GTS mortality rate milestones, with no change in trend projected between 2021 and 2030.



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

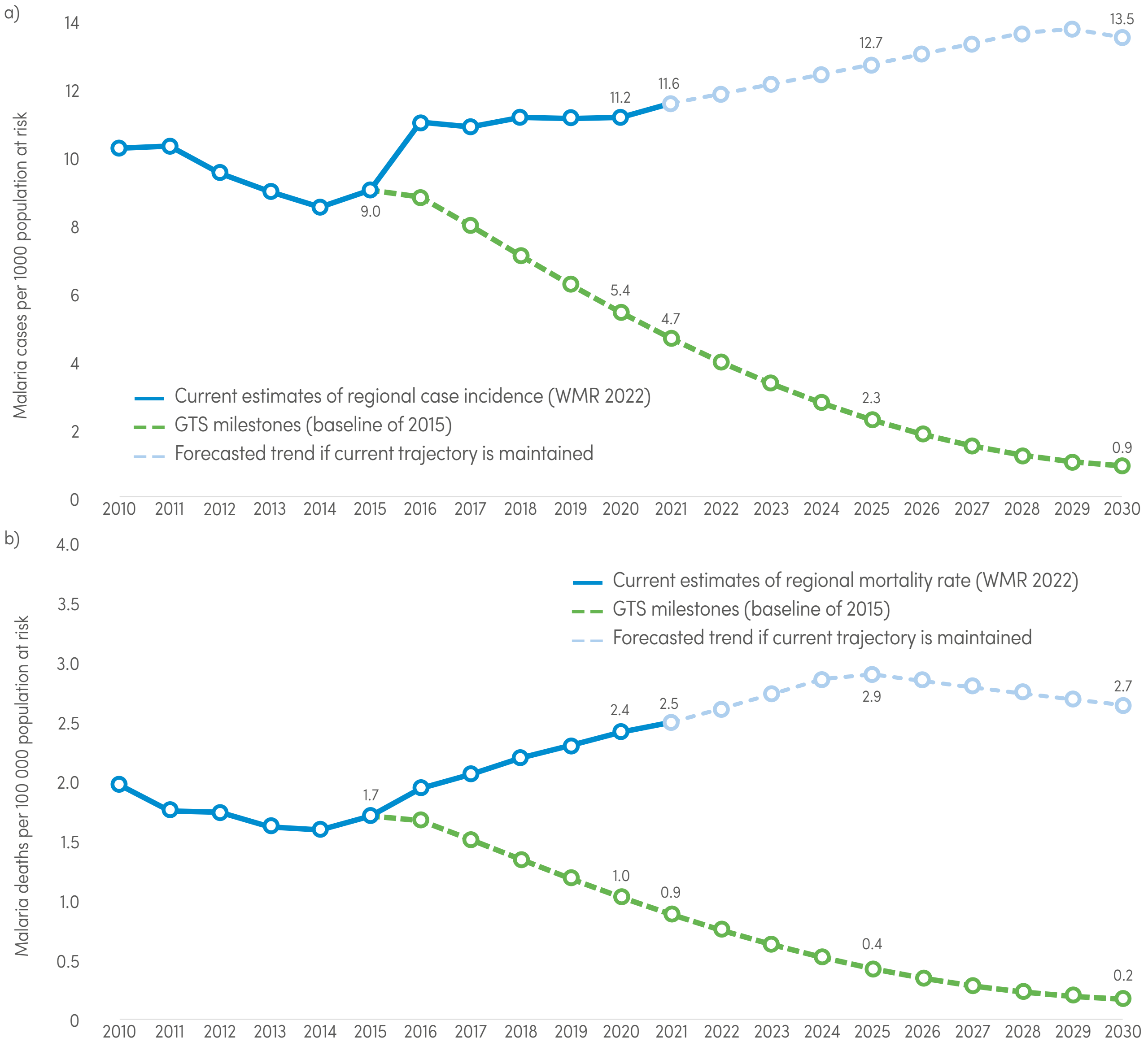
8.4 WHO EASTERN MEDITERRANEAN REGION

Since 2015, there has been an increase in case incidence and mortality rates in the WHO Eastern Mediterranean Region, and these rates are now off track by 60% and 65%, respectively (**Fig. 8.6**). The Islamic Republic of Iran reported no indigenous malaria cases for the fourth consecutive year in 2021, and Saudi Arabia reported zero indigenous malaria cases for the first time. It is estimated that Afghanistan and Pakistan reduced case incidence by 40% or more in 2021 compared with 2015, although these estimates need to be verified through ongoing subnational analysis.

Djibouti, the Sudan and Yemen were off track, with malaria case incidence higher by 40% or more. Case incidence also increased in Somalia but by less than 25% (**Fig. 8.2**). Malaria mortality rates decreased by 40% or more in Afghanistan and Pakistan in 2021 compared with 2015. There was no increase or decrease in Somalia, but deaths increased by 40% or more in Djibouti, the Sudan and Yemen. Zero malaria deaths have been reported in Saudi Arabia since 2000 and zero malaria deaths have been reported in the Islamic Republic of Iran since 2018. In 2021, Afghanistan and Pakistan both reported zero malaria deaths (see **Section 3.4** for issues related to data uncertainty in this region).

FIG. 8.6.

Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Eastern Mediterranean Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green) *Source: WHO estimates.*



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

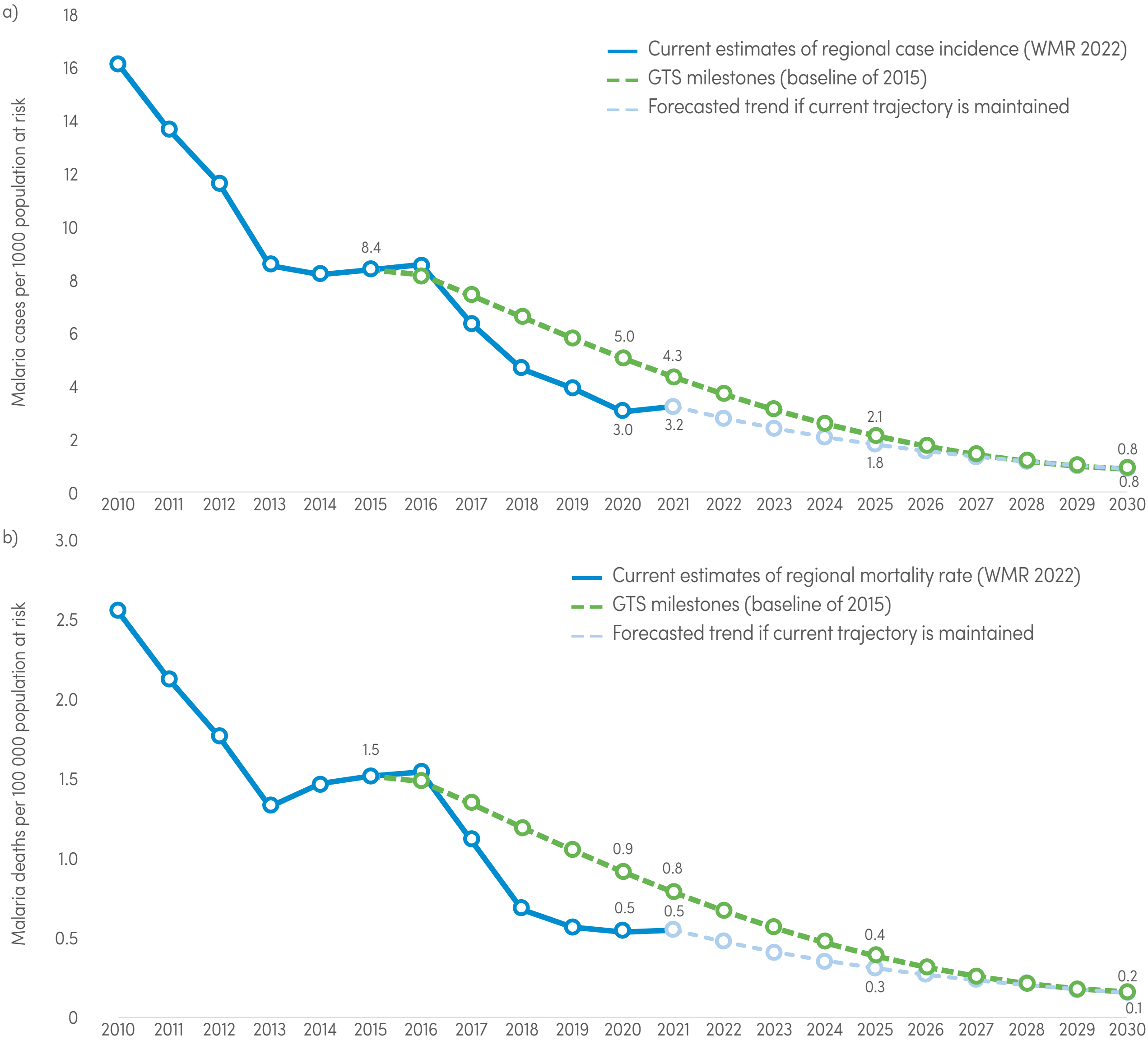
8.5 WHO SOUTH-EAST ASIA REGION

The WHO South-East Asia Region met the GTS 2020 milestones for both mortality and morbidity (**Fig. 8.7**) and remains on track to meet the GTS 2025 and 2030 targets. Sri Lanka was certified malaria free in 2016 and remains malaria free. Seven of the nine endemic countries in the region – Bangladesh, Bhutan, the Democratic People's Republic of Korea, India, Nepal, Thailand and Timor-Leste – reduced malaria case incidence by more than 40% in 2021 compared with 2015, with Timor-Leste reporting zero malaria cases in 2021. Indonesia reduced malaria case incidence by less than 40%, and in Myanmar there was no increase or decrease over the same period. For the first time since 2012, Myanmar had an increase in case incidence (by 2.5%) in 2021 compared with 2020 (**Fig. 8.2**).

Zero malaria deaths were reported in Bhutan, the Democratic People's Republic of Korea, Thailand and Timor-Leste. All other countries in the region had reductions in mortality rate of 40% or more except for Indonesia, where the reduction was less than 25% (**Fig. 8.3**).

FIG. 8.7.

Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO South-East Asia Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)
Source: WHO estimates.



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

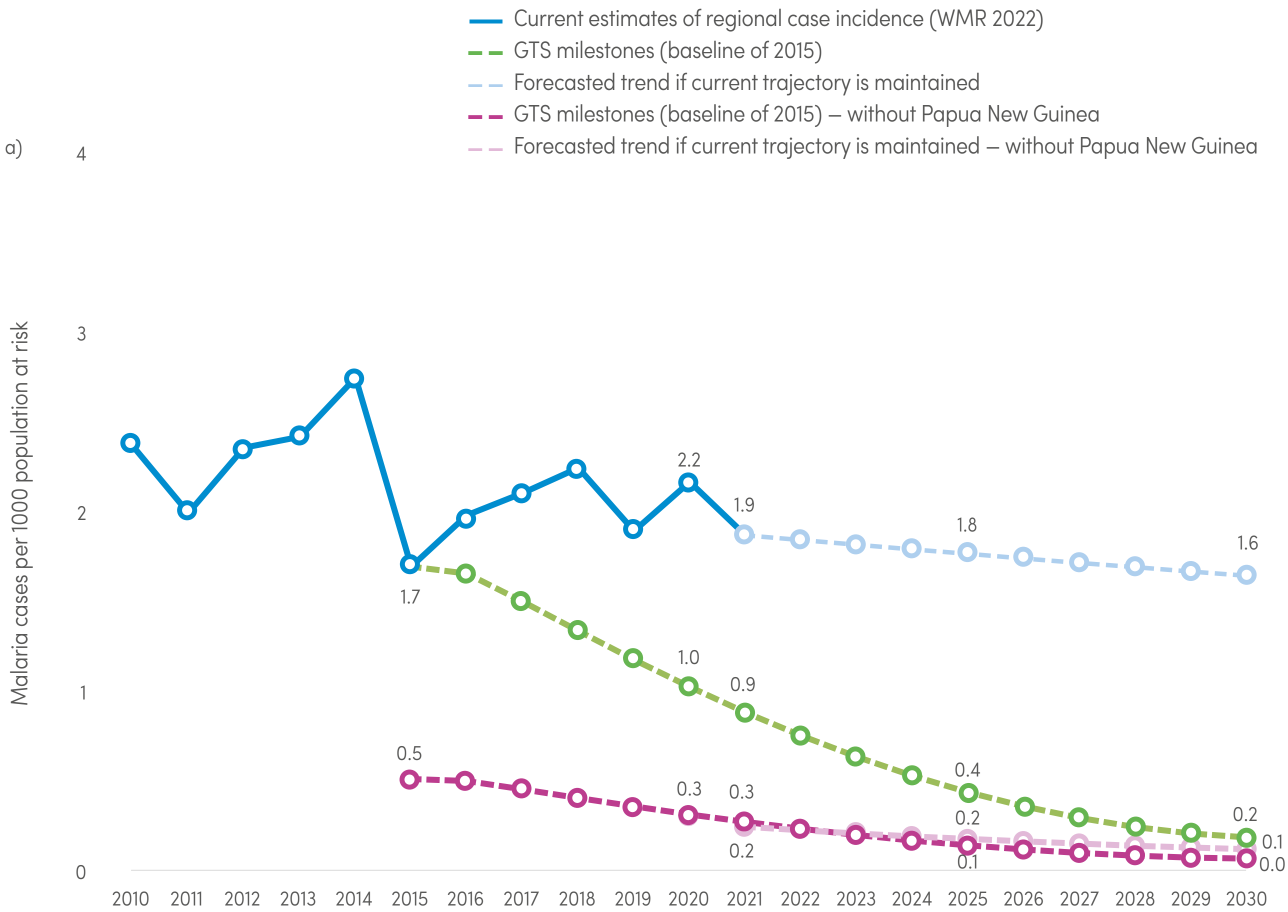
8.6 WHO WESTERN PACIFIC REGION

The WHO Western Pacific Region did not achieve the GTS 2020 milestones for malaria morbidity or mortality, and in 2021 case incidence and the mortality rate were off target by 53% and 51%, respectively (**Fig. 8.8**). Between 2015 and 2021, case incidence increased by 10% and the mortality rate by 4%. At the current trajectory, the burden and mortality rate are predicted to reduce by 12% and 24%, respectively, by 2030 (**Fig. 8.8b**).

The lack of reduction in malaria case incidence and mortality rates is mainly due to an increase of between 5% and 25% in cases and deaths in Papua New Guinea, which accounts for about 87% of the burden of malaria in the region. If cases from Papua New Guinea are excluded from the analysis, then it is estimated that by 2030 the GTS case incidence milestone will be off track by 52%, whereas it will be off track by 90% if cases from Papua New Guinea are included in the projections (**Fig. 8.8a**). Increases of 40% or more in case incidence

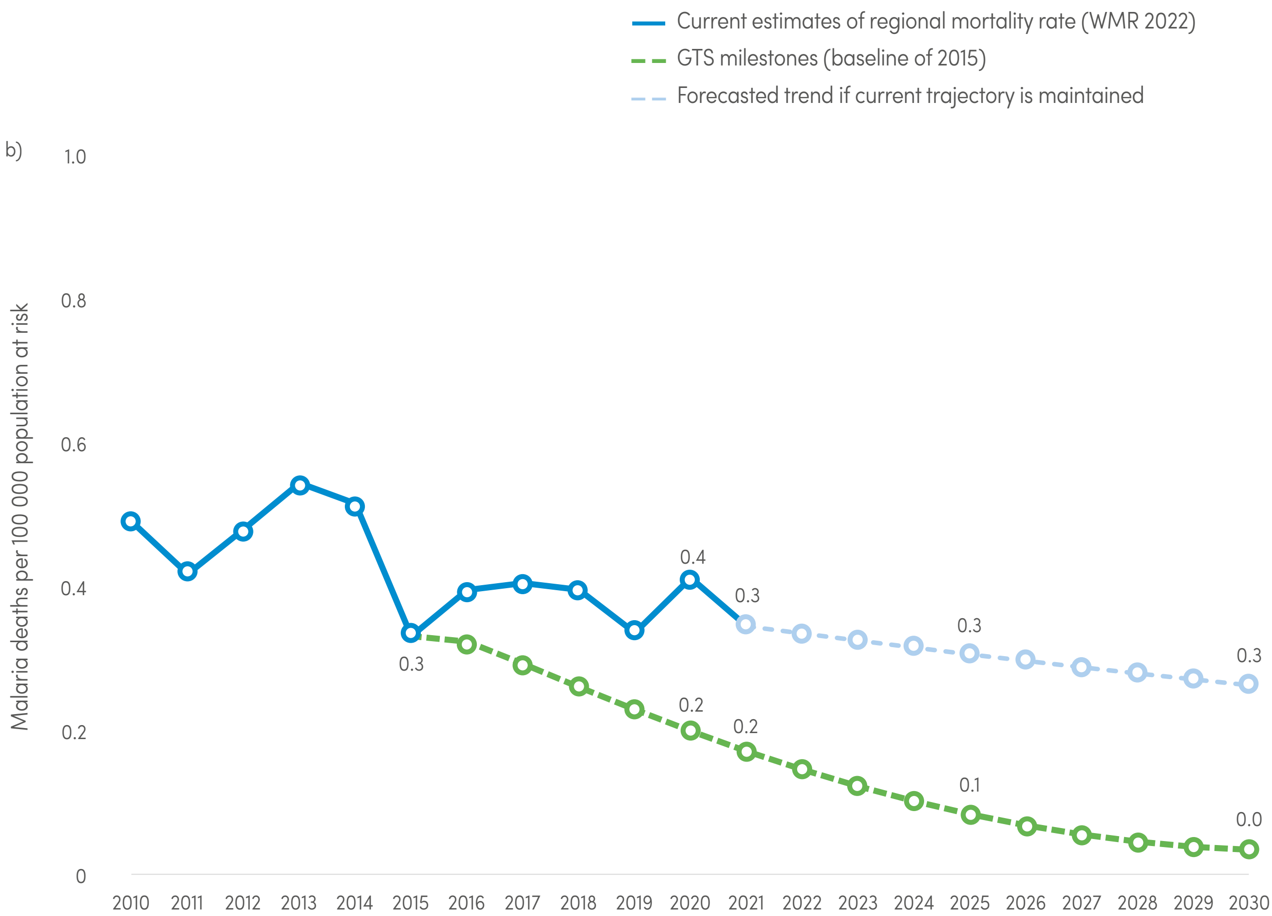
FIG. 8.8.

Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Western Pacific Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)
Source: WHO estimates.



were seen in Solomon Islands, which also accounts for a large proportion of cases in the region.

China was certified malaria free in 2021, and Malaysia reported zero malaria cases for the fourth consecutive year in 2020. Decreases in case incidence of 40% or more occurred in all other countries in the region, except in Vanuatu, where there was a reduction in case incidence by less than 40% in 2021 compared with the GTS 2015 baseline (**Fig. 8.2**). In 2015, Vanuatu was affected by a major cyclone that severely disrupted malaria diagnostic services and care seeking. As a result, it is likely that malaria cases in 2015 were underestimated. This confounds assessment of progress towards the GTS targets relative to a 2015 baseline for Vanuatu. Between 2016 and 2021, estimated case incidence declined by 87%. Cambodia, the Republic of Korea, Vanuatu and Viet Nam all reported zero malaria deaths. There were also zero deaths from human malaria in Malaysia, but 13 deaths occurred due to zoonotic *P. knowlesi* infection. All other countries in the region reported fewer than 10 deaths, apart from Papua New Guinea.



GTS: *Global technical strategy for malaria 2016–2030*; WHO: World Health Organization; WMR: world malaria report.

9 BIOLOGICAL AND OTHER THREATS TO MALARIA INTERVENTIONS

9.1 DELETIONS IN *P. FALCIPARUM* HISTIDINE-RICH PROTEIN 2 AND PROTEIN 3 GENES

Histidine-rich protein 2 (HRP2) is the predominant target of the 413 million *P. falciparum*-detecting malaria RDTs that are sold each year. Parasites that cannot express HRP2 may not be detectable by RDTs based on HRP2, and those that no longer express both HRP2 and histidine-rich protein 3 (HRP3) are completely undetectable by such RDTs. Deletions in the *P. falciparum* genes for HRP2 (*Pfhrp2*) and HRP3 (*Pfhrp3*) in clinical isolates were first reported in 2010 in the Peruvian Amazon basin, by researchers characterizing blood samples that were negative by HRP2-based RDTs but positive by microscopy (*70*). In recent years, *Pfhrp2/3*-deleted parasites have been documented outside of South America, including in Asia, the Middle East, and central, east, southern and west Africa. Prevalence estimates vary widely, both within and between countries. The examples of Djibouti, Eritrea and Peru (where the prevalence of dual *Pfhrp2*- and *Pfhrp3*-deleted parasites among symptomatic patients was as high as 80% in some areas) demonstrate that these parasites can become dominant in the population, posing a serious global threat to malaria patients and increasing the risk that missed cases will progress to severe disease or death (*71*).

WHO has published guidance on investigating suspected *Pfhrp2/3* deletions (*72*) and recommends that countries that have reports of *Pfhrp2/3* deletions, and their neighbouring countries, should conduct representative baseline surveys among suspected malaria cases, to determine whether the prevalence of *Pfhrp2/3* deletions causing false negative RDT results has reached a threshold that requires a change of RDT (>5% *Pfhrp2* deletions causing false negative RDT results). Alternative RDT options (e.g. based on detection of *Plasmodium* lactate dehydrogenase [LDH]) are limited; in particular, there are currently no WHO-prequalified non-HRP2 combination tests that can detect and distinguish between *P. falciparum* and *P. vivax*.

WHO is tracking published reports of *Pfhrp2/3* deletions using the Malaria Threats Map application (*69, 73*) and is encouraging a harmonized approach to mapping and reporting of *Pfhrp2/3* deletions through publicly available survey protocols. In 2022, several countries in the WHO African Region began planning or implementing representative surveys for *Pfhrp2/3* deletions, financed mainly through Global Fund grants and groups funded by the Bill & Melinda Gates Foundation; results from these surveys are expected in 2022 and 2023. WHO has launched a dashboard for tracking surveillance activities globally to inform priorities and resource allocation and RDT forecasting, and to avoid duplication of efforts. The dashboard features key characteristics of surveillance activities as well as timelines.

Based on literature searches informing the Malaria Threats Map, there were 17 new publications between September 2021 and September 2022. These publications included data from 17 countries – Benin, Brazil, Cameroon, the Democratic Republic of the Congo, Djibouti, Ecuador, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, India, Kenya, Madagascar, Rwanda, Sierra Leone and the United Republic of Tanzania. Of these, studies in Equatorial Guinea, Kenya and Rwanda did not identify any *Pfhrp2* deletions, although deletions in all three countries have been reported in previous publications. The studies from Benin, Cameroon, Gabon and Sierra Leone were the first *Pfhrp2* papers published from these countries. Based on all data from publications included in the Malaria Threats Map, some form of investigation for *Pfhrp2/3* deletions has been conducted in 47 countries and the presence of deletions has been confirmed in 40 countries (85%).

The WHO Global Response Plan for *Pfhrp2/3* deletions outlines several areas for action beyond the scaling up of surveillance. These other areas for action include identifying new biomarkers, improving the performance of non-HRP2 RDTs, undertaking market forecasting and strengthening laboratory networks to support the demand for using molecular characterization to determine the presence or absence of these gene deletions.

9.2 STATUS OF ANTIMALARIAL DRUG EFFICACY AND RESISTANCE (2015–2021)

Effective treatment for malaria is a key component in the fight against this disease. The emergence of resistance to artemisinin and partner drugs is a significant risk to the global effort to reduce the malaria burden (*2*). Artemisinin partial resistance in *P. falciparum* is suspected or has been confirmed in countries in the WHO African Region, the GMS and South America, and in Papua New Guinea. Resistance to ACT partner drugs has prompted changes in first-line treatment of *P. falciparum* in countries in the GMS, the Horn of Africa and south Asia. As part of the response to counter the threat of antimalarial drug resistance, WHO calls on malaria endemic countries and global malaria partners to strengthen the surveillance of antimalarial drug efficacy and resistance, and to ensure that the most effective treatments are selected for national treatment policy.

Antimalarial drug efficacy is monitored through therapeutic efficacy studies (TES), which track clinical and parasitological outcomes among patients receiving antimalarial treatment. Studies conducted according to the criteria established in the WHO protocol (*74*) help to detect changes in treatment efficacy over time. Polymerase chain reaction (PCR) correction is required to distinguish between cases with treatment failure caused by reinfection and those due to recrudescence. WHO recently updated the guidance on methodology to distinguish reinfection from recrudescence in areas of high malaria transmission (*75*). TES are considered the gold standard by which NMPs can best determine their national treatment policies. In countries where malaria transmission is low and in countries pursuing elimination, surveillance systems for case management have been strengthened so that all malaria cases are detected, treated and followed up to ensure cure. In this context, drug efficacy monitoring can be conducted by integrated drug efficacy surveillance (iDES). Four countries – Cambodia, the Lao People's Democratic Republic, Thailand and Viet Nam – have adopted this approach to monitoring drug efficacy.

Antimalarial drug resistance can be assessed using several tools. For some drugs, genetic changes associated with reduced drug sensitivity have been identified. For example, several *P. falciparum Kelch13* (*PfKelch13*) mutations are associated with delayed clearance after a treatment containing artemisinin; thus, surveys of these mutations can provide information on the spread of artemisinin partial resistance (defined as delayed clearance). Resistance to SP (an ACT partner drug and chemoprevention drug) can be monitored by the detection of mutations in the dihydrofolate reductase (*dhfr*) and dihydropteroate synthase (*dhps*) genes of *P. falciparum*. Resistance to mefloquine is associated with an increase in *Pfmdr1* copy numbers, whereas resistance to piperaquine is associated with an increase in *Pfplasmepsin 2/3* copy numbers and mutations in the *P. falciparum* chloroquine resistance transporter (*PfCRT*) (*76*). Some mutations have only been validated as markers associated with resistance in parasite strains from specific regions.

This section of the report summarizes the status of antimalarial drug efficacy and resistance in malaria endemic countries, focusing on studies that found high proportions of treatment failures. Key results are presented for each WHO region for TES for *P. falciparum* and *P. vivax* from 2015 to 2021. Treatment failure rates were calculated using the per protocol method unless otherwise indicated. A minimum sample size of 20 patients was applied to the analysis. Details of studies referenced here can be found in the Malaria Threats Map (*73*).

WHO African Region

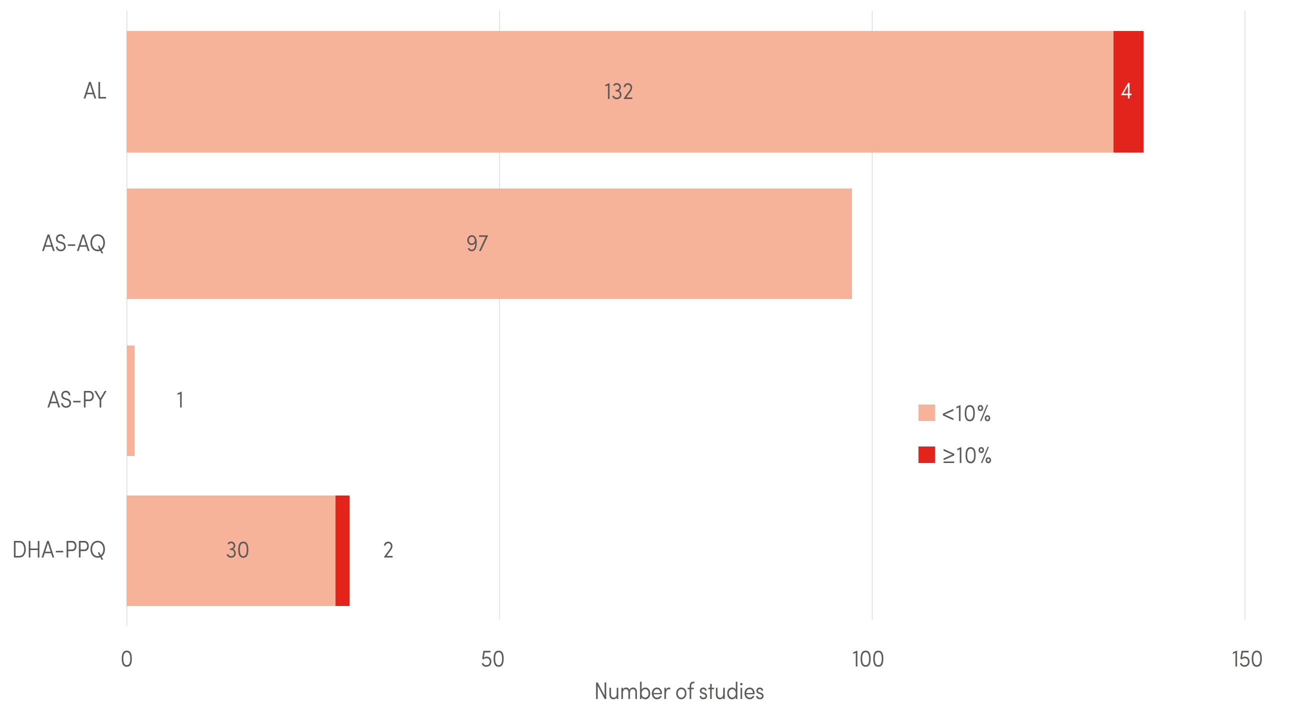
In the WHO African Region, the first-line treatments for *P. falciparum* include artemether-lumefantrine (AL), artesunate-amodiaquine (AS-AQ), artesunate-pyronaridine (AS-PY) and dihydroartemisinin-piperaquine (DHA-PPQ). Most TES conducted according to the WHO standard protocol have demonstrated good efficacy (**Fig. 9.1**). Some studies in the WHO African Region have shown higher levels of treatment failure; these results warrant further investigation, but should be treated with caution because of significant deviations from the WHO standard protocol.

Fig. 9.1 shows four studies reporting treatment failure rates greater than 10% after treatment with AL using the WHO-recommended methodology in the WHO African Region in 2015–2021: studies conducted at three sites in Burkina Faso (*77*) and one study conducted in Uganda (*78*). Two of the study sites in Burkina Faso (both reporting high failure rates with AL) reported treatment failure rates greater than 10% after treatment with DHA-PPQ (*77*); however, concern has been raised about the quality of microscopy in Burkina Faso (*79*).

A further five studies with AL and two studies with DHA-PPQ reported treatment failure rates greater than 10% when using Bayesian algorithms to distinguish between reinfection and recrudescence: they included studies in Angola (*80, 81*), the Democratic Republic of the Congo (*82*) and Uganda (*83*). For the studies in the Democratic Republic of the Congo and Uganda, results using the WHO-recommended methodology were also available; this methodology resulted in very low estimated rates (≤2%) of treatment failure.

FIG. 9.1.

Number of *P. falciparum* TES finding more or less than 10% treatment failures in the WHO African Region, by ACT (2015–2021), among studies with at least 20 patients



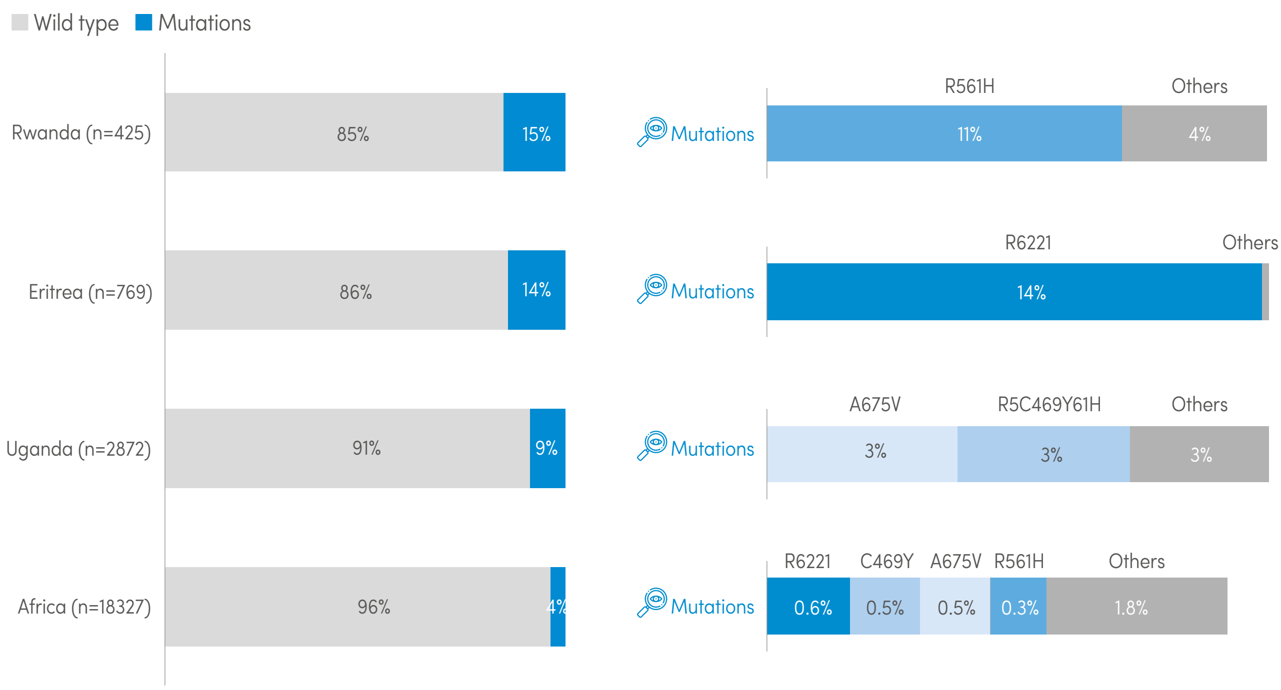
ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AQ: amodiaquine; AS: artesunate; DHA: dihydroartemisinin; PPQ: piperaquine; PY: pyronaridine; TES: therapeutic efficacy studies; WHO: World Health Organization.

Surveillance of *PfKelch13* polymorphisms associated with artemisinin partial resistance has been undertaken in several countries in the WHO African Region (*73*). There is now evidence of clonal expansion of *PfKelch13* mutations in Eritrea, Rwanda and Uganda (**Fig. 9.2**) (*84, 85*). In Rwanda, the R561H mutation was first identified in 2014. Several studies undertaken in 2018 and 2019 found R561H in more than 15% of the samples (*86*). Further, the presence of the R561H mutation has been associated with delayed parasite clearance among patients treated with AL (*86, 87*). Rwanda was the first country in the WHO African Region to confirm the presence of artemisinin partial resistance. In Uganda, the validated markers of artemisinin partial resistance, C469Y and A675V, were also identified; in addition, in a recent survey of samples from 2018 and 2019, those two mutations were found in more than 15% of samples from three sites (*85*). Treatment failure rates in Rwanda and Uganda remained below 10% because the partner drug is still effective. Additionally, R622I, a validated marker of artemisinin partial resistance, has been found in an increasing proportion of samples in the Horn of Africa, particularly in Eritrea. WHO launched its *Strategy to respond to antimalarial drug resistance in Africa* (*10*) in 2022.

P. vivax is endemic in only a few countries in the WHO African Region. The efficacy of chloroquine (CQ) and DHA-PPQ for the treatment of *P. vivax* was investigated in Ethiopia: all seven studies of CQ and one study of DHA-PPQ demonstrated treatment failure rates of less than 5%.

FIG. 9.2.

Countries in the WHO African Region with more than 5% of parasites sampled with *PfKelch13* mutations and main mutations identified (2015–2020)



n=number of samples collected.

WHO: World Health Organization.

WHO Region of the Americas

The first-line treatments for *P. falciparum* in the WHO Region of the Americas include AL, artesunate-mefloquine (AS-MQ) and CQ. Limited data are available from the WHO Region of the Americas. TES undertaken using AL in Brazil (2015) and Colombia (2018) demonstrated high efficacy of this drug (*88, 89*).

All malaria endemic countries in the WHO Region of the Americas recommend CQ as a first-line treatment for *P. vivax*. Efficacy of CQ was studied in Brazil and was found to be high.

In Guyana, the C580Y mutation was sporadically observed between 2010 and 2017 (*90*); the mutation has not been found in any of the more recent samples, indicating that the mutation has probably disappeared.

WHO South-East Asia Region

The first-line treatments for *P. falciparum* in the WHO South-East Asia Region include AL, AS-MQ, AS-PY, AS plus SP (AS+SP) and DHA-PPQ. As can be seen in **Fig. 9.3a**, no TES reported more than 10% treatment failures. Treatment failures with AS+SP remained low in India; however, findings from a study in Chhattisgarh state between 2015 and 2017 looking at *dhfr* and *dhps* mutations (*91*) could be an early warning of changes that prompted a need for treatment policy change from AS+SP in north-eastern India. In Thailand, drug efficacy is assessed using iDES (*92*). In 2019, a disproportionately high treatment failure rate was detected in Sisaket province, with failure rates of up to 50%; this led the province to change its first-line treatment to AS-PY in 2020.

In the GMS, *PfKelch13* mutations associated with artemisinin partial resistance have reached a high prevalence. Among samples collected in Myanmar and western Thailand between 2015 and 2020, *PfKelch13* wild-type parasites were found in 65.5% of samples (*73*).

The first-line treatments for *P. vivax* are CQ, AL and DHA-PPQ. High treatment efficacy was found in all studies of CQ, DHA-PPQ and AS-PY.

WHO Eastern Mediterranean Region

The first-line treatments for *P. falciparum* in the WHO Eastern Mediterranean Region are AL and AS+SP. TES detected high treatment failure rates with AS+SP only in Somalia and the Sudan (*93, 94*) (**Fig. 9.3b**). These findings led to treatment policy changes to AL in both countries.

The first-line treatments for *P. vivax* are AL and CQ. Data on the efficacy of first-line treatments are available from one study of AL in Somalia and one study of CQ in Afghanistan, with no treatment failures observed in either study.

WHO Western Pacific Region

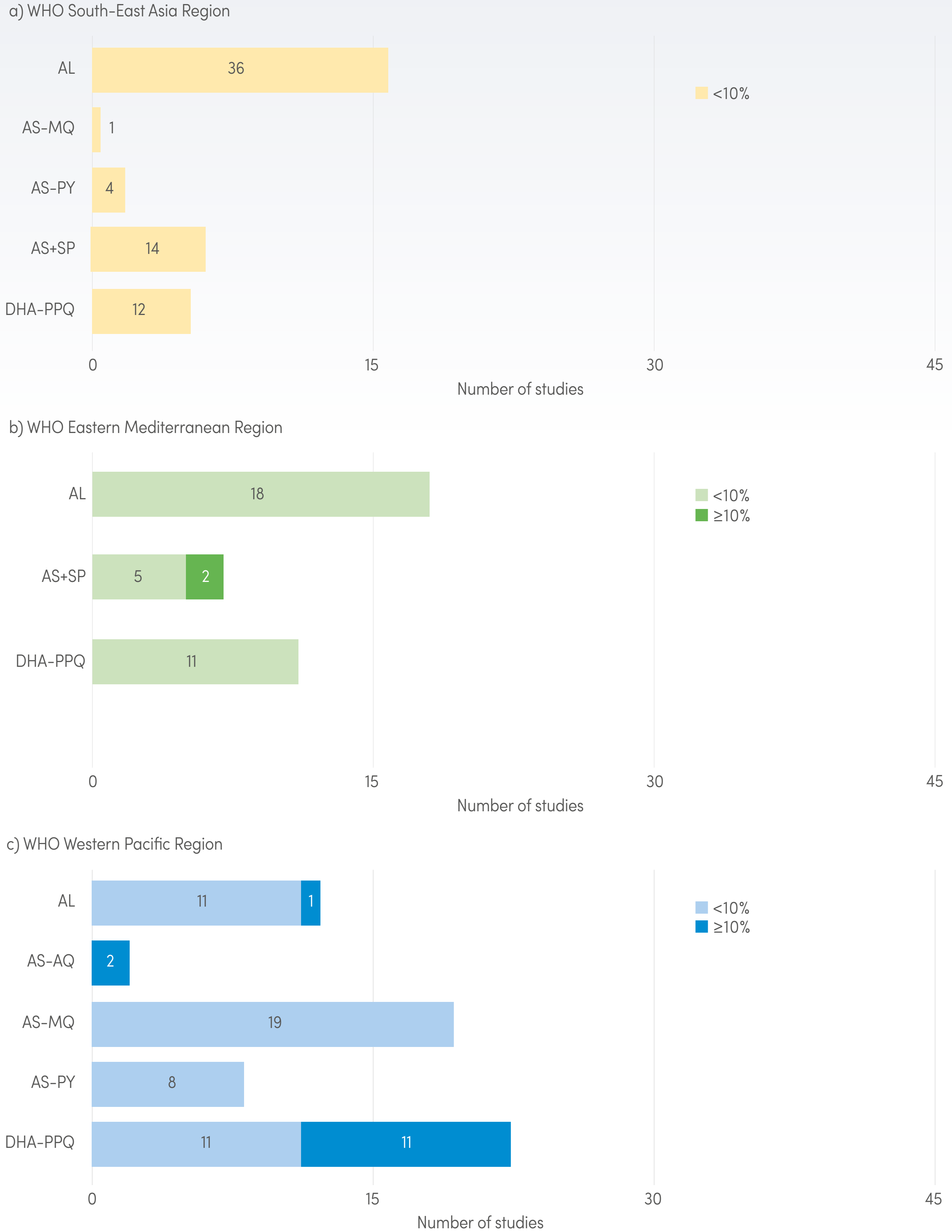
The first-line treatments for *P. falciparum* in the WHO Western Pacific Region include AL, AS-MQ, AS-PY and DHA-PPQ. In this region, TES have found high failure rates in studies with AL, AS-AQ and DHA-PPQ (**Fig. 9.3c**). In the Lao People's Democratic Republic, a high treatment failure rate was observed with AL in one study in Sekong province in 2017 (17.2%); however, the study was limited to 29 patients. AL was subsequently found to be effective in the Lao People's Democratic Republic provinces of Champassak, Salavan and Savannakhet in 2019, with failure rates of up to 5%. The presence of AQ resistance was documented in Cambodia in 2016–2017, with high treatment failure rates with AS-AQ in the provinces of Mondulkiri (22.6%) and Pursat (13.8%) (*94*). High rates of treatment failure were detected with DHA-PPQ in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Cambodia, the findings prompted the replacement of DHA-PPQ with AS-MQ as the first-line treatment in 2016. In Viet Nam, AS-PY has replaced DHA-PPQ in provinces where high treatment failure rates were detected.

PfKelch13 wild-type parasites were found in 29.9% of samples collected between 2015 and 2020 in Cambodia, the Lao People's Democratic Republic and Viet Nam. In Papua New Guinea, the *PfKelch13* C580Y mutation has emerged and appears to be spreading (*95*).

The first-line treatments for *P. vivax* in the WHO Western Pacific Region are AL, AS-MQ and CQ. In Viet Nam in 2015, one study of CQ found treatment failure rates of 9.8%.

FIG. 9.3.

Number of *P. falciparum* TES finding more or less than 10% treatment failures, a) in the WHO South-East Asia Region, b) in the WHO Eastern Mediterranean Region, c) in the WHO Western Pacific Region, by ACT (2015–2021), among studies with at least 20 patients



ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AQ: amodiaquine; AS: artesunate; DHA: dihydroartemisinin; MQ: mefloquine; PPQ: piperaquine; PY: pyronaridine; SP: sulfadoxine-pyrimethamine; TES: therapeutic efficacy studies; WHO: World Health Organization.

9.3 VECTOR RESISTANCE TO INSECTICIDES

Of the 88 countries that reported insecticide resistance monitoring data to WHO between 2010 and 2020, 78 confirmed resistance to at least one insecticide in one malaria vector species from one mosquito collection site. Of these countries, 29 confirmed resistance to four insecticide classes – pyrethroids, organophosphates, carbamates and organochlorines – in at least one malaria vector species across different sites in the country (**Fig. 9.4**). Of these, 19 presented at least one site where resistance was confirmed for all these four classes in at least one local vector.

Globally, resistance to pyrethroids was detected in at least one malaria vector in 87% of the countries and 68% of the sites, to organochlorines in 82% of the countries and 64% of the sites, to carbamates in 69% of the countries and 34% of the sites, and to organophosphates in 60% of the countries and 28% of the sites. Resistance to these four insecticide classes was confirmed in all WHO regions; however, its geographical extent varied considerably between regions (**Fig. 9.5**). Maps showing the status of resistance to different insecticides at each site are available in the Malaria Threats Map (*73*).

Of the 38 countries that reported data on the intensity of pyrethroid resistance, high intensity resistance was detected in 27 countries and 293 sites, moderate to high intensity resistance in 34 countries and 406 sites, and moderate intensity resistance in 21 countries and 78 sites. High intensity resistance to pyrethroids has been detected in western Africa more frequently than in other regions.

Between 2019 and 2020, WHO Member States reported the results of 835 bioassays conducted with chlorfenapyr and 603 with clothianidin. For chlorfenapyr, WHO requirements are more elaborate than for previous procedures for testing of mosquito resistance to other insecticides. Specifically, bottles

FIG. 9.4.

Reported insecticide resistance status as a proportion of sites for which monitoring was conducted, by WHO region, 2010–2020, for pyrethroids, organochlorines, carbamates and organophosphates *Status was based on mosquito mortality where <90% = confirmed resistance, 90–97% = possible resistance, and ≥98% = susceptible. Where multiple insecticide classes or types, mosquito species or time points were tested at an individual site, the highest resistance status was considered. Numbers above bars indicate the total number of sites for which data were reported. Sources: reports from NMPs and national health institutes, their implementation partners, research institutions and scientific publications.*

AFR: WHO African Region; AMR: WHO Region of the Americas; EMR: WHO Eastern Mediterranean Region; EUR: WHO European Region; n: number; NMP: national malaria programme; SEAR: WHO South-East Asia Region; WHO: World Health Organization; WPR: WHO Western Pacific Region.

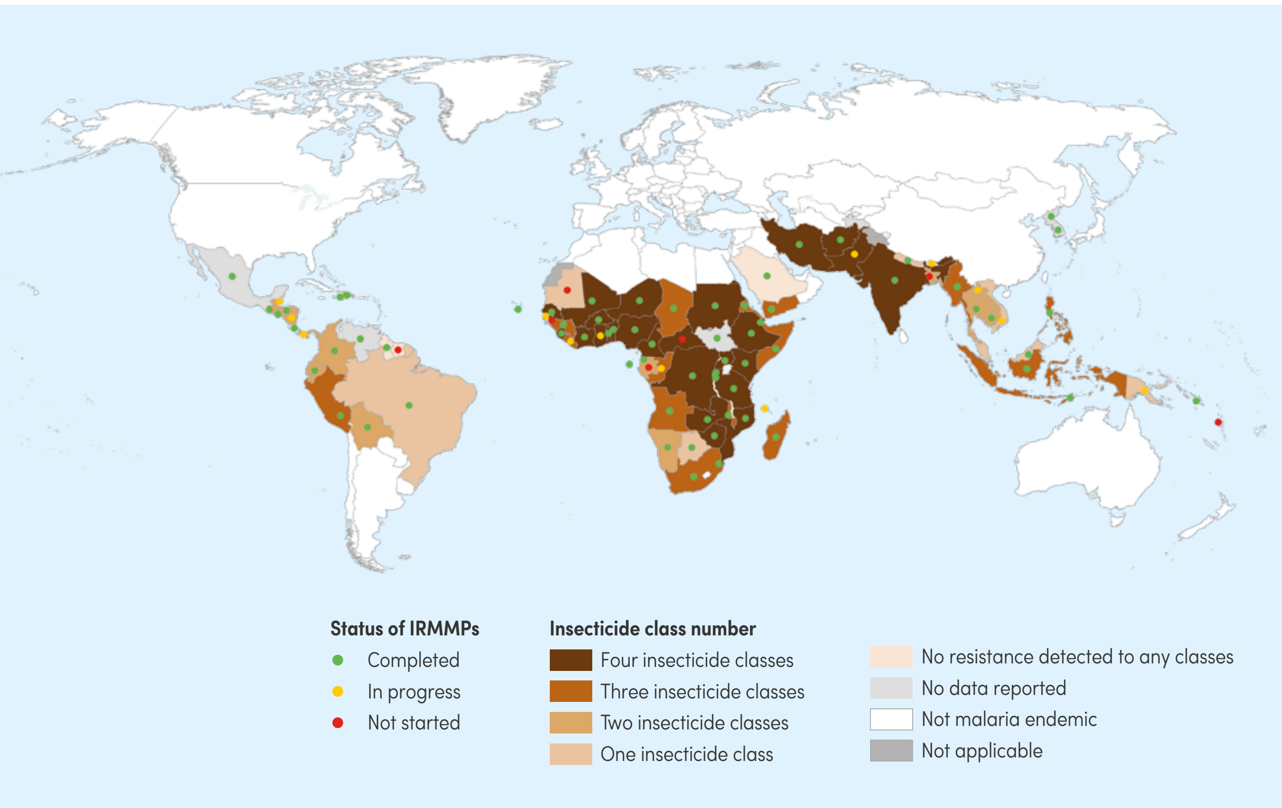
need to be coated with 1 mL of chlorfenapyr-acetone mixture at the discriminating dose 24 hours before the test; tests need to be conducted strictly within a temperature range of 27 ±2 °C and a humidity range of 80% ±10%; mosquito mortality has to be measured 72 hours after exposure in bottles; and a susceptible colony has to be tested in parallel to the wild mosquitoes. Resistance can only be confirmed when mortality in the exposed wild vector population 72 hours after exposure is less than 90% and mortality in the susceptible colony tested in parallel is more than 98%; the same mortality must be recorded in at least three bioassays conducted at the same site with the same wild vector population at different time points. To date, WHO has received results from 80 tests conforming to these requirements, conducted in 62 sites across seven countries. Until three complete tests are available from each of these sites, WHO cannot interpret these results.

Results of biochemical and molecular assays to detect metabolic resistance mechanisms were available for 35 countries and 364 sites for the period 2010–2020. Mono-oxygenases were detected in 68.3% of the sites for which reports were available, glutathione *S*-transferases were detected in 81.9% of the sites, esterases in 78.5% of the sites and acetylcholinesterases in 73.5% of the sites. Results of assays to detect target-site resistance mechanisms were available for 40 countries and 596 sites. *Kdr L1014F* was detected in 76% of the sites and *Kdr L1014S* in 53.1% of the sites.

Insecticide resistance data collected using WHO procedures are included in the WHO global database on insecticide resistance (*96*) and are publicly available via the Malaria Threats Map (*73*). This tool provides a summary table showing the status of phenotypic resistance and resistance mechanisms by country; presents maps to inform discussions on the deployment of pyrethroid-PBO nets; allows selected datasets to be downloaded; and includes an animation of insecticide resistance evolution over time, based on reports received by WHO.

FIG. 9.5.

Number of classes to which resistance was confirmed in at least one malaria vector in at least one monitoring site, 2010–2020 *Sources: Reports from NMPs and national health institutes, their implementation partners, research institutions and scientific publications.*



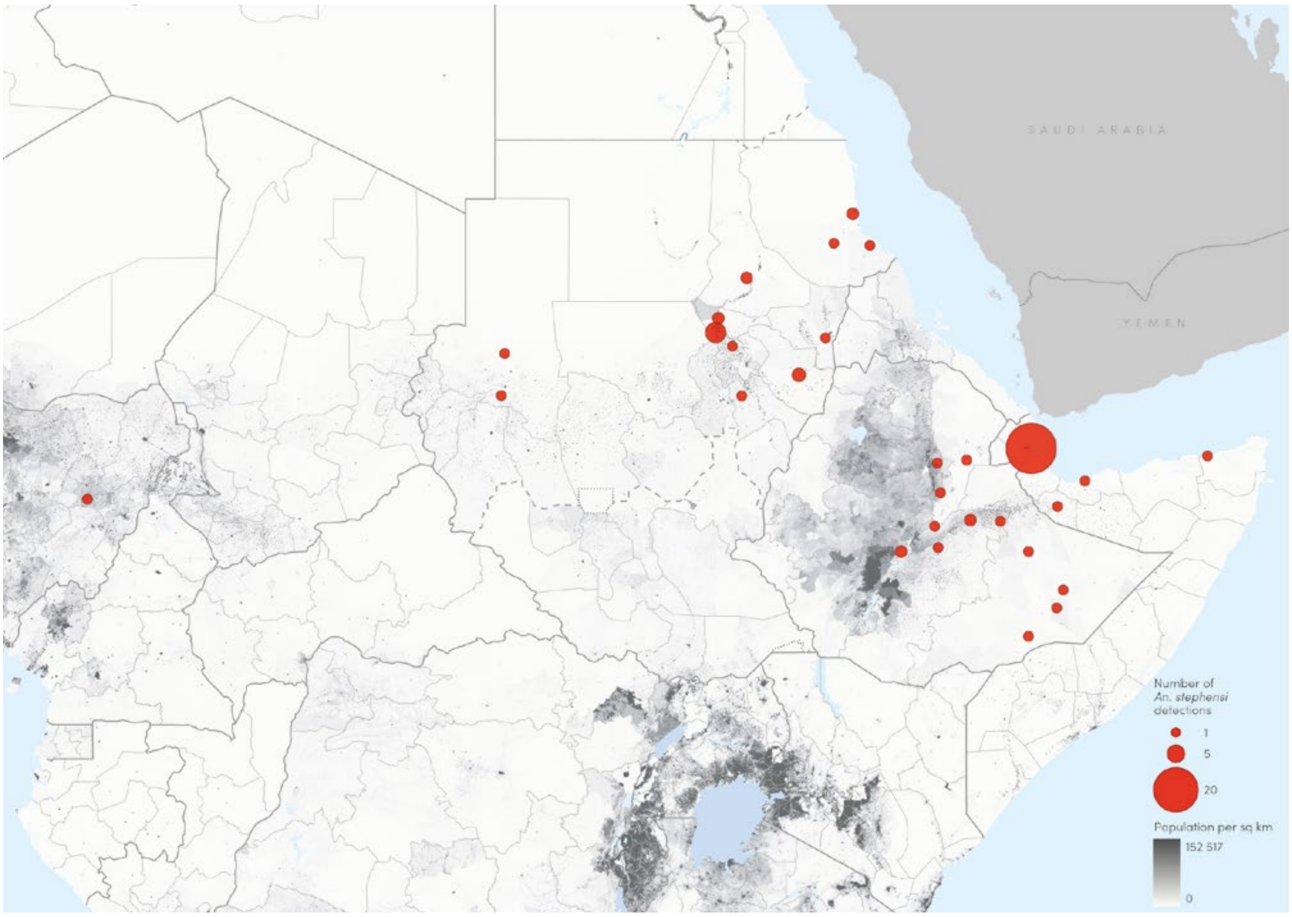
IRMMP: insecticide resistance monitoring and management plan; NMP: national malaria programme.

9.4 *ANOPHELES STEPHENSI* INVASION AND SPREAD

Anopheles stephensi is an efficient vector of both *P. falciparum* and *P. vivax* parasites. It was originally native to parts of Asia and the Arabian Peninsula, where it is a major malaria vector in rural and urban areas. In 2012, it was detected in Djibouti and was implicated in two consecutive malaria outbreaks (*97*). Since then, it has continued to spread in the Horn of Africa and has also been detected in Nigeria. To date, WHO has received reports of *An. stephensi* detections from over 64 different sites in Djibouti, Ethiopia, Somalia and the Sudan (**Fig. 9.6**). The characteristics of this vector make its control challenging. *An. stephensi* breeds in human-made water storage containers in urban areas and appears to quickly adapt itself to the local environment (including cryptic habitats such as deep wells). It also survives extremely high temperatures during the dry season, when malaria transmission usually reaches a seasonal low. Insecticide resistance data reported to WHO show that *An. stephensi* has exhibited resistance to pyrethroids, organophosphates, carbamates and organochlorines in the Arabian Peninsula and Asia. In the Horn of Africa, it has exhibited resistance to pyrethroids, organophosphates and carbamates. *An. stephensi* poses a threat to malaria control and elimination in Africa, the Arabian Peninsula and southern Asia. If uncontrolled, its spread across the Horn of Africa, combined with rapid and poorly planned urbanization, may increase the risk of malaria transmission in African cities. WHO therefore encourages countries where *An. stephensi* invasion is suspected or has been confirmed to take immediate action. WHO recommends that countries increase vector surveillance to delineate the geographical spread of this vector, and use the data to implement interventions aimed at preventing its further spread, especially into urban and periurban areas. Research institutions and implementation partners are encouraged to immediately report any detection of *An. stephensi* to ministries of health and WHO, to inform national and global responses. Further guidance on how to monitor and control *An. stephensi* is provided in the relevant WHO vector alert (*17*).

FIG. 9.6.

Detections of *An. stephensi* in the Horn of Africa and Nigeria, reported to WHO (2012–2021) *Sources: Reports from NMPs and national health institutes, their implementation partners, research institutions, scientific publications and WorldPop* (*73*, *98*).



An. stephensi: Anopheles stephensi; NMP: national malaria programme; WHO: World Health Organization.

9.5 EFFECTIVENESS OF ITNS

ITNs are the most widely used malaria vector control intervention. Since 2005, about 2.5 billion ITNs, mainly pyrethroid-only LLINs, have been distributed for malaria prevention globally (**Section 7**). Modelling analysis suggests that ITNs were the main drivers of the declines in malaria transmission and burden in the period 2005–2015 (*99*), especially in settings with moderate to high transmission. Despite widespread pyrethroid resistance, WHO considers that LLINs continue to provide better protection than untreated nets, and encourages their continued use to prevent malaria (*9*).

Since 2015, progress against malaria has slowed (and did so even before the COVID-19 pandemic), especially in moderate and high transmission settings (**Section 3**). Many factors are likely to have contributed to this situation, including a stagnation of malaria funding amid increasing populations in countries with moderate to high transmission (**Section 6**), considerable gaps in prevention and therapeutic interventions (**Section 7**), biological threats to malaria interventions (**Section 9**), and additional challenges of health and other humanitarian emergencies (**Section 2.5**).

Given that LLINs are the main vector control tool in most malaria endemic countries, the factors that impair their effectiveness (and the effectiveness of ITNs more generally) in malaria prevention are likely to be important in progress against malaria. In operational settings, these factors can be grouped into four broad categories:

- insecticide resistance resulting in reducing the effects of LLINs on repelling and killing mosquitoes;
- operational and behavioural constraints (e.g. delivery, access, coverage and acceptability, use, maintenance and retention);
- physical durability, which comprises fabric integrity; and chemical durability (bioefficacy), which is the availability of one or more active ingredients on the surface of the net over time; and
- vector dynamics (species biting and resting behaviours).

This section summarizes the implications of these factors on the overall effectiveness of ITNs in operational settings.

9.5.1 Epidemiological impact of insecticide resistance

The emergence and wide geographical spread of pyrethroid resistance (**Section 9.3**) is the most recognized threat to ITN effectiveness, but the epidemiological impact of such resistance remains contested. Many factors make it difficult to measure the epidemiological impact of insecticide resistance, including the physical barrier to mosquitoes provided by the nets, the difference in fitness between resistant and susceptible mosquitoes, and the variations in insecticide concentration and bioavailability between pyrethroid-only nets and PBO on non-pyrethroid nets tested in the field (*100*). A multicountry trial commissioned by WHO showed that ITNs remained highly protective against malaria even in the presence of high pyrethroid resistance (*101*). In contrast, data from experimental hut studies suggest that as vector susceptibility to pyrethroids falls the repellent and mortality effects on mosquitoes are greatly reduced (*102*). In addition, evidence from two trials, one from Uganda (*103*) and one from the United Republic of Tanzania (*104*), compared the epidemiological impact of pyrethroid-PBO nets against malaria with that of pyrethroid-only LLINs. Both trials were conducted in areas with mosquitoes that are highly resistant to pyrethroid (defined by the review team as mosquitoes demonstrating <30% mortality in discriminating dose assays), and showed that ITNs with PBO had a greater impact than pyrethroid-only LLINs. In addition, a systematic review of the impact of PBO ITNs (*105*) provided evidence of high to moderate certainty (according to the WHO grading system) that malaria parasite prevalence was lower where pyrethroid-PBO nets were deployed.

With this evidence – and taking into account that PBO is less wash-resistant than a pyrethroid-only net treatment, resulting in faster declines in bioavailability over the 3-year estimated lifespan – WHO published a conditional recommendation for pyrethroid-PBO ITNs in areas of high pyrethroid resistance (*9*).

Modelling analysis suggests that the epidemiological impact of ITNs is considerably reduced at high levels of pyrethroid resistance, and that even moderate levels of pyrethroid resistance may lead to an increase in incidence in areas where ITNs are widely used (*106, 107*).

9.5.2 Defining the durability of LLINs

According to WHO guidelines (*108*), there are three elements to be considered in assessing the durability of ITNs: net survivorship, fabric integrity and insecticidal activity (bioefficacy). These elements are determined partly by factors intrinsic to the manufacture of the net (e.g. material composition, knitting pattern, quality of finishing, insecticide type and content, and additives) and partly by extrinsic factors that cause wear and tear (e.g. storage, exposure to sunlight and rodents, use, washing frequency, housing condition and other household level maintenance). These factors vary between and within countries and between and within households.

Survivorship of ITNs is defined as the proportion of distributed nets still available for use as intended in the households to which they were given after a defined period. *Attrition* (the opposite of survivorship) is the proportion of nets no longer in use as intended after a defined period after their distribution to the households. Attrition can be categorized by the main reasons why a net is no longer used; that is, decay (e.g. destroyed or so torn or worn out that it is considered useless for protection against mosquitoes), absence (e.g. stolen, given away or moved) or used for other purposes.

Physical or fabric integrity reflects the number, location and size of holes in each net. When possible, the assessment can also be categorized by type of hole (burn, tear, seam failure or chewed by animals). The physical or fabric integrity of the surviving nets can be assessed as a function of length of use, until deterioration leads to the net being discarded or used for another purpose.

Insecticidal activity (bioefficacy) is the degree of knock-down, mortality or inhibition of blood-feeding induced in susceptible mosquitoes, as determined by standard WHO test procedures and criteria (i.e. cone bioassay or tunnel test). Insecticidal activity is associated with the type and content or availability of insecticide and the length of use.

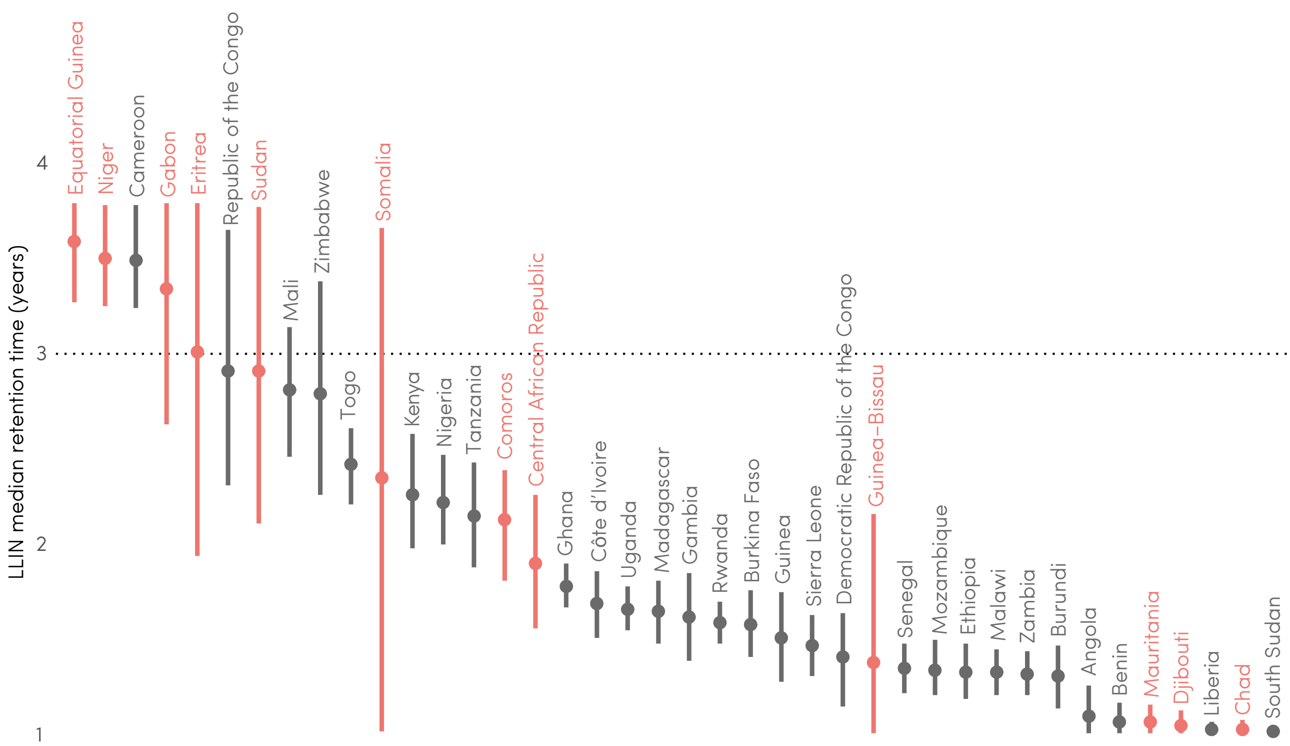
9.5.3 Operational and behavioural constraints

In sub-Saharan Africa, where most ITNs are distributed, about 590 million ITNs were delivered to communities in the period 2019–2021 (**Section 7**). At a ratio of one ITN to two persons, a population of about 1 billion people, and assumptions of perfect universal coverage and a 3-year median lifespan for a long-lasting ITN, the distribution of 590 million ITNs would mean that 100% of the population in this region would have access to an ITN. In reality, in 2021, the estimated percentage of the population with access to an ITN within their household and the percentage of the population sleeping under an ITN was 54% and 47%, respectively (**Section 7**). This is in part because net loss starts almost immediately and net retention reduces over time, while initial allocation inefficiencies mean that some populations may not own a net at all.

Research on ITN access, use and nets-per-capita over time has identified three main barriers to universal ITN ownership and use: allocation efficiency, retention and use rate (*69*). The allocation barrier is seen in the relationship between ITN nets-per-capita and ITN access; at higher coverage levels, instead of the two being almost linearly correlated, additional nets-per-capita lead to diminishing returns in terms of gains in access because

FIG. 9.7.

Median LLIN retention time by country, ordered from highest to lowest Dots show mean parameter values, and vertical bars indicate 95% CI width. Countries with fewer surveys have less stable model fits; those having fewer than three surveys are indicated in red. *Source: Bertozzi-Villa et al. (2021)* (*69*).



CI: confidence interval; LLIN: long-lasting insecticidal net.

it becomes increasingly difficult to allocate an ITN to someone who does not already have access to one (*69*).

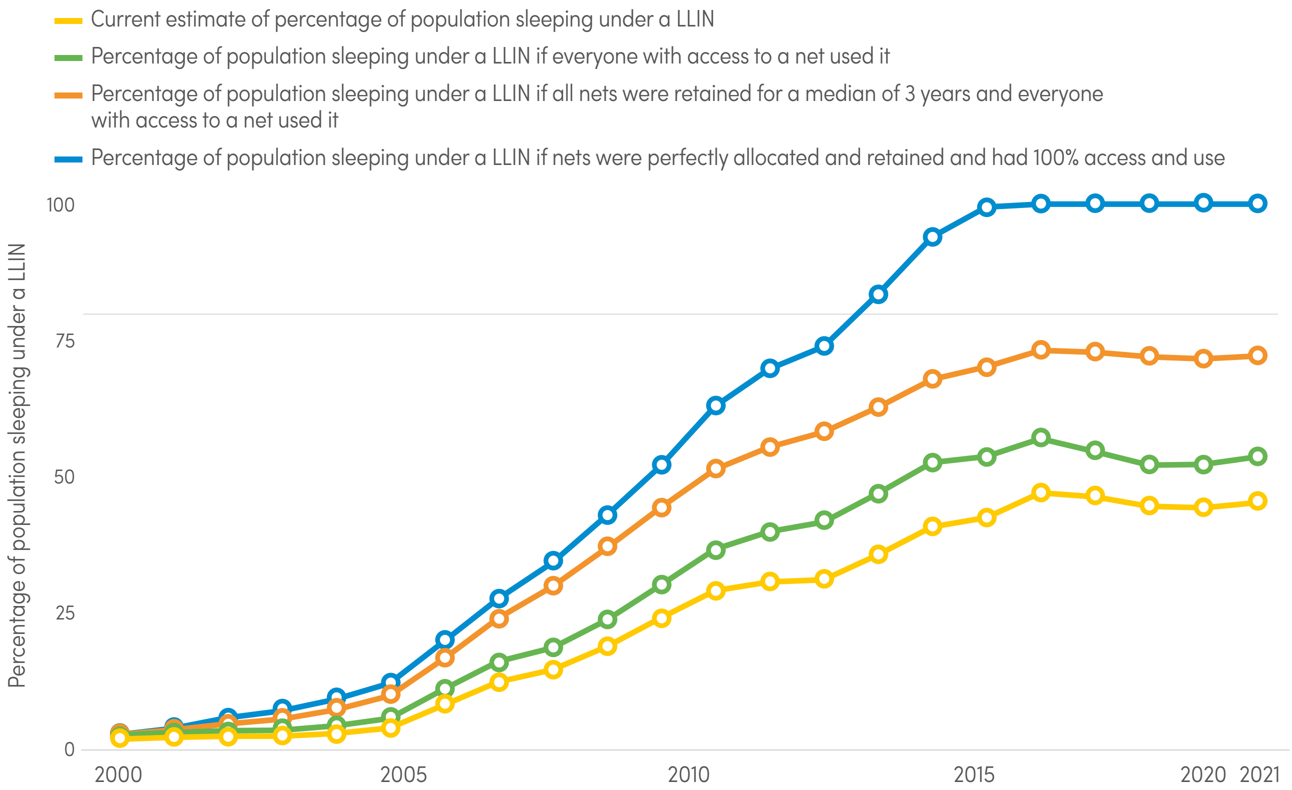
In terms of retention, there is growing evidence that, in some settings, nets are discarded on average much sooner than they are replaced by new mass distribution campaigns (*109–112*), mainly owing to the nets developing holes (*113*) through the stresses of day-to-day use, which reduces their effectiveness at preventing mosquito entry and increases the likelihood that nets will be discarded (*114*). Therefore, the household's attitudes towards their nets, net handling behaviours and other hazards to and durability of the net fabric and construction (*115*) are key drivers of retention (*69*). Retention of ITNs is variable between and within countries, with the median retention period ranging from 1 year to 6 years (*69, 109*), and most countries having median retention times of 1.0–2.7 years (**Fig. 9.7**). Pooled data suggest a median retention time of about 1.9 years (*69*).

Even when nets are available to household members, they are not used 100% of the time, with factors such as age, season, gender and malaria risk affecting usage (*116–119*). For example, children and teenagers aged 5–19 years often have a lower level of ITN use than other age groups, particularly in households with insufficient nets (*116, 117*). This age group has also been identified as an important reservoir of malaria transmission (*120*). ITN use is higher in children aged under 5 years and pregnant women (**Section 7**) – the two population groups with the highest risk of developing disease in areas of moderate to high transmission.

The same modelling framework used to estimate ITN access and use over time (**Fig. 7.2** and **Fig. 7.3**) was harnessed to explore the hypothetical impact of overcoming each of these barriers, by first setting the use rate to 100%, then setting median net retention time to 3 years and finally imagining perfect allocation of nets (**Fig. 9.8**). Under these scenarios, net use is less of a barrier to universal coverage targets than net retention or net access. Results suggest that improving net retention alone would, over time, be able to lift most countries above the 80% universal coverage target and that improving net allocation would provide a substantial additional boost to coverage. When net use, retention and allocation barriers are removed, it is estimated that 29 of 40 countries in sub-Saharan Africa would meet their universal coverage targets (**Annex 1**). In addition to allocation efficiency, overall impact may also be improved through subnational tailoring of ITNs based on epidemiological and other factors. These operational constraints are challenging to overcome and require considerable investments in delivery systems and public awareness (**Section 9.5.5**).

FIG. 9.8.

The impact on ITN use of reducing operational and behavioural constraints in sub-Saharan Africa *Source: Institute for Disease Modeling and Malaria Atlas Project* (*68*).



ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net.

9.5.4 Implications for overall ITN effectiveness

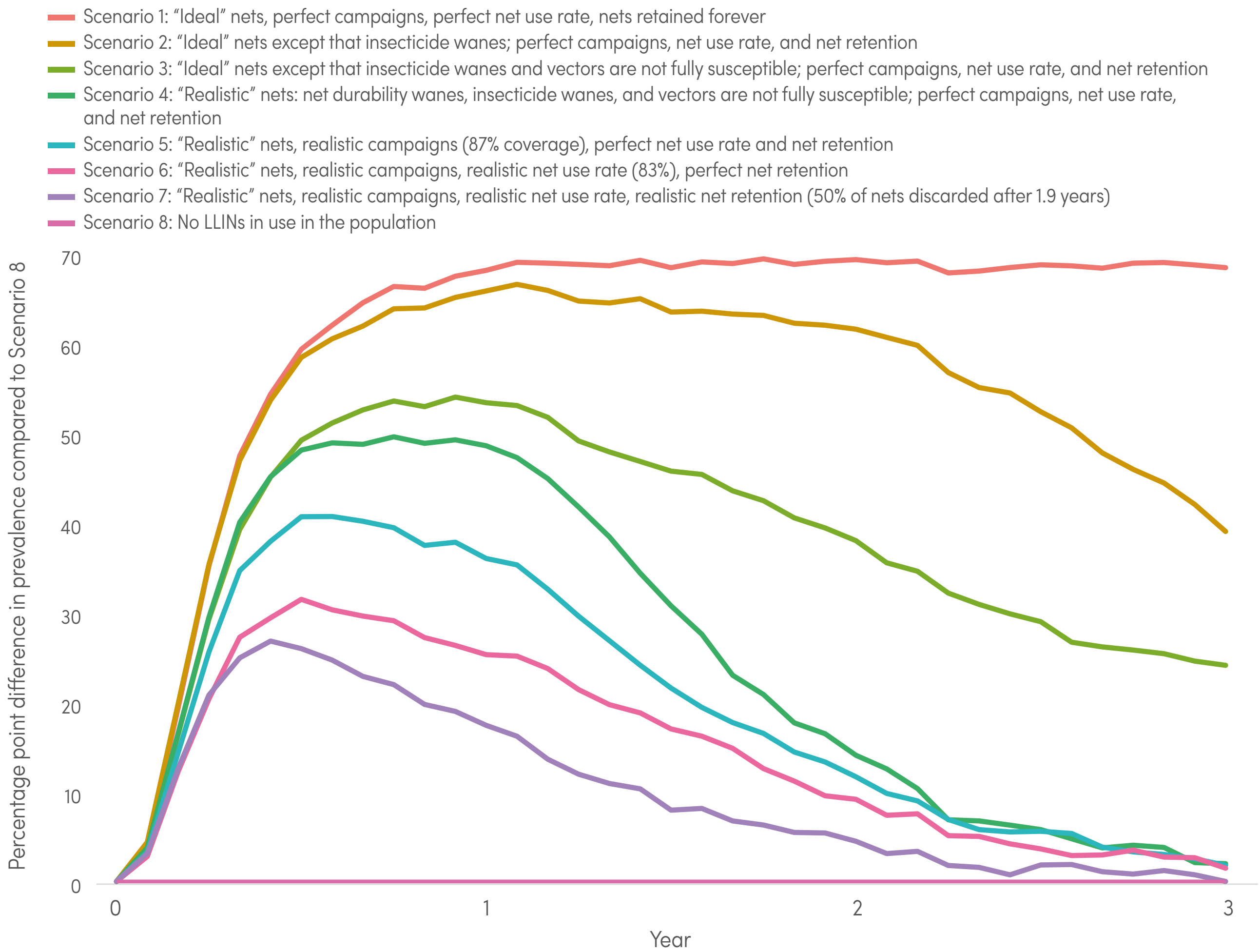
Insecticide resistance and challenges of allocation, retention and use collectively reduce the impact of ITNs in real-life settings. This section presents a modelling analysis to describe the interaction of these factors and their impact on overall ITN effectiveness.

A malaria transmission model (*121*) was used to estimate how much impact each of these constraints has on the potential effectiveness of ITNs over the 3 years after net distribution (**Fig. 9.9**, **Table 9.1**). Starting from a net that has the required insecticidal levels, and is highly durable, perfectly allocated, always used and never discarded, scenarios were explored in which each constraint was re-introduced sequentially.

To create scenarios that mirrored the effectiveness of the ITNs distributed today, first, insecticidal efficacy was assumed to wane over time, then mosquitoes were assumed to be less susceptible to insecticide, then net durability was assumed to wane over time, and so on. The decomposition of ITN impact, in units of percentage point reduction in prevalence compared with a scenario with no nets, is shown for a baseline moderate to high transmission setting in **Fig. 9.9**. Shortly after net distribution, lower killing due to insecticide resistance has a large impact on overall net effectiveness. By the end of the time series, however, the main causes of reductions in net effectiveness are the waning of both insecticide efficacy and physical durability. When combined with barriers to ITN access, use rates and retention, the impact of the ITN campaign is almost zero by the end of the third year. The physical durability

FIG. 9.9.

Sequential decomposition of LLIN effectiveness over 3 years (modelling pyrethroid-only ITNs; further details explaining different scenarios are provided in Table 9.1) *Sources: Institute for Disease Modeling and Malaria Atlas Project* (*68*).



ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net.

of ITNs was assumed to decline in a piecewise linear fashion over the years following distribution, such that the probability of a mosquito breaching a net declined by 10% at the end of year one, 50% at the end of year two and 80% at the end of year three.

Pyrethroid-only LLINs are modelled in this analysis (**Fig. 9.9**, **Table 9.1**). The modelling does not include any potential impact achieved by nets distributed through continuous distribution systems including school-based distributions.

The results shown in **Fig. 9.9** are sensitive to the order in which constraints are re-introduced, because every subsequent scenario is working on the margin of the impact of the previous scenario. Therefore, this plot should be interpreted as sequential and cumulative, rather than reflecting the independent effect of each intervention change on the burden overall. In this case, the order was chosen to first consider the impact of the physical and chemical properties of the net (killing and physical durability), followed by features of campaigns (access), followed by the impact of net use and retention by owners.

This analysis is illustrative and is intended to demonstrate that, in relative terms, ITNs suffer a considerable effectiveness decay that impairs their impact in preventing malaria. The analysis must be interpreted with the understanding that the results have important uncertainties and represent a simulated scenario. Actual effectiveness of ITNs will vary between and within countries.

TABLE 9.1.

Descriptions of scenarios presented in Fig. 9.9[a] *Sources: Institute for Disease Modeling and Malaria Atlas Project* (*68*).

	Full details
Scenario 1	60% mosquito killing without waning; 90% net physical durability without waning; 100% coverage; 100% use rate; nets never discarded before 3 years
Scenario 2	60% mosquito killing with waning (3-year half-life); 90% net physical durability without waning; 100% coverage; 100% use rate; nets never discarded before 3 years
Scenario 3	42% mosquito killing with waning (3-year half-life); 90% net physical durability without waning; 100% coverage; 100% use rate; nets never discarded before 3 years
Scenario 4	42% mosquito killing with waning (3-year half-life); 90% net physical durability with waning (decline by 10% after year 1, 50% after year 2, 80% after year 3); 100% coverage; 100% use rate; nets never discarded before 3 years
Scenario 5	42% mosquito killing with waning (3-year half-life); 90% net physical durability with waning (decline by 10% after year 1, 50% after year 2, 80% after year 3); 87% coverage; 100% use rate; nets never discarded
Scenario 6	42% mosquito killing with waning (3-year half-life); 90% net physical durability with waning (decline by 10% after year 1, 50% after year 2, 80% after year 3); 87% coverage; 83% use rate; nets never discarded before 3 years
Scenario 7	42% mosquito killing with waning (3-year half-life); 90% net physical durability with waning (decline by 10% after year 1, 50% after year 2, 80% after year 3); 87% coverage; 83% use rate; nets discarded with a 1.9-year median retention time
Scenario 8	No LLINs in use in the population

LLIN: long-lasting insecticidal net.

[a] The term "net physical durability" refers to the probability of a mosquito not breaching a net after landing on it. "Killing" refers to the probability of death for a mosquito that lands on a net.

9.5.5 Improving the effectiveness of ITNs

ITNs are the foundation of the malaria vector control that has driven many of the gains recorded so far, but efforts must be made to improve their effective coverage of vulnerable populations. This starts with producing more robust ITNs that can counteract the effects of pyrethroid resistance; however, other (extrinsic) factors must also be considered. Locally appropriate distribution models could help to reduce wastage and ensure that old nets are efficiently replaced, while a focus on the end user and usage practices could help to prolong the life of ITNs and the protection they afford.

Improving the physical durability of LLINs

Over the years, the focus of global efforts has been to keep the price of LLINs low, create predictability in supply and ensure increased community-level coverage. Analyses of the effect of these price reductions on quality of ITNs have been limited, although all ITNs originally recommended by the WHO Pesticide Evaluation Scheme (WHOPES) and all of those that are now WHO prequalified were subject to minimum quality standards (*122*). Under the current recommendation, an LLIN would be expected to retain its biological activity for at least 20 standard washes under laboratory conditions and 3 years of recommended use under field conditions (*123*). Ongoing discussions on ITN effectiveness have focused on the design of the product and its potential efficacy; selection of an appropriate product for the cultural and entomological context in which the ITN is intended to be used; consistent formulation and manufacturing; proper storage, transport and handling; and use of the product as instructed (*115*). In particular, it is challenging to develop predictive metrics of the operational physical durability of ITNs because of the many influencing factors. This makes it difficult to establish the level of physical quality that confers optimum benefits at affordable costs, which is needed to guide a value-based approach to the process of ITN production and purchase.

In an attempt to address the issue of physical durability, some indices have been explored in the published literature. For example, resistance to damage (RD) scores have been proposed as correlates of physical survival of ITNs (*124*). The RD score, ranging from 0 to 100, was developed as a composite measure of ITN snag strength, bursting strength, abrasion resistance and resistance to hole enlargement. An analysis of data from 10 sites in four countries where ITN durability was monitored for six LLIN brands showed that the RD score was a strong predictor of physical durability of ITNs in the field (*125*). Another metric of physical durability, functional survival – defined as survival of nets in "serviceable" condition – of three pyrethroid-only LLINs was compared in a study in the United Republic of Tanzania (*126*). At the end of the 3-year period, the median functional survival was significantly different between the three net products, at 2.0, 2.5 and 2.6 years. Functional survival in other settings has varied from 3.2 to 5.6 years for the same product in different areas of Nigeria (*110*), 1.6 to 2.2 years for the same product in the Democratic Republic of the Congo (*111*), 2.3 to 2.8 years for different products in Ghana (*127*), 2.0 to 2.4 years for different products in Kenya (*128*), 4.0 to 4.6 years for the same product in Liberia (*129*), 2.2 to 3.1 years for the same product in Mozambique (*130*), 2.1 to 3.4 years for different products in Mali (*131*) and 2.7 to 2.9 years for different products in Zanzibar (United Republic of Tanzania) (*132*).

In view of the various challenges of measuring ITN durability, in October 2022, the WHO Prequalification Department launched an open public consultation on updated guidelines for the prequalification assessments of ITNs, followed by a technical consultation (*133*). Among the many issues covered in the draft guidelines were the post-production stages in the life of an ITN, from its shelf-life to initiation of use (i.e. storage, transport and distribution) and the life-stage of ITNs when in use (e.g. reduction of active ingredients over time, physical durability, resilience to washing and exposure to sunlight).

Improving allocation efficiency of ITNs

Analysis shows that, under current assumptions of populations in need, increasing net-per-capita is challenging because saturation levels are reached (*69*). However, many countries rely on projections of census data for the purposes of microplanning and quantifying target populations for ITN distribution. As shown in the recent example of Benin (*134*), such census-based projections can underestimate populations in need and result in suboptimal coverage. By switching to digitalized mass campaign distribution of ITNs (based on household mapping and an enumeration exercise), an additional 14% of the population was identified, leading to over 94% coverage of LLINs (*134*). Digitalized campaign microplanning can therefore help to bridge the persistent coverage gap observed in many countries, increase access and ensure fairer distribution of nets. Although the upfront costs of establishing such digital platforms and the field enumeration of households can be relatively high, the overall investment can have a high return on investment and improve cost–effectiveness, not just by ensuring high and equitable LLIN coverage, but also by supporting the establishment of the platforms and data repositories needed to improve population access across other interventions for other types of campaign (e.g. SMC and immunizations).

With the median ITN half-life being about 2 years, it has been suggested that reducing the frequency of mass campaign cycles from 3 years to 2 years could sustain coverage levels and achieve greater impact; however, this would lead to considerably higher commodity and operational costs, including a strain on human resources. Alternative configurations of continuous distribution channels may yield high and sustained coverage compared with 3- or 2-year ITN campaign cycles. A modelling analysis using specific indicators from the United Republic of Tanzania suggests that using continuous school-based distributions, in addition to current distributions through Expanded Immunization Programme (EPI) and ANC clinics, is likely to achieve higher sustained coverage with fewer nets compared with 3-year mass campaigns (*135*). Across the WHO African Region, however, there is variation in access to schools and EPI and ANC clinics; hence, further analysis is required on the potential impact on equity of continuous distribution under different settings. Although studies show that the costs of continuous distribution are in line with the costs of mass campaigns (*136, 137*), additional cost analysis from different settings and operational approaches is needed.

Improving maintenance and use of ITNs

Net durability and retention are affected by attitudes towards care for ITNs, behaviour such as improper storage and frequent washing, and damage through hanging, exposure to sunlight and rodents. Behavioural change interventions could positively impact on these factors (*138*). For example, an intervention–control design study in Nigeria showed that targeted behavioural change interventions communicated through different channels improved the overall condition of ITNs, increasing median lifespan and retention (*139*). Similarly, a summary of studies on behavioural change interventions, communicated in culturally sensitive ways through multiple context-specific channels, showed that such interventions can improve the use of ITNs by household members (*140*). Although clear social and behaviour change communication (SBCC) strategies exist, these critical interventions remain underresourced and greater investment is required (*141*).

Mitigating the impact of widespread insecticide resistance

In many settings, pyrethroid-only LLINs remain effective, even if they are less effective than before the local mosquito populations started to become resistant. However, as pyrethroid resistance becomes widespread and increases in intensity in many settings (*9, 142*), nets with newer chemistries are needed. Fortunately, there has been progress in this area. For example, the combination of pyrethroid with PBO has led to the development of pyrethroid-PBO ITNs, which have higher efficacy than pyrethroid-only nets; such nets are now recommended by WHO (*9*). Two pyrethroid combination ITNs are under evaluation: alphacypermethrin+pyriproxyfen ITNs and alphacypermethrin+chlorfenapyr ITNs. Pyriproxyfen is an insect growth regulator that reduces adult mosquito fertility, thereby reducing the vector population (*9*). Chlorfenapyr targets the mosquitoes' mitochondria, stopping respiration at the cellular level and thus killing the mosquito. A recent randomized controlled trial (RCT) in the United Republic of Tanzania compared the effectiveness of pyrethroid-only LLINs with these three types of net with pyrethroid combinations (*143*). The study showed that, overall, the combination ITNs performed better at preventing malaria infections in children aged under 5 years; however, the difference was statistically significant only for the chlorfenapyr combination (odds ratio 0.45; 95% CI: 0.30–0.67; *P*=0.0001). This evidence was recently presented to WHO and formal assessment and development of a recommendation is currently ongoing. Other ITN products in the R&D pipeline are discussed in **Section 10.4**.

9.6 EFFECTIVENESS CHALLENGES RELATED TO IRS

IRS is the second most widely implemented vector control intervention by NMPs (**Section 7.2**). When carried out correctly, IRS has been shown to be a powerful intervention to reduce adult mosquito vector density and longevity and, therefore, to reduce malaria transmission (*144*).

However, despite its long tradition and the large body of associated operational experience, few RCTs have been conducted on IRS (*8*). There are some conditions similar to those considered for ITNs that are important for IRS if it is to have impact: most of the vector population feeds and rests indoors, people mainly sleep indoors at night and there are high levels of acceptance in the community. However, implementation of IRS at the required quality is logistically more challenging and considerably more expensive than the distribution of ITNs. In addition, evidence showing the impact of IRS when implemented in areas with high levels of ITN coverage is limited (*8*). Many factors influence the effectiveness of IRS, including insecticide resistance, the timing of spraying and the level of training of spray operators (which affects the quality of spraying) (*145*). In addition, at large scale, the costs are high. A recent review showed that, compared with ITNs, IRS was about five times more expensive per person protected per year, making it considerably less cost effective (*146*).

There have been suggestions that community-based delivery of IRS, where spray operators and materials are closer to the households and engagement of community health workers, may improve performance efficiencies, as observed in a study in Ethiopia (*147*). However, this study found a modest increase in coverage at a slightly lower cost without major differences in quality between community-based and campaign-type delivery systems. Although such alternative approaches may offer a pathway to implement less costly IRS, the maintenance of equipment, the sustained supervision of sprayers and the large budgets needed for widespread scale-up will remain a challenge. Costs are likely to increase even further as resistance to insecticides used in IRS emerges and more expensive chemicals are needed. Longer lasting insecticides, if developed and made available at reasonable prices, will reduce the frequency of IRS and may eventually reduce the cost of logistics.

9.7 BEYOND THE REACH OF ITNS: ADDRESSING RESIDUAL TRANSMISSION

Neither ITNs nor IRS are suited to reducing the effects of outdoor biting, a situation made even more challenging by both the genetic (insecticide resistance) and behavioural adaptations of the mosquitoes. Insecticide resistance is well known and closely monitored. However, the behavioural adaptation of the mosquito – in terms of changes to biting, feeding and resting behaviour – may be equally important, but is less well known and far less monitored (*148–150*). Evidence is increasing of the vector's attempts to reduce contact with insecticides; for example, by biting early before people go to bed, spending more time resting outdoors or feeding on livestock instead of humans. In addition, vectors that have this behavioural plasticity become more dominant than those with limited behavioural changes.

One example of such evidence comes from a 4-year longitudinal study of the malaria vectors *An. arabiensis* and *An. funestus* s.l. – which rest indoors and outdoors and seek a host indoors – in four villages in the United Republic of Tanzania. The study found evidence of changes in mosquito vector abundance, resting habitat and host that were consistent with the emergence of behavioural avoidance strategies, following a mass distribution of LLINs (*149*).

Although not explicitly considered in the effectiveness analysis presented in **Section 9.5.4**, this behavioural adaptation reduces the effectiveness of ITNs and IRS, independent of other factors, and is implicated in residual transmission in some settings (*151*).

Behavioural adaptation on the part of the vector will require investment in R&D into interventions that target outdoor transmission (**Section 10**).

10 MALARIA PREFERRED PRODUCTS AND R&D PIPELINE

WHO/GMP has been involved in the development of preferred product characteristics (PPCs) and target product profiles (TPPs) as key tools to incentivize and guide the development of products with high public health impact and suitability for use in LMIC. In close coordination with WHO, product development partnerships such as the Foundation for Innovative New Diagnostics (FIND) (*152*), the Medicines for Malaria Venture (MMV) (*153*) and the Innovative Vector Control Consortium (IVCC) (*154*) have worked with partners such as Unitaid (*155*) and the Global Fund (*156*) and with the private sector to catalyse malaria R&D to develop innovative antimalarial tools.

10.1 PREFERRED PRODUCT CHARACTERISTICS AND TARGET PRODUCT PROFILES FOR NEW MALARIA INTERVENTIONS

WHO PPCs and TPPs aim to communicate unmet public health needs and stimulate the development of products to meet those needs (*157, 158*). PPCs outline the intended use, target populations and other desired attributes of products, including characteristics related to safety and efficacy. Over recent years, new and updated PPCs have been developed for several malaria products.

10.1.1 Diagnostics

WHO is coordinating the development of TPPs for glucose-6-phosphate dehydrogenase (G6PD) tests to meet the needs for *P. vivax* control (*159*). Several drugs used for *P. vivax* radical cure, such as primaquine and tafenoquine, can lead to haemolysis in G6PD-deficient individuals in malaria endemic areas; hence, there is a need for G6PD testing, to guide drug administration. Therefore, TPPs are being developed for point-of-care screening or triage tests for G6PD activity, and for one-time quantitative tests for G6PD activity to establish baseline G6PD activity (phenotype) +/- genotype (of common variants) and haemoglobin concentration. PPCs for point-of-care and laboratory-based testing of *P. vivax* recent infection have also been developed.

10.1.2 Vaccines

Since the first malaria vaccine PPCs were published in 2014 (*160*), major milestones in R&D have been achieved. In 2021, RTS,S/AS01 became the first malaria vaccine to be recommended by WHO for use in settings with moderate to high transmission in sub-Saharan Africa. However, a healthy supply of vaccines will be needed to meet the global demand.

Updated malaria vaccine PPCs were published in 2022 (*161*); they include an expanded set of strategic goals for malaria vaccine R&D for the prevention of blood-stage infection, reduction of morbidity and mortality, and reduction of community-level transmission.

10.1.3 Vector control

Several PPCs for vector control have been published, ranging from the use of ITNs and indoor residual surface treatments (IRST) to endectocide and ectocide products:

- PPCs for ITNs for malaria transmission control in insecticide-resistant mosquito populations, published in 2021 (*162*);
- PPCs for vector control interventions to control malaria in complex humanitarian emergencies and in response to natural disasters, published in 2021 (*163*);
- PPCs for endectocide and ectocide products for malaria transmission control, published in 2022 (*164*) – these products may be existing drugs that have been repurposed for malaria control or new drugs specifically developed for this purpose; and
- PPCs for IRST for malaria transmission control in areas with insecticide-resistant mosquitoes, published in 2022 (*165*).

10.1.4 Chemoprevention

In December 2020, WHO/GMP and MMV co-convened a technical consultation to develop PPCs for drugs for malaria chemoprevention (*166*). PPCs for malaria chemoprevention drugs aim to address several use-cases: chemoprevention in children (SMC, IPTi/PMC, IPTsc and PDMC), during pregnancy (IPTp) and in nonimmune travellers. Development of new malaria chemoprevention drugs can include repurposing of approved malaria treatments for use in chemoprevention; recombining approved individual drugs into new combinations for chemoprevention; or development of new drug combinations specifically for chemoprevention.

10.1.5 Monoclonal antibodies

Passive immunization via the direct administration of functional antibodies could potentially be used as prophylaxis for several months, providing short-term protection to populations at high risk of clinical malaria or individuals less able to develop robust immune responses. In November 2021, WHO/GMP and IVB convened a scientific development group (*166*) to develop PPCs and address clinical development considerations for monoclonal antibodies (mAbs) for malaria prevention. The most immediate public health priority is the reduction of morbidity and mortality in infants and children due to *P. falciparum*. Another use-case for future consideration is the reduction of morbidity and mortality in adults, particularly the prevention of infection in pregnant or lactating women, women of childbearing age and other high-risk or vulnerable adult populations.

10.2 MALARIA DIAGNOSTICS

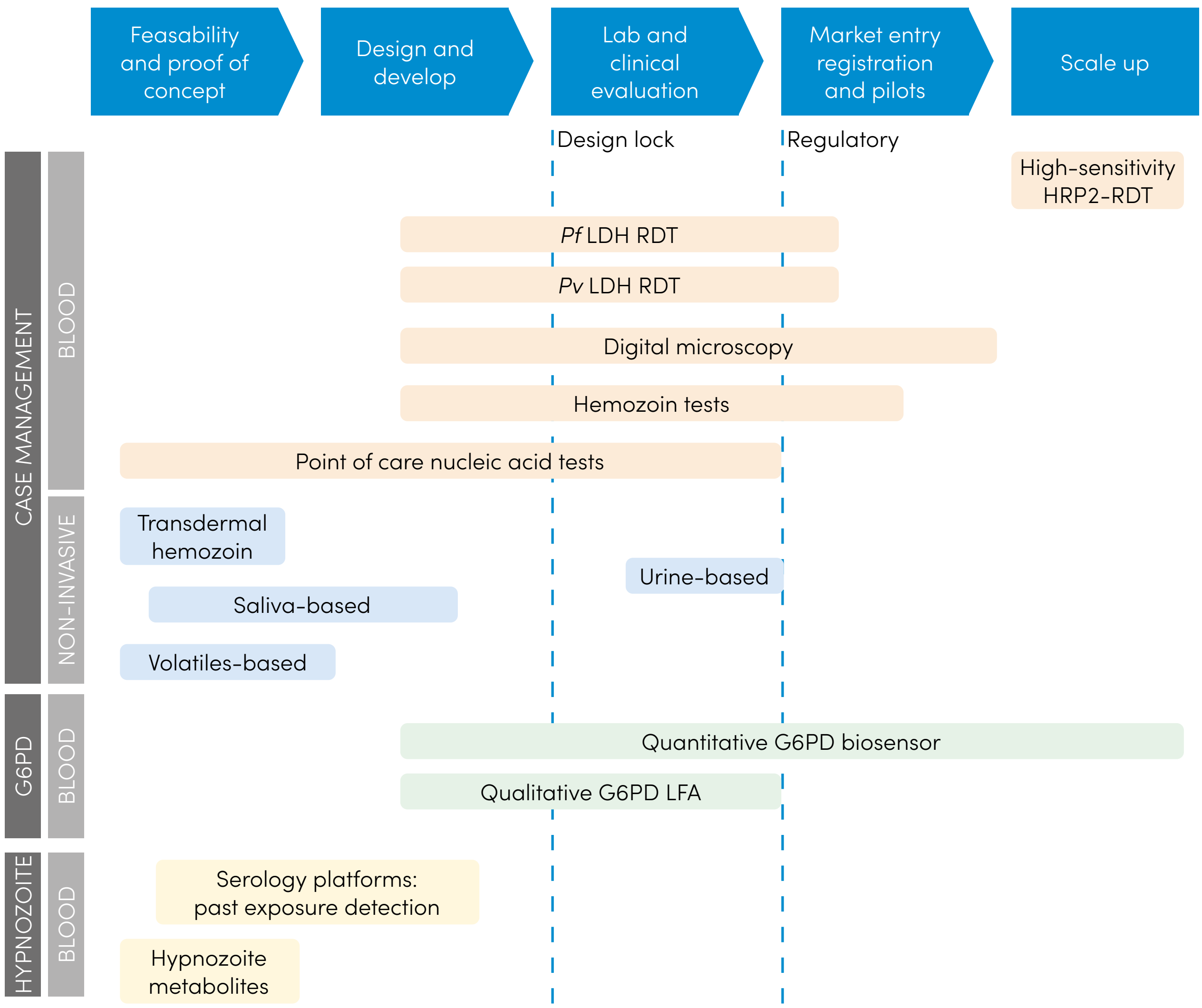
The malaria diagnostic tests market is dominated by RDTs that detect the HRP2 antigen expressed by *P. falciparum*. Single-line tests reliant on this one antigen represented 80% of the 413 million RDTs procured from WHO-prequalified suppliers in 2021. However, the spread of *P. falciparum* parasites with *Pfhrp2/3* gene deletions presents a major threat to reliable diagnosis. A diversified diagnostic landscape is needed to address this liability and the inadequate sensitivity of tools for species other than *P. falciparum*; also needed is a broader range of diagnostic use-cases (e.g. highly sensitive noninvasive screening for the prevention of re-introduction). The R&D pipeline includes products to address these gaps through efforts to both improve existing point-of-care platforms (specifically, lateral-flow immune-chromatographic antigen-detection tests [RDTs] and microscopy) and develop alternatives that use a range of sample types and technologies (**Fig. 10.1**).

10.2.1 Improvements to existing test types

In response to the critical need for non-HRP2 tests for *P. falciparum* and for improved *P. vivax* assays, efforts have centred on improving the sensitivity of detecting the species-specific LDH biomarker. RDTs based on

FIG. 10.1.

Malaria diagnostics pipeline, showing the development stage of main product types according to primary intended use-case and sample type *Source: Unitaid (2022) (167).*



G6PD: glucose-6-phosphate dehydrogenase; HRP2: histidine-rich protein 2; LDH: lactate dehydrogenase; LFA: lateral-flow assay; *Pf: Plasmodium falciparum*; *Pv: Plasmodium vivax*; RDT: rapid diagnostic test; WHO: World Health Organization.

[a] Test types currently eligible for the WHO prequalification programme.

*Pf*LDH and *Pv*LDH are currently under clinical evaluation by FIND and PATH, with expected submissions for WHO prequalification in 2022 and 2023. Three products are eligible for Global Fund procurement through the Global Fund/Unitaid Evidence Review Panel for diagnostics (ERPd). *P. falciparum* parasites express lower levels of *Pf*LDH than HRP2, which presents a technical challenge for testing sensitivity; however, *Pf*LDH does not persist in the blood after infection clearance and is thus an indicator of acute infection. Products in development have a range of test line configurations (e.g. single line for detection of both HRP2 and *Pf*LDH, versus separate lines, versus inclusion of *Pv*LDH), which may suit different clinical applications.

Digital apps (e.g. RDT readers and clinical decision-support tools) are being developed to support quality assurance and real-time surveillance. Demonstrating the benefits of such tools across use-cases is important to justify the additional costs these apps incur.

Outside sub-Saharan Africa, microscopy is the most widely used method of diagnosis because it allows for speciation and estimation of parasite loads. To support quality assurance and standardized performance, several approaches have been taken to develop digital microscopy, with different degrees of automation. Several such devices have recently come to market and others are in development.

10.2.2 Alternative platforms and sample types

There are numerous ongoing efforts to adapt complex laboratory nucleic acid detection methods into point-of-care devices, for the detection of very low parasite densities. The pipeline of molecular diagnostics includes early feasibility efforts through to commercially available products.

Noninvasive diagnosis is a growing area of interest, with potential applications for rapid screening outside conventional medical settings. Several projects are in early development; analytes of interest include saliva, volatile organic compounds, urine and hemozoin (a crystalline by-product of parasite metabolism, found in the digestive vacuole of *Plasmodium*). Promising biomarkers in saliva have been identified and are now the focus of product development efforts, whereas standardized panels of volatile biomarker signatures are more challenging to characterize. A simple dipstick assay that detects HRP2 in urine has been developed and commercialized in Nigeria for use in self-testing, but this application is not currently recommended by WHO. Technological platforms are also being developed for use with varied analytes and biomarkers, with biosensors promising a field-adapted and highly sensitive option. Hemozoin can be detected, for example, through optical and magnetic methods, as an indicator of infection. In development are blood-sample-based methods and noninvasive strategies that detect hemozoin through the skin. Commercial hemozoin-based products using blood samples are currently available, although speciation remains a challenge; noninvasive approaches are in early-stage development.

These new technologies are not currently eligible for submission for WHO prequalification, which to date include only lateral-flow RDT format assays.

10.2.3 Beyond diagnosis of acute infection of *P. vivax*

Diagnosis of G6PD status is recommended before radical cure treatment of *P. vivax* patients. A biosensor for quantitative G6PD activity measurement is currently under review for WHO prequalification and has already been approved by ERPd; other diagnostic tests are in the pipeline. Simpler qualitative lateral-flow assays are also in development; these could increase access to testing, but it may not be possible to adapt them for the diagnosis of female patients, who express a continuum of G6PD enzyme activity levels. Manufacturer interest in this diagnostic application is limited by the small market and the constraints of ensuring affordability. However, neonatal screening could represent an additional use for the devices and expand their uptake.

Another diagnostic application to recently join the pipeline but with prospects of a limited market size is the detection of latent *P. vivax* hypnozoite infection. Such diagnostic tests could have several uses, ranging from demonstrating an absence of transmission to identifying individuals at risk of relapse who could benefit from radical cure treatment. Investigation of both indirect and direct diagnostic approaches is ongoing. Serological platforms detecting antibody biomarkers that identify past exposure can be used as a proxy indicator of hypnozoite infection risk; product development using this indirect approach is ongoing. In terms of direct diagnostic approaches, feasibility studies to detect hypnozoite metabolites are being explored.

10.2.4 Supporting the diagnostic pipeline and landscape to promote quality diagnosis

Supporting manufacturers to develop new products is necessary, given the pressures of low profit margins that characterize the malaria market and deter many suppliers. Before 2020, donor-funded procurement depended on only two suppliers that shared over 80% of the market. Since 2018, the supplier base has shifted significantly, partly due to deliberate efforts by large procurers to diversify and strengthen the market. There are ample WHO-prequalified products for each of the major conventional case management test types in which *P. falciparum* detection is by HRP2 (e.g. *Pf*-only, *Pf*/pan and *Pf/ Pv*); however, for areas with *Pfhrp2/3* deletions, there are limited quality assured tests. Maintaining an active pipeline of new products and a resilient diagnostics market requires further efforts to support both manufacturers and country programmes.

WHO guidelines recommend a shift to non-HRP2-based tests in areas where 5% or more of *P. falciparum* infections are false negative on HRP2 RDTs because of *Pfhrp2/3* gene deletions. However, the uptake of new products (e.g. *Pf*LDH RDTs) has been slow. This may be due to insufficient evidence on the presence of deletions and the increased unit costs of the new RDTs, which would result in programmes being unable to meet their total demand. There has been slow uptake of a "high-sensitivity" HRP2-based RDT that came to market in 2017, possibly because of an unclear use-case and cost–benefit demonstration of its impact, as well as storage constraints (i.e. shorter shelf-life and tighter requirements for storage conditions compared with conventional RDTs).

Clear communication around the use-cases for new test types in the pipeline, their anticipated market sizes and public health benefits is critical to incentivize manufacturers to develop products and countries to take up new products. Generating evidence around the impact of new diagnostic tests will help to develop investment cases for tools that may have higher costs than current RDTs; forecasts of procurement demands also help suppliers to commit to R&D investments and countries to budget for new diagnostic tests. In addition, guidance is needed on the evidence requirements for policy implementation of new technologies, including those that are not currently included in the scope of the WHO prequalification programme.

Finally, concerted efforts to promote quality diagnosis in the largely unregulated retail sector, where about 40% of malaria consultations in the WHO African Region occur, could improve patient outcomes and create new market opportunities to encourage investment in malaria diagnostics.

10.3 MALARIA MEDICINES

MMV (*153*) works in partnership with a network of international organizations, academic institutions and public-sector, nongovernmental organization (NGO) and private-sector entities, to discover, develop and facilitate access to new antimalarial medicines. The current focus of the malaria medicine R&D is on the development of next-generation life-saving medicines for adults, particularly pregnant women and children who are at elevated risk from the consequences of malarial infection. Delivering a non-ACT treatment option, to simplify therapy or as a contingency against the intensification of either artemisinin or the partner drug resistance, is a high priority. These medicines should also reduce the probability of onward disease transmission. Parenteral formulations are being developed to provide new options for the management of severe malaria. Next-generation products are also needed for chemoprevention to address the paucity of alternative options to SP and SP-AQ, to protect millions of pregnant women and vulnerable children, to assist in responses to epidemics, and to provide MDA and prophylaxis for nonimmune travellers.

Under the coordination of MMV, there have been efforts to accelerate investment in promising new chemical entities (NCEs) in drug discovery, to offset the high attrition in the pipeline expected during clinical development of new oral treatments. Options under consideration for chemoprevention also include once per season injections with either prodrugs or mAbs. Currently, MMV and partners are progressing two candidate NCEs to preclinical development each year, a rate of output that has been maintained over the past 10 years.

10.3.1 Innovations with existing antimalarial treatments

Triple artemisinin-based combination therapy

The triple artemisinin-based combination therapy (TACT) approach relies on a combination of the short-acting artemisinin with two long-acting partner drugs to mitigate the risk of resistance. The combination of artemether-lumefantrine and amodiaquine (AL-AQ) is the most advanced in development. A loose combination of AL and AQ has been shown to be efficacious and well tolerated, with no new safety signals identified. The next study will probably involve the final presentation of a fixed-dose combination of the three drugs, to improve patient compliance.

ACT plus single low-dose primaquine for transmission blocking

A child-friendly primaquine tablet formulation is being developed for prequalification by WHO. Once quality manufacturing of required doses has been secured, co-blister packs with primaquine and ACTs, particularly AL, will be investigated to support the scale-up of this complementary transmission-blocking intervention.

Artemether-lumefantrine for neonates

In 2008, Coartem® Dispersible (AL) became the first fixed-dose ACT approved specifically for the treatment of children weighing 5 kg or more. A clinical trial is currently underway evaluating a different drug ratio of the two components to address the needs of neonatal patients under 5 kg with acute, uncomplicated malaria.

10.3.2 Next-generation antimalarial treatments

Ganaplacide-lumefantrine
Ganaplacide-lumefantrine is currently the most advanced non-artemisinin combination treatment in development. Ganaplacide (formerly known as KAF156) is a novel agent and it is paired with lumefantrine that has been reformulated to support a once-daily dosing regimen (compared with the current twice-daily dosing in combination with artemether). Results from Phase 2 studies showed safety and efficacy in adults, adolescents and children, and the combination is currently undergoing further evaluation in children aged down to 6 months as a 3-day oral regimen. A fixed-dose combination of the two components is expected to be tested in a Phase 3 trial. In addition to clearance of artemisinin resistant strains, this combination has the potential for transmission blocking.

M5717-pyronaridine
The M5717-pyronaridine combination has the potential for a shorter dosing regimen and is ready to enter Phase 2 development. Pyronaridine is a component of Pyramax®, an approved antimalarial medicine, and it has potent activity against multidrug-resistant strains. M5717 is a compound that has a novel mechanism of action, targeting the parasite protein synthesis pathway. The compound has demonstrated activity against all stages of the *P. falciparum* life cycle and thus has the potential to not only treat but also prevent malaria.

ZY19489-ferroquine
The ZY19489-ferroquine combination has the potential to be a single-dose cure owing to the long half-life of ferroquine; it is ready to start Phase 2 trials. Ferroquine, a derivative of chloroquine, was previously evaluated in Phase 2 studies in combination with artesunate but was not developed further. ZY19489 is a novel agent with potent antimalarial activity, with no resistance detected in vitro.

Cipargamin
Cipargamin (formerly known as KAE609) is a fast-acting, potent compound that is active against drug-resistant strains of malaria. The molecular target for cipargamin was identified as *Pf*ATP4, a cell membrane channel. The compound has been shown to be safe by oral route against the parasite as monotherapy in Phase 2 trials in adults in Africa. A new formulation for intravenous injection has been developed and the compound is currently being tested in a Phase 2 study in severe malaria. A combination drug partner has not yet been chosen.

10.3.3 Candidate molecules in early development

Table 10.1 presents a list and description of candidate molecules for malaria therapy in early development.

TABLE 10.1.
Candidate molecules in the early development portfolio for the treatment of clinical malaria

Molecule	Description
MMV533	A highly potent compound against *P. falciparum* and *P. vivax* strains, although its mechanism of action is unknown. It demonstrates no cross-resistance and is unable to select for resistant mutants in vitro. It has a long half-life in humans, and a predicted low human dose which together with the fast-killing parasite activity are desirable attributes for a single-dose regimen. It has completed a Phase 1 first-in-human and controlled human malaria infection study.
INE963	A fast-killing compound that is highly potent against *P. falciparum* and *P. vivax* strains, although its mechanism of action is unknown. It demonstrates no cross-resistance and is unable to select for resistant mutants in vitro. It has a moderate half-life in humans. The molecule is currently being evaluated in a Phase 1 first-in-human study.
GSK701	A compound with a novel mechanism of action and fast-killing parasite activity, highly potent only against *P. falciparum* strains, with a predicted low human dose. It has a short half-life and is currently being evaluated in a Phase 1 first-in-human study.
MMV183	A compound with a low predicted human dose, a short to moderate half-life, and no pre-existing resistance or resistance generation in vitro. The very high solubility together with fast-killing activity make it an attractive candidate for use in severe malaria as an injectable formulation. It also has demonstrated transmission-blocking activity. It is currently in preclinical development.
GSK484	A fast-killing compound with a predicted long half-life and low human dose – attributes that, if confirmed in humans, make it an attractive candidate for a single-dose regimen. No resistant parasite strains have been identified in the laboratory. It is currently in preclinical development.
IWY357	A compound with a predicted low human dose and long half-life. It is fast killing and demonstrates no ability to select resistant mutants in vitro. It is currently in preclinical development.
MMV609	A compound that shares the same mechanism of action as cipargamin. It is a fast-killing compound, with a predicted low human dose and long half-life. It has demonstrated transmission-blocking activity. It is currently in preclinical development.

10.3.4 Next-generation chemoprevention treatments

MMV has proposed a three-pronged approach for the R&D of new chemoprevention treatments, which was endorsed by WHO at a December 2020 meeting on PPCs for malaria chemoprevention. The three elements are summarized here and discussed below:

- **Repurpose** – aimed at achieving a policy change to allow approved treatments with 3-day drug combinations (e.g. DHA-PPQ, pyronaridine-artesunate or atovaquone-proguanil) to be used for monthly, three-dose chemoprevention regimens similar to those currently used for protecting children, or single-dose cures similar to those used for protecting pregnant women.
- **Recombine** – aimed at using approved antimalarial drugs in new combinations for prevention. This is a key R&D effort that needs to be accelerated immediately to help reduce the antimalarial burden in high-risk individuals and to bridge the time gap to the development of new drug combinations.
- **Develop** – aimed at developing novel drugs in combinations for chemoprevention and getting approval through a joint process between WHO and a stringent regulatory authority. This is a long-term effort and is not expected to result in the launch of a new combination until after 2030.

Repurpose

DHA-PPQ has garnered most of the attention because it provides the longest post-prophylactic benefit of all ACTs. It has been used for monthly prophylaxis in sickle cell disease where older drugs have showed little benefit (*168, 169*). Hospital post-discharge prophylaxis for 3 months has also been explored for children with severe anaemia, and has shown significant reduction in hospital re-admissions and mortality (*170*). DHA-PPQ is also being explored for SMC in east Africa. In addition, three trials of DHA-PPQ have been conducted in east Africa for IPTp. The DHA-PPQ was well tolerated in the second and third trimesters of pregnancy. DHA-PPQ improved malaria outcomes in pregnant mothers and prevented moderate anaemia compared with the standard SP and is cost effective. Stillbirth and neonatal death were also reduced with DHA-PPQ, but low birthweight was marginally better with the use of SP (*171*). Further studies are needed on infant outcomes at 6 and 12 months.

Recombine

Combination of DHA-PPQ with SP is being evaluated for chemoprevention in pregnancy. The meta-analysis (*171*) suggests that SP is providing additional benefit to the fetus, resulting in improved birthweight in additional to its antimalarial properties. MMV tested a three-drug combination of atovaquone-proguanil and amodiaquine in 2019, but development did not progress beyond Phase 1 owing to a higher risk of severe neurological reactions than was seen with individual drugs. Other options for recombination include selecting two known members of the 4-aminoquinoline family (pyronaridine, piperaquine or chloroquine). Alternatively, a monthly treatment dose of atovaquone-proguanil combined with a 4-aminoquinoline, to protect against the development of resistance, might be useful.

Develop

Identifying a small molecule for either oral administration or injection for chemoprevention is a high priority. Several molecules with the potential for oral chemoprevention when given once monthly are in preclinical testing. With new technologies and formulations, long-acting oral or injectable approaches represent a long-term investment solution complementary to malaria vaccines. The two most advanced injectable prodrugs in the MMV portfolio are highlighted below. Monoclonal antibodies are also being investigated as a potential cost-effective approach for a once per season injection. Outside of the MMV portfolio, there are two monoclonal antibodies from the NIH of which L9LS is the most advanced, currently in Phase 2 development.

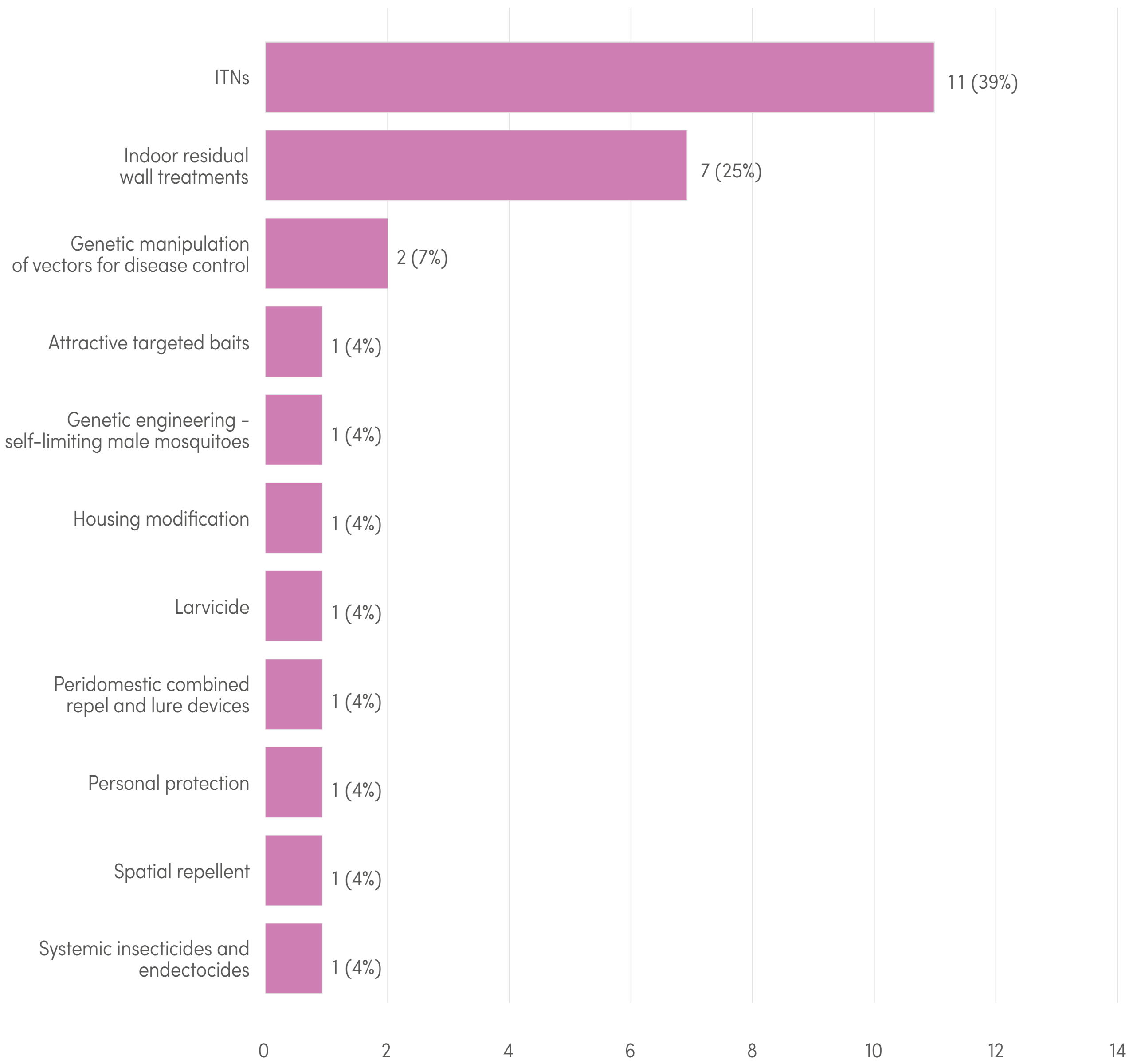
- **MMV371** is a prodrug of atovaquone with high liver-stage potency that is in development as a long-acting injection for malaria prevention. It has completed the preclinical safety package and is ready to enter a Phase 1 first-in-human study. A partner drug will have to be identified for further development to protect against resistance.
- **MMV167 (ELQ-331)** is the prodrug of ELQ300, a potent inhibitor of *P. falciparum* cytochrome bc1 that is entering preclinical development. Formulation for oral administration is available, and efforts are ongoing to develop a long-acting injectable formulation.

10.4 MALARIA VECTOR CONTROL R&D PIPELINE

The WHO Global Observatory on Health Research and Development (GOHRD) has collated malaria vector control interventions that are currently under development, reported by disease, type of intervention and stage of development (*172*). The GOHRD currently lists 28 vector control products in the R&D pipeline (**Fig. 10.2**). Eleven (39%) of these products are ITNs and seven (25%) are indoor residual wall treatments. Thirteen products (46%) are in the data-generation stage to support assessment of safety, quality and entomological efficacy. Seven products (25%) are undergoing epidemiological trials, six (21%) are being assessed by WHO to inform prequalification listing or WHO policy recommendation and two (7%) are at the prototype development stage.

FIG. 10.2.

Distribution of vector control products in the R&D pipeline by intervention type *Source: WHO (2022) (172).*



ITN: insecticide-treated mosquito net; R&D: research and development; WHO: World Health Organization.

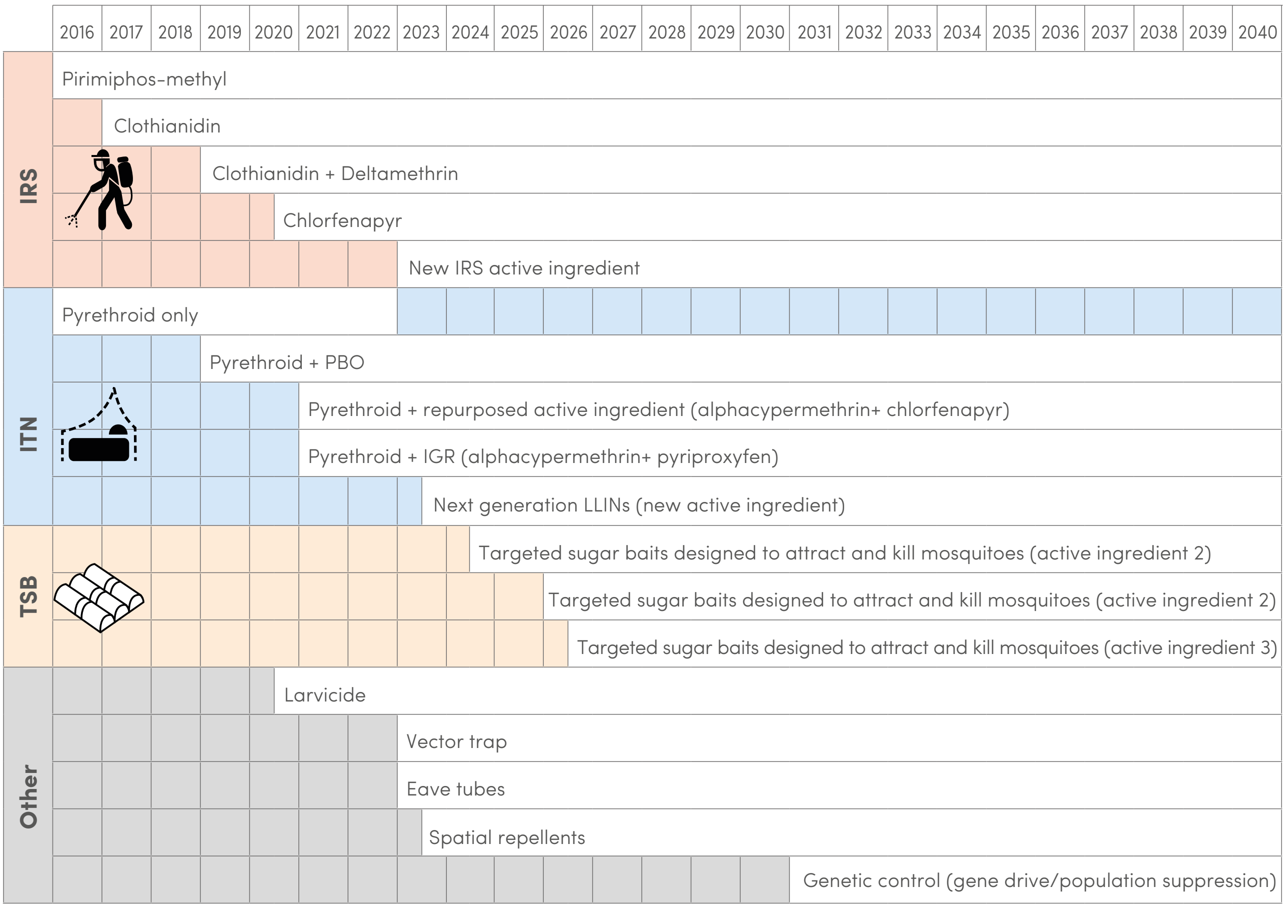
An overview of the current and previous malaria intervention products pipeline was provided by IVCC (*154*) and is presented in **Fig. 10.3**. Since its formation, IVCC has been helping to bring to market novel and repurposed insecticides with different modes of action, for use in ITNs and IRS, to support best practice insecticide resistance management (IRM). The ability to change modes of action every 3 years for ITNs and annually for IRS will preserve the efficacy of the insecticide by reducing the rate at which insecticide resistance will develop. Maintaining insecticide susceptibility by avoiding the use of a single class of insecticide across the same geographies and over consecutive years is key for the efficacy of vector control interventions.

The IVCC discovery programme has supported the development and deployment of a suite of IRS products with different modes of action. Pirimiphos-methyl was listed by WHOPES in January 2013, clothianidin was WHO prequalification listed in October 2017 and clothianidin + deltamethrin was WHO prequalification listed in December 2018. These three agents represent a group of new insecticides being deployed across endemic countries as part of their IRM strategies. In addition, chlorfenapyr and broflanilide, for which a prequalification listing is expected in the near future, will provide additional resistance management options.

The ability to change the mode of action on an ITN will also preserve, for as long as possible, the efficacy of new or repurposed insecticides applied to ITNs. Pyrethroids are becoming less efficacious because of their widespread use without an alternative mode of action. In 2017, a new ITN received a WHO recommendation. It combines a pyrethroid with a repurposed insecticide, chlorfenapyr, which has a different mode of action. The mixture of these two active ingredients is a step forward in insecticide resistance. Three further active ingredients are either in late-stage research or have progressed to full development and are expected to obtain a prequalification listing between 2026 and 2030.

FIG. 10.3.

A roadmap of current and new vector control products *Sources: IVCC (2022)* (*173*).



IGR: insect growth regulator; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; IVCC: Innovative Vector Control Consortium; PBO: piperonyl butoxide; TSB: targeted sugar baits.

An expanded vector control toolbox that includes larviciding, eave tubes and targeted sugar baits designed to attract and kill mosquitoes will further support IRM principles. This sugar bait, which is being developed to address the emerging threat of outdoor biting, is expected to achieve a prequalification listing in 2025. Other new interventions such as vector traps, eave tubes, spatial repellents and genetic control of mosquitoes are under different phases of development (**Fig. 10.3**).

Preserving vector susceptibility is the foundation of malaria and other vector-borne disease control and requires an approach that can be addressed through an integrated vector management (IVM) framework.

Compared with the situation a decade ago, today there are more vector control products available with different modes of action. However, these tools differ in their suitability for different disease transmission settings and geographies. How they are deployed in locally tailored IVM strategies will be critical in determining their effectiveness against malaria vectors and, ultimately, our ability to eradicate malaria.

10.5 MALARIA VACCINES

The malaria vaccines currently in clinical development target various stages of the parasite life cycle, including the pre-erythrocytic stage (targeting sporozoite or liver stage antigens), the blood stage, and the sexual, sporogonic or mosquito stage (targeting pre-fertilization gametocytes/gametes or post-fertilization zygotes/ookinetes). A summary of the main candidates is presented in **Table 10.2**. Further details can be found in the WHO review of malaria vaccine clinical development on the GOHRD malaria vaccine dashboard (*174*).

TABLE 10.2.
Malaria vaccine candidates (in active development) by life cycle stage and R&D phase *Source: WHO (2022) (174).*

Pre-erythrocytic stage
P. falciparum ■ **WHO recommended and prequalified** – RTS,S/AS01 (circumsporozoite protein) ■ **Phase 3** – R21/MatrixM (circumsporozoite protein) ■ **Phase 2** – *Pf*SPZ Vaccine (whole sporozoite); *Pf*SPZ-CVac (*Pf*SPZ challenge under chemoprophylaxis) ■ **Phase 1** – VLPM01 (virus-like particle); rCSP/AP10-602 (circumsporozoite protein); *Pf*GAP3-KO (genetically attenuated whole sporozoite); FMP013 and FMP014 (self-assembling nanoparticles); *Pf*SPZ-GA1 (genetically attenuated whole sporozoite); DNA-ChAd63 *Pf*CSP (heterologous prime-boost) ***P. vivax*** ■ **Phase 2** – *Pv*CSP (circumsporozoite protein); *Pv*SPZ (whole sporozoite)
Blood stage
P. falciparum ■ **Phase 2** – Rh5 (reticulocyte binding protein) ■ **Phase 1** – BK-SE36 (*Pf*SERA5 antigen) ***P. vivax*** ■ **Phase 2** – *Pv*DBP (Duffy-binding protein); *Pf*7G8 (chemically attenuated whole parasite); DNA-ChAd63 *Pf*CSP *Pf*AMA1 ME-TRAP (heterologous prime-boost)
Sexual, sporogonic or mosquito stage (interrupting transmission)
P. falciparum ■ **Phase 2** – *Pfs*230D1M-EPA/AS01B (pre-fertilization); *Pfs*25M-EPA/AS01B (post-fertilization) ■ **Phase 1** – *Pfs*25-IMX313/MatrixM (post-fertilization) ***P. vivax*** ■ **Phase 1** – *Pvs*25-IMX313/MatrixM (post-fertilization)
Malaria in pregnancy (targeting VAR2CSA antigens)
■ **Phase 1** – PRIMVAC; PAMVAC

DNA: deoxyribonucleic acid; *P.*: *Plasmodium*; WHO: World Health Organization.

11 KEY FINDINGS AND CONCLUSION

The *World malaria report 2022* tracks trends in the global malaria response and the impact of that response in the period 2000–2021. It highlights important barriers to progress, and the resilience needed to overcome them; it also provides the latest information on malaria intervention products that are in the R&D pipeline.

11.1 GLOBAL MALARIA RESPONSE AND TRENDS IN CASES AND DEATHS

Malaria endemic countries, with support from partners, have largely held the line against further setbacks to malaria control in 2021. They have achieved this despite disruptions to malaria prevention, testing and treatment services owing to the COVID-19 pandemic and the often-devastating impacts of the pandemic on health, social and economic systems.

In 2019, before the pandemic struck, there were an estimated 568 000 malaria deaths worldwide (**Section 3**). This estimate rose to 625 000 in the first year of the pandemic (2020) and then fell to 619 000 in 2021. During the 2 peak years of the pandemic (2020 and 2021), about 63 000 of the additional malaria deaths could be attributed to disruptions related to the COVID-19 pandemic. Although malaria cases continued to rise in 2021, the rate of increase was considerably lower than in the period 2019–2020. Cases stood at an estimated 247 million in 2021, compared with 245 million in 2020 and 232 million in 2019. Over the period 2020–2021, an estimated 13.4 million cases were attributed to disruptions to essential malaria services during the COVID-19 pandemic, mainly in moderate and high transmission countries. In the 11 HBHI countries, cases increased from 163 million to 168 million (**Section 4**).

Many countries with a low burden of disease maintained effective malaria responses during the pandemic and continued their drive towards elimination (**Section 4**). Among the 25 countries and one territory identified as having the capacity to eliminate malaria by 2025 (E-2025), the number of malaria cases fell by about 83% in the period since 2010. Between 2020 and 2021, case reductions were observed in 12 countries: Bhutan, Botswana, the Dominican Republic, Mexico, Nepal, the Republic of Korea, Saudi Arabia, South Africa, Suriname, Thailand, Timor-Leste and Vanuatu (note that in South Africa, case detection rates in the community during the pandemic and overall case burden may be higher than reported). However, there was a 30% increase in cases in 2021 compared with 2020 in the E-2025 countries, owing to increases in the Comoros, Costa Rica, the Democratic People's Republic of Korea, Ecuador, Eswatini, Guatemala, Honduras, Panama, Sao Tome and Principle and the territory of French Guiana.

Countries in the GMS continued to successfully battle antimalarial drug resistance through lowering the case burden of *P. falciparum*. Across the region, *P. falciparum* has repeatedly developed drug resistance to artemisinin, the most effective medicine for treating malaria. In some areas, parasites have also developed resistance to the drugs that are commonly combined with artemisinin. Importantly, these mutations have not spread beyond the GMS, although drug resistance has evolved independently in parts of the WHO African Region. Between 2000 and 2021, the six GMS countries (Cambodia, China, the Lao People's

Democratic Republic, Myanmar, Thailand and Viet Nam) reported a decrease of about 77% in indigenous malaria cases and of 94% in indigenous *P. falciparum* malaria cases (**Section 4**). During the pandemic period of 2020–2021, there was a 17% increase in indigenous malaria cases overall, but a 12% decline in *P. falciparum* cases. In 2021, Myanmar continued to account for most of the indigenous malaria cases (88%) and indigenous *P. falciparum* malaria cases (81%) in the subregion. The surveillance system has been disrupted in Myanmar, and estimated cases in 2021 may be lower than would have otherwise been reported.

The impact of disruptions on intervention delivery varied for different tools and contexts. Even though the disruptions to essential services were greater in 2020 than in 2021, the absolute numbers of ITNs and RDTs distributed by NMPs were higher in 2020 than in any year since 2000 (**Section 2** and **Section 7**). ACT distributions were also at a similar level to that seen in recent years before the pandemic. SMC distributions continued to increase in 2020 and 2021 relative to the period before the pandemic.

The strong commitment by malaria endemic countries and partners to deliver vital interventions for malaria prevention, diagnosis and treatment led to countries reporting fewer deaths in 2021 than in 2020, and a much slower rate of increase in malaria cases in the same period. However, the pandemic continues to be disruptive; for example, six countries in the WHO African Region distributed less than 60% of their ITNs, with the high-burden countries of Nigeria and Uganda distributing only 53% and 41%, respectively (**Section 2**).

11.2 RISKS TO PROGRESS AGAINST MALARIA

The overall progress towards malaria control began to slow after 2015, well before the COVID-19 pandemic (**Section 3** and **Section 8**). Efforts to reach the milestones set by the GTS face even bigger challenges, particularly in the WHO African Region (**Section 8**) – an estimated 96% of all malaria deaths occurred in this region in 2021, with about four in five of those deaths being among children aged under 5 years (**Section 3**).

Disruptions during the pandemic – combined with other humanitarian crises, health system challenges, restricted funding, rising biological threats and a decline in the effectiveness of core malaria control tools – threaten progress against malaria (**Section 3**, **Section 6** and **Section 9**). By 2021, global malaria case incidence was 59 cases per 1000 population at risk, against a target of 31 cases per 1000 – off track by 47%. Also, malaria deaths per 100 000 population at risk stood at 14.8 against a target of 7.8 – also off track by 47%. In 2021, the WHO African Region was off track for both the morbidity and mortality GTS milestones, by 45% and 47%, respectively (**Section 8**).

Gaps in access to equitable and quality care remain an important challenge to malaria. In sub-Saharan Africa, care was not sought for about a third of children who had fever in the 2 weeks before household surveys (**Section 7**). An analysis of inequality in malaria risks and access to interventions showed that although children in the poorest households were five times more likely to be infected with malaria, they were also two times less likely to access care (*175*). Among those who sought care, about 28% used the private sector, incurring costs that put considerable strain on the poorest households. Although nearly 70% of children with fever were cared for in the public sector, only about 1% were attended to by community health workers. The chances of a child being tested for malaria after seeking treatment nearly doubled in the period 2016–2021 compared with the period 2011–2015; nevertheless, about 42% of children with fever for whom treatment was sought did not receive a parasitological test. Comparing overall use of ACTs among these children to use of ACTs in children who were tested, it appears that most children were given ACTs without a test. This is supported by recent published literature showing important challenges with the quality of malaria case management; despite the increasing rollout of RDTs, many patients are still treated with ACTs without testing, as seen, for example, in sites in Angola (*176*), Ghana (*177*), Guinea (*178*) and Nigeria (*179*).

The COVID-19 pandemic and disease outbreaks, serious climate events and conflict contributed to the global economy contracting by 3.4% in 2020 and have limited countries' fiscal space to address multiple pressing concerns (**Section 2** and **Section 6**). In 2020, 70% of malaria endemic LMIC experienced a shock in their annual real GDP. The GDP of 34 of these countries, half of which are in the WHO African Region, shrank by more than 1%. Although the global economy expanded by 5.5% in 2021, GDP remained lower in most countries than it was in 2019 (**Section 6**).

Total funding in 2021 was estimated at US$ 3.5 billion, an increase from US$ 3.3 billion in 2020 and US$ 3.0 billion in 2019. However, investments in 2021 were well below the estimated US$ 7.3 billion that was required globally to stay on track for the GTS milestones. The funding gap between the amount invested and the resources needed has continued to widen, particularly over the past 3 years, increasing from a gap of US$ 2.6 billion in 2019, to US$ 3.5 billion in 2020 and US$ 3.8 billion in 2021. Since the COVID-19 pandemic and the war in the Ukraine, NMPs are being hit by rising costs associated with fuel, local distribution and supply chains. In addition, the cost of commodities used for malaria control are expected to rise, as newer ITNs and diagnostics need to be purchased to counter increasing resistance (**Section 6**). With the changing economic environment and the seventh Global Fund replenishment not achieving the expected targets (despite historic contributions by countries and partners), the challenges in the funding space for the malaria response will continue to increase.

Although more efficient procurement processes and market priming will help to keep global commodity prices within an affordable range, countries will also need greater efficiencies in implementation. Here, data-informed and locally tailored approaches will be essential. Under the HBHI approach, countries are increasingly using their data through a subnational tailoring process to identify optimal mixes of interventions (*180*). However, more work is needed to improve both data quality and data use. WHO has developed a toolkit to assess the status of malaria surveillance systems (*56*), and a few countries have used early versions of these tools to measure the performance of their systems, with support from partners (**Section 5**). Data from Burkina Faso, the Democratic Republic of the Congo and Ghana showed impressive reporting rates from the public sector of above 90%. However, the completeness of core malaria variables from health facility registers was modest, ranging from 40% in Ghana to 74% in the Democratic Republic of the Congo. More concerning was the concordance between aggregate reported data and health facility registers, which was less than 40% in all countries (**Table 5.2**). To accelerate progress in Pillar 3 of the GTS (*2*), similar assessments are needed to design national surveillance action plans, supported by considerable investment across the surveillance cycle. In most malaria endemic countries, such investment should be directed at strengthening health information systems more broadly.

Even where access to interventions is adequate, the effectiveness and performance of core malaria control tools face considerable challenges that threaten progress against malaria. Long-lasting ITNs treated with the insecticide pyrethroid alone have been one of the most important tools in the fight against malaria. Since 2005, over 2 billion such ITNs have been distributed for malaria prevention globally. A modelling analysis suggests that ITNs drove the declines in malaria seen from 2005 to 2015, especially in higher burden settings. Since 2015, however, progress against malaria has slowed and this world malaria report includes an extended analysis that describes the threats to this important prevention tool and highlights the collective impact of these challenges. The main challenges are insecticide resistance, physical and chemical durability of ITNs, allocation efficiency of delivery systems, retention of nets by households and the use of nets by household members. Although the data are widely variable by setting, analysis of pooled data suggest a median ITN retention time of about 1.9 years (*69*). A modelling analysis (**Section 9.5.4**) suggests that, shortly after net distribution, lower killing due to insecticide resistance has a large impact on overall net effectiveness. By the end of the time series, however, the waning of both insecticide and physical durability play the largest roles in reducing net effectiveness. When combined with barriers to ITN access, use and retention, the impact of the ITN campaign wanes dramatically by the end of the third year. In addition, the changing behaviour of mosquitoes to avoid ITNs – with changes to when and where they bite, feed and rest – limits the overall impact of ITNs, potentially increasing the risks of residual transmission.

An increasing proportion of *P. falciparum* parasites no longer express the *Pfhrp2/3* proteins most widely used to detect malaria through RDTs. Parasites that no longer produce HRP2 or the related HRP3 protein can escape detection by RDTs, presenting a major threat to reliable diagnosis. In 2021, nearly 80% of RDTs in use were based on HRP2 detection. Deletions in the genes for HRP2/3 proteins were first reported in 2010 in the Peruvian Amazon basin, and have since been documented in Asia, the Middle East, and central, east, southern and west Africa. Prevalence has reached 80% among symptomatic patients in Djibouti, Eritrea and Peru, demonstrating that these parasites can become dominant in the population, increasing the risk that missed cases will progress to severe disease and death.

Recent studies have confirmed the emergence of *P. falciparum* artemisinin partial resistance in Africa (**Section 9.2**). There are also worrying signs of resistance to the partner drugs used in combination with artemisinin in ACTs. Resistance to ACT partner drugs has prompted changes in first-line treatment of *P. falciparum* malaria in countries in the GMS, the Horn of Africa and south Asia. Artemisinin partial resistance is associated with mutations in the parasite's *PfKelch13* gene, and the proportion of parasites carrying these mutations is expanding in Eritrea, Papua New Guinea, Rwanda and Uganda. Treatment failure rates in the countries affected by artemisinin partial resistance remained below 10%, and the ACTs remain highly efficacious. However, the rising proportion of parasites with mutations associated with artemisinin partial resistance is worrying.

An. stephensi, a mosquito that can transmit both *P. falciparum* and *P. vivax* parasites, is posing an added challenge to disease control efforts in the WHO African Region. It can thrive in urban environments and is resistant to many of the insecticides used in public health. Originally native to parts of south Asia and the Arabian Peninsula, *An. stephensi* has now been reported in five countries in the WHO African Region. Although this mosquito can also adapt to rural settings, the WHO African Region is rapidly urbanizing, with 40% of the population already living in urban areas, increasing concerns of malaria outbreaks if *An. stephensi* spreads.

11.3 ENHANCING RESILIENCE

The concept of health system resilience has become widespread as a result of the excess mortality associated with disruptions to health services during the Ebola outbreak in west Africa and the ongoing COVID-19 pandemic. Although different definitions of resilience exist, in the context of health systems, the overall focus is the ability to effectively manage change or the impact of extreme events, while maintaining essential health services. Despite agreement on the importance of resilience, there has been a relative failure to decisively translate the objectives and attributes of resilience into national policy, planning and service operations.

In spite of the many challenges, malaria endemic countries and partners have demonstrated some good examples of resilience through the worst of times. Even before the COVID-19 pandemic, countries were dealing with a broad range of challenges. However, a more predictable and systematic approach to building resilience is needed because of the increasing frequency of natural and human-made disasters and conflict, and the threat of climate change and future disease pandemics at a time when global financial resources for health and malaria are constrained. There have been some useful lessons from the COVID-19 response, which illustrate how countries can make intentional efforts to build health system resilience to respond to a wide range of shocks and demands, using recovery as a platform and harnessing current political and economic impetus.

At the start of the pandemic, as reported in the *World malaria report 2021* (*180*), WHO convened partners to contribute to a malaria and COVID-19 response that included the development of guidance to countries for tailoring the malaria response to the COVID-19 pandemic. This was followed by concerted efforts by donors, especially the Global Fund and the US President's Malaria Initiative (PMI), to provide additional funding or increase flexibilities within existing funding to help countries deliver essential malaria services. In March 2021, the government of the USA provided a US$ 3.7 billion emergency contribution to the Global Fund, to support the COVID-19 Response Mechanism (C19RM) (*181*). The C19RM has been critical to reinforcing the response by supporting COVID-19-related adaptation of programmes to fight HIV, TB and malaria, and by strengthening health and community systems.

In September 2022, the World Bank established the financial intermediary fund (FIF), with technical leadership by WHO, to support LMIC in pandemic prevention, preparedness and response (*182*) (PPR). Building stronger and more resilient health systems is an important part of the FIF's work programme and, to this end, other major diseases such as malaria are likely to benefit. Closer synergies between disease programmes and institutions responsible for pandemic PPR is essential.

To support a unified approach to recovery and to build resilience, WHO outlined seven policy recommendations in its position paper, including focused support to countries with settings that are fragile or affected by conflict or violence (*183*).

Although many definitions of resilience focus on unforeseen and extreme events, such as the COVID-19 pandemic, WHO is also providing support and guidance to countries to help them withstand some of the more predictable and chronic stresses that threaten the malaria response. Thus, WHO has increased the transparency and flexibility of and the access to its malaria recommendations, to help countries to easily adapt the recommendations to their local context (**Section 2.2**) (*8*). Also, in September 2022, WHO launched an initiative to stop the spread of the *An. stephensi* malaria vector in Africa (**Section 2.4**) (*18*). This initiative calls for collaboration, improved surveillance, information exchange, normative guidance and research as the key to the response. In October 2022, WHO launched the *Global framework for the response to malaria in urban areas* (*20*), along with UN-Habitat (**Section 2.5**). By 2050, almost 70% of people globally will live in cities, and unplanned urbanization is likely to result in a malaria disease burden that disproportionately affects the urban poor. The new framework provides guidance for city leaders, health programmes and urban planners for the control and elimination of malaria. In November 2022, WHO launched a new strategy to curb antimalarial drug resistance in the WHO African Region (**Section 2.3**) (*10*). The strategy aims to tackle drug resistance through, among other measures, tracking its spread, identifying the populations most at risk, and developing viable alternative treatments through four interconnected pillars. Global investment in surveillance systems has expanded the digitization of health information systems in many countries (**Section 5.1**). However, the overall status of surveillance systems, especially in moderate and high transmission countries where the malaria burden is concentrated, remain weak (**Section 5.2**). Strengthening surveillance will require greater investment not only in digital solutions, but also in greater health workforce capacity and synergies across disease and health programmes.

Being ready to address these foreseen challenges and less predictable extreme events will require a multidisciplinary and multisectoral response with trusted national leadership and well-functioning, equitable and resilient health systems. Such systems will need to be built on a platform of primary health care and essential public health functions that encompasses the importance of a resilient community response that is able, and supported, to withstand, adapt to and recover from adversity. The revised GTS recognizes that these resilient systems underpin the overall success of the malaria response, delivering quality services to all those in need and effectively adapting to disruptive events – such as epidemics, pandemics and other natural disasters, including climate change. The benefits of such resilient systems would extend to all sectors and the economy.

Despite uncertainties about exactly how climate change will affect malaria, it will certainly affect the geographical range, intensity and seasonality of vector-borne diseases. More broadly, climate change will directly affect human health across the world and threaten the capacity of health systems to manage and protect people's health – particularly in areas of conflict and disaster, as climate change compounds these challenges. The WHO *Operational framework for building climate resilient health systems* (*184*) provides a wide range of guidance to support countries on health adaptation to climate change.

11.4 R&D PRODUCTS PIPELINE

Despite recent setbacks, investment in R&D has played a crucial role in the success against malaria since 2000 (**Section 10**). Over the past 20 years, the backbone of the development of the malaria response has been RDTs to accurately diagnose malaria in primary health care settings and by community health workers, ACTs to respond to resistance to chloroquine and SP, and ITNs and eventually LLINs as vector control tools that were effective and relatively easy to scale up. In addition, new chemicals have been developed to address resistance of mosquitoes to the insecticides used in IRS.

The most widely used RDT, which detects the parasite's HRP2/3 protein, is becoming less effective as the malaria parasite mutates; however, there is hope that new diagnostic tests will be developed to replace current tests (**Section 9.1**). Currently, WHO recommends a shift to non-HRP2-based tests in countries where more than 5% of symptomatic *P. falciparum* infections have the genetic mutation that allows them to escape detection (*72*). Researchers are also pursuing the development of diagnostic tests that use alternative biomarkers (**Section 10.2**). In addition, noninvasive diagnosis using saliva and urine is a growing area of investigation, with potential for rapid screening outside of conventional medical settings. Other efforts seek to improve diagnostic tools related to *P. vivax*, which would allow the safe use of medical treatments for radical cure of the disease. Global health organizations and donors are supporting diversification of the diagnostic pipeline. Before 2020, only two suppliers of RDTs shared over 80% of the market. Procurement strategies by PMI and the Global Fund diversified this landscape, leading to seven new tests being approved in 2020. Currently, there are 19 prequalified RDTs from seven manufacturers, with a further eight tests from five suppliers under prequalification review.

There are several ongoing innovations in malaria medicines for case management and chemoprevention (**Section 10.3**). Delivering non-ACT treatment options, as a contingency against the emergence of artemisinin resistance, is a global priority. A summary by MMV of medicines under development includes triple ACT that relies on a combination of the short-acting artemisinin with two long-acting partner drugs to mitigate the risk of resistance, and next-generation antimalarial treatments that use non-artemisinin chemical entities. Four novel drug combinations are now in clinical trials, and a host of candidate molecules are in early development; there are also new treatments to prevent malaria, particularly in pregnant women and in children at risk of infection. Work is ongoing to use currently approved treatments in new ways, with different schedules, and to recombine approved antimalarial drugs novel ways; there is also a longer term strategy to develop novel drugs for chemoprevention. Passive immunization with mAbs is a promising area of chemoprevention. A recent study suggests that human antibodies to malaria can be used to provide short-term protection to populations at high risk of clinical malaria (*185*).

Innovations in vector control suggest a promising pipeline of products. Already, as pyrethroid resistance becomes more widespread and reduces the effectiveness of LLINs, the R&D pipeline has resulted in a new generation of ITNs to mitigate the development of resistance and improve effectiveness (**Section 10.4**). For example, based on trial evidence showing that pyrethroid-PBO nets were more effective than pyrethroid-only nets in lowering parasite prevalence, WHO has recommended pyrethroid-PBO nets for use in areas of high pyrethroid resistance (*9*). In 2021, 46% of the 220 million ITNs delivered were PBO nets (25% more than in 2020), with plans for further scale-up (**Section 7**). Promising results from pyrethroid + chlorfenapyr ITN trials also showed a marked improvement in preventing malaria compared with pyrethroid-only nets (*143*), and WHO is now reviewing evidence for a potential recommendation for its use. Overall, a summary by WHO and IVCC shows that there are 28 vector control products in the R&D pipeline, including new ITNs and IRS, targeted sugar baits, spatial repellents, endectocides and genetic modifications of the mosquito to limit their ability to transmit malaria (**Section 10.4**).

In October 2021, WHO recommended the RTS,S/AS01 malaria vaccine for the prevention of *P. falciparum* malaria in children living in regions with moderate to high transmission – broader vaccine rollout is expected later in 2023, although supply will initially be limited. Gavi will facilitate the rollout to Gavi-eligible countries. A host of vaccine candidates are in development. As with RTS,S, many of them target the parasite before it enters the human liver where it can quickly multiple. The most advanced of these vaccine candidates is R21 (*186*). Other vaccines in development target later stages in the parasite's life cycle, target *P. vivax* or seek to protect women during pregnancy.

Globally, funding for malaria basic research and product development still falls short of the estimated US$ 851 million projected to be required to stay on track towards the GTS milestones (*2*). In 2021, an estimated US$ 626 million was invested in malaria R&D, a decline of US$ 54 million from 2020. This fall represented the third consecutive year of funding decline since its 2018 peak, taking headline investment to its lowest level since 2013; the decline is driven by reductions in research in vaccines and other products. With the threats faced by the current malaria interventions and the need for new and improved tools, there is an urgent need to ramp up investments in malaria R&D.

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Annexes

Fig. 2.1. Response interventions clustered into the strategy's four pillars to address antimalarial drug resistance in Africa

Figure extracted and adapted from the 2022 *Strategy to respond to antimalarial drug resistance in Africa* (*1*).

Fig. 2.2. Aims of the WHO initiative to support an effective response to *An. stephensi* on the African continent

Figure extracted and adapted from the World Health Organization (WHO) brochure *WHO initiative to stop the spread of* Anopheles stephensi *in Africa* (*2*).

Fig. 2.3. Building blocks of the *Global framework for the response to malaria in urban areas*

Figure extracted and adapted from the *Global framework for the response to malaria in urban areas* (*3*).

Fig. 2.4. People in humanitarian need in malaria endemic countries as of December 2021

Figure developed from data extracted from the *Global humanitarian overview 2022* (*4*).

Fig. 2.5. ITNs planned and distributed during mass campaigns in 52 malaria endemic countries, 2020–2022

The figure summarizes the planned insecticide-treated mosquito net (ITN) distributions via mass campaigns in 2020 and 2021 and their spillover into 2022. In countries where no data were reported on planned distribution or where ITNs distributed were more than ITNs planned for distribution, adjustments were made so that ITNs planned for distribution are equal to ITNs distributed in the respective year. Data were submitted by countries to WHO, the Alliance for Malaria Prevention, the RBM Partnership to End Malaria and the Global Fund.

Fig. 2.6. Results from WHO surveys on disruptions to malaria diagnosis and treatment services during the COVID-19 pandemic from three rounds of surveys in 2020–2021

Data used in these graphs are based on rounds 1, 2 and 3 of the essential health services (EHS) disruption surveys implemented by the WHO Integrated Health Services Department to determine the effects of the coronavirus (COVID-19) pandemic (*5–7*).

Fig. 2.7. Number of malaria tests performed, by WHO region, in 86 malaria endemic countries

Countries submitted data to WHO.

Fig. 3.1. Countries with indigenous cases in 2000 and their status by 2021

Data on the number of indigenous cases (an indicator of whether countries are endemic for malaria) were as reported to WHO by national malaria programmes (NMPs). Countries with 3 consecutive years of zero indigenous cases are considered to have eliminated malaria.

Table 3.1. Global estimated malaria cases and deaths, 2000–2021

a) Global estimated malaria cases

For each country or area, the number of malaria cases was estimated by one of the three methods described below.

Method 1

Method 1 was used for countries and areas outside the WHO African Region, and for low transmission countries and areas in the African Region as follows: Afghanistan, Bangladesh, the Bolivarian Republic of Venezuela, Botswana, Brazil, Cambodia, Colombia, the Dominican Republic, Eritrea, Ethiopia, French Guiana, the Gambia, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, the Lao People's Democratic Republic, Madagascar, Mauritania, Myanmar, Namibia, Nepal, Nicaragua, Pakistan, Panama, Papua New Guinea, Peru, the Philippines, the Plurinational State of Bolivia, Rwanda, Senegal, Solomon Islands, Timor-Leste, Vanuatu, Viet Nam, Yemen and Zimbabwe.

Estimates were made by adjusting the number of reported malaria cases for completeness of reporting, the likelihood that cases were parasite positive, and the extent of health service use. The procedure, which is described in the *World malaria report 2008* (*8*), combines national data annually reported by NMPs (i.e. reported cases, reporting completeness and likelihood that cases are parasite positive) with data obtained from nationally representative household surveys on health service use among children aged under 5 years, which was assumed to be representative of the service use in all ages. Briefly:

$T = (a + (c \times e))/d \times (1 + f/g + (1-g-f)/2/g)$

where:

a is malaria cases confirmed in the public sector

b is suspected cases tested

c is presumed cases (not tested but treated as malaria)

d is reporting completeness

e is test positivity rate (malaria positive fraction)=a/b

f is the fraction seeking treatment in the private sector

g is the fraction seeking treatment in the public sector

Factor to adjust for those not seeking treatment: $(1-g-f)$

Cases in the public sector: $(a + (c \times e))/d$

Cases in the private sector: $(a + (c \times e))/d \times f/g$

To estimate the uncertainty around the number of cases, the test *positivity rate* was assumed to have a normal distribution centred on the test positivity rate value and standard deviation – defined as 0.244 × *f*0.5547 and truncated to be in the range 0, 1. *Reporting completeness* (*d*), when reported as a range or below 80%, was assumed to have one of three distributions, depending on the value reported by the NMP. If the value was reported as a range greater than 80%, the distribution was assumed to be triangular, with limits of 0.8 and 1.0, and the peak at 0.8. If the value was more than 50% but less than or equal to 80%, the distribution was assumed to be rectangular, with limits of 0.5 and 0.8. Finally, if the value was less than or equal to 50%, the distribution was assumed to be triangular, with limits of 0 and 0.5, and the peak at 0.5 (*9*). If the reporting completeness was reported as a value and was more than 80%, a beta distribution was assumed, with a mean value of the reported value (maximum of 95%) and confidence intervals (CIs) of 5% around the mean value. The fraction of children brought for care in the public sector and in the private sector was assumed to have a beta distribution, with the mean value being the estimated value in the survey and the standard deviation being calculated from the range of the estimated 95% CIs. The fraction of children not brought for care was assumed to have a rectangular distribution, with the lower limit being 0 and the upper limit calculated as 1 minus the proportion that were brought for care in the public and private sectors. The three distributions (fraction seeking treatment in the public sector, fraction seeking treatment in the private sector only and fraction not seeking treatment) were constrained to add up to 1.

Sector-specific care seeking fractions were linearly interpolated between the years that had a survey, and were extrapolated for the years before the first or after the last survey. The parameters used to propagate uncertainty around these fractions were also imputed in a similar way or, if there was no value for any year in the country or area, were imputed as a mixture of the distributions of the region for that year. CIs were obtained from 10 000 draws of the convoluted distributions. The data were analysed using R statistical software, using the *convdistr* R package to propagate uncertainty and manage distributions (*10*).

For India, the values were obtained at subnational level using the same methodology but adjusting the private sector for an additional factor because of the active case detection activities, estimated as the ratio of the test positivity rate in active case detection divided by the test positivity rate for passive case detection. This factor was assumed to have a normal distribution, with mean value and standard deviation calculated from the values reported in 2010. An additional adjustment was applied in several states in India for 2020 and 2021, to control for the reductions in reported testing rates associated with disruptions in health services related to the COVID-19 pandemic. The states with reductions in testing rates below those expected (defined as a change in testing rates of more than 10% observed between 2018 and 2019) in 2020 were Bihar, Chandigarh, Chhattisgarh, Dadra and Nagar Haveli, Delhi, Goa, Jharkhand, Karnataka, Puducherry, Punjab, Uttar Pradesh, Uttarakhand and West Bengal. In 2021, the states with reductions in testing rates were Assam, Chandigarh, Chhattisgarh, Daman and Diu, Delhi, Goa, Himachal Pradesh, Karnataka, Kerala, Manipur, Puducherry, Punjab, Uttar Pradesh, Uttarakhand and West Bengal. In these states, the excess number of indigenous cases expected in the absence of diagnostic disruptions was calculated by estimating the number of additional tests that would have been conducted if testing rates were similar to those observed in 2019 then applying the test positivity ratio observed in 2019 (or in 2020, for Delhi and Jharkhand, or in 2021 for Delhi and Puducherry) to this number. The malaria burden in countries outside the WHO African Region was affected by the COVID-19 pandemic in different ways. In several countries, the movement disruptions led to transmission reductions; in other cases, testing rates remained unchanged. This made it challenging to apply a single source of data for correction to all countries, considering also that it was difficult to relate the reported data to the EHS response. No adjustment for private sector treatment seeking was made for the following countries and areas because they report cases from the private and public sector together: Bangladesh, the Bolivarian Republic of Venezuela, Botswana, Brazil, Colombia, the Dominican Republic, French Guiana, Guatemala, Guyana, Haiti, Honduras, Myanmar (since 2013), Nicaragua, Panama, Peru, the Plurinational State of Bolivia and Rwanda.

Method 2

Method 2 was used for high transmission countries in the WHO African Region and for countries in the Eastern Mediterranean Region in which the quality of surveillance data did not permit a robust estimate from the number of reported cases. These countries were Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, the Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mozambique, the Niger, Nigeria, Sierra Leone, Somalia, South Sudan, the Sudan, Togo, Uganda, the United Republic of Tanzania and Zambia. In this method, estimates of the number of malaria cases were derived from information on parasite prevalence obtained from household surveys.

First, data on parasite prevalence from almost 60 000 survey records were assembled within a spatio-temporal Bayesian geostatistical model, together with environmental and sociodemographic covariates, and data distribution on interventions such as ITNs, antimalarial drugs and indoor residual spraying (IRS) (*11*) that are updated yearly to review the model. The geospatial model enabled predictions of *Plasmodium falciparum* prevalence in children aged 2–10 years, at a resolution of 5 × 5 km^2, throughout all malaria endemic WHO African Region countries for each year from 2000 to 2020. Second, an ensemble model was developed to predict malaria incidence as a function of parasite prevalence (*12*). The model was then applied to the estimated parasite prevalence, to obtain estimates of the malaria case incidence at 5 × 5 km^2 resolution for each year from 2000 to

2021.[1] Data for each 5 × 5 km^2 area were then aggregated within country and regional boundaries, to obtain both national and regional estimates of malaria cases (*14*).

In 2020 and 2021, additional cases estimated using this method were added to account for the disruptions in malaria prevention, diagnostic and treatment services as a result of the COVID-19 pandemic and other events that occurred during this period. Disruption information was reported per country and was obtained from the national pulse surveys on continuity of EHS during the COVID-19 pandemic conducted by WHO (first round in May–July 2020, second in January–March 2021 and third in November–December 2021) (*5-7*). The medium, minimum and maximum (with a limit of 50%) values of the ranges provided by countries to define disruptions were used to quantify the percentage of malaria service disruptions. This information was integrated into the estimates by applying an approach previously used for assessing the impacts of interventions on malaria burden through the creation of counterfactual burden estimates for scenarios with varying levels of intervention coverage. It was assumed that COVID-19-related disruptions to health care manifested themselves as reduced treatment seeking for malaria and thus reduced effective treatment with an antimalarial drug. The counterfactual estimates were then aligned, per country, with the estimates from the pulse surveys to produce a set of estimates, adjusted for the COVID-19 pandemic, for 2020 and 2021. A comparison of the result of both models (in the presence and absence of diagnosis and treatment disruptions, with both models accounting for disruptions to prevention interventions) made it possible to estimate the number of additional cases associated with the disruptions that occurred during the COVID-19 pandemic. For countries for which the estimates with the updated spatio-temporal model were considerably different from previous estimates without addition of new data, or where trends in reported cases were significantly different in direction (Angola, Central African Republic, Chad, the Democratic Republic of the Congo, Mali, South Sudan, the Sudan, Uganda and Zambia), the case series published in the *World malaria report 2020* (*14*) were used until 2020, adjusting for the changes in population at risk values. The values for 2021 were estimated by applying the change rate between the cases estimated using the spatio-temporal model of incidence between 2020 and 2021, and adjusting for population changes between these two years.

Method 3

For most of the elimination countries and countries at the stage of prevention of reintroduction, the number of indigenous cases registered by NMPs are reported without further adjustments. The countries in this category were Algeria, Argentina, Armenia, Azerbaijan, Belize, Bhutan, Cabo Verde, China, the Comoros, Costa Rica, the Democratic People's Republic of Korea, Djibouti, Ecuador, Egypt, El Salvador, Eswatini, Georgia, Iran (Islamic Republic of), Iraq, Kazakhstan, Kyrgyzstan, Malaysia, Mexico, Morocco, Oman, Paraguay, the Republic of Korea, Sao Tome and Principe, Saudi Arabia, South Africa, Sri Lanka, Suriname, the Syrian Arab Republic, Tajikistan, Thailand, Türkiye, Turkmenistan, the United Arab Emirates and Uzbekistan.

Country-specific adjustments

For some years, information for certain countries was not available or could not be used because it was of poor quality. For countries in this situation, the number of cases was imputed from other years where the quality of the data was better (adjusting for population growth), as follows: for Afghanistan, values for 2000–2001 were imputed from 2002–2003; and for Bangladesh, values for 2001–2005 were imputed from 2006–2008. For Ethiopia, values for 2000–2019 were taken from a mixed distribution between values from Method 1 and Method 2 (50% from each method). For the Gambia, values for 2000–2010 were imputed from 2011–2013; for Haiti, values for 2000–2005, 2009 and 2010 were imputed from 2006–2008; for Indonesia, values for 2000–2003 and 2007–2009 were imputed from 2004–2006; and for Mauritania, values for 2000–2010 were imputed from a mixture of Method 1 and Method 2, starting with 100% values from Method 2 for 2001–2002, with that percentage decreasing to 10% of Method 1 in 2010. For Myanmar, values for 2000–2005 were imputed from 2007–2009; and for Namibia, values for 2000 were imputed from 2001–2003 and values for 2012 were imputed from 2011 and 2013. For Pakistan, values for 2000 were imputed from 2001–2003; and for Papua New Guinea, values for 2012 were imputed from 2009–2011. For Rwanda, values for 2000–2006 were imputed from a mixture of Method 1 and Method 2, starting with 100% values from Method 2 in 2000, with that percentage decreasing to 10% in 2006. For Senegal, values for 2000–2006 were imputed from a mixture of Method 1 and Method 2, with 90% of Method 2 in 2000, decreasing to 10% of Method 2 in 2006. For Thailand, values for 2000 were imputed from 2001–2003; for Timor-Leste, values for 2000–2001 were imputed from 2002–2004; and for Zimbabwe, values for 2000–2006 were imputed from 2007–2009.

Estimation of P. vivax cases

The number of malaria cases caused by *P. vivax* in each country was estimated by multiplying the country's reported proportion of *P. vivax* cases (computed as 1 – *P. falciparum*) by the total number of estimated cases for the country. For countries where the estimated proportion was not 0 or 1, the proportion of *P. falciparum* cases was assumed to have a beta distribution and was estimated from the proportion of *P. falciparum* cases reported by NMPs.

Population at risk

To transform malaria cases into incidence, an estimate of population at risk was used. The proportion of the population at high, low or no risk of malaria was provided

[1] See the Malaria Atlas Project website for methods on the development of maps (*13*).

by NMPs. Population at risk was estimated as the population at risk in high endemic areas and half of the population at risk in low endemic areas. This was applied to the latest United Nations (UN) population estimates available (2022, an update from the estimates used for the world malaria reports for 2020 and 2021), to compute the number of people at risk of malaria. This number was sustained over time to ensure comparability of incidence estimates across years in the same cohort of countries that had been endemic since 2000. The population at risk at regional and global level was aggregated; it included the population of all endemic countries since 2000, even though some of them achieved elimination during this time.

b) Global estimated malaria deaths

The number of malaria deaths was estimated using methods from Category 1, 2 or 3, as outlined below.

Category 1 method

The Category 1 method was used for low transmission countries and areas, both within and outside the WHO African Region: Afghanistan, Bangladesh, the Bolivarian Republic of Venezuela, Botswana, Cambodia, the Comoros, Djibouti, Eritrea, Eswatini, Ethiopia, French Guiana, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, the Lao People's Democratic Republic, Madagascar, Myanmar, Namibia, Nepal, Pakistan, Papua New Guinea, Peru, the Philippines, the Plurinational State of Bolivia, Solomon Islands, Somalia, the Sudan, Timor-Leste, Vanuatu (between 2000 and 2012), Viet Nam, Yemen and Zimbabwe.

A case fatality rate of 0.256% was applied to the estimated number of *P. falciparum* cases, which represents the average of case fatality rates reported in the literature (*15-17*) and rates from unpublished data from Indonesia, 2004–2009.[1] The proportion of deaths followed a rectangular distribution of between 0.01% and 0.40% – the minimum and maximum values available that were reported. A case fatality rate of 0.0375% was applied to the estimated number of *P. vivax* cases, representing the midpoint of the range of case fatality rates reported in a study by Douglas et al. (*18*), following a rectangular distribution of between 0.012% and 0.063%. Following the nonlinear association explained for the Category 2 method below, the proportion of deaths in children aged under 5 years was estimated as:

$\text{Proportion of deaths}_{\text{under 5}} = -0.2288 \times \text{Mortality}_{\text{overall}}^{2} + 0.823 \times \text{Mortality}_{\text{overall}} + 0.2239$

where $\text{Mortality}_{\text{overall}}$ is the number of estimated deaths over the estimated population at risk per 1000 (see **Annex 4-G** for national estimates of population at risk).

Category 2 method

The Category 2 method was used for countries in the WHO African Region with a high proportion of deaths due to malaria: Angola, Benin, Burkina Faso, Burundi, Cameroon, the Central African Republic, Chad, the Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, the Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Sudan, Togo, Uganda, the United Republic of Tanzania and Zambia.

With this method, child malaria deaths were estimated using a new multinomial Bayesian least absolute shrinkage and selection operator (LASSO) model that was reviewed by the WHO Maternal and Child Health Epidemiology Estimation Group (MCEE) in 2021, to produce updated estimates of cause of death (CoD) in children aged 1–59 months between 2000 and 2019 (*19*). Mortality estimates (and 95% CIs) were derived for eight causes of post-neonatal death (pneumonia, diarrhoea, malaria, tuberculosis, meningitis, injuries, pertussis and other disorders), four causes arising in the neonatal period (prematurity, birth asphyxia and trauma, sepsis and other conditions of the neonate) and other causes (e.g. malnutrition). Deaths due to measles, unknown causes and HIV/AIDS were estimated separately. The resulting cause-specific estimates were adjusted, country by country, to fit the estimated all-cause mortality envelope of 1–59 months (excluding HIV/AIDS and measles deaths) for corresponding years.

The number of malaria deaths among children aged under 5 years was calculated by applying the country-specific yearly malaria CoD fraction to the all-cause mortality envelope of 1–59 months estimated by the UN Inter-agency Group for Child Mortality Estimation (*20*). The same malaria CoD fractions observed in 2019 were used in 2020 and 2021. It was considered that the number of deaths follows a rectangular distribution, with limits being the estimated 95% CI.

The malaria mortality rate in children aged under 5 years estimated with this method was then used to infer malaria-specific mortality in those aged 5 years and over, using the relationship between levels of malaria mortality in a series of age groups and the intensity of malaria transmission (*21*), and assuming a nonlinear association between under-5-years mortality and over-5-years mortality, as follows:

$\text{Proportion of deaths}_{\text{over 5}} = -0.293 \times \text{Mortality}_{\text{under 5}}^{2} + 0.8918 \times \text{Mortality}_{\text{under 5}} + 0.2896$

where $\text{Mortality}_{\text{under 5}}$ is estimated from the number of deaths from the MCEE-estimated malaria cause of death fractions and the all-cause under-5 malaria death envelope.

In 2020 and 2021, additional malaria deaths estimated using this method were included to account for the disruptions in malaria diagnostic and treatment services as a result of the COVID-19 pandemic. Country-specific mortality inflation ratios were calculated by comparing the malaria mortality estimates for 2020 and 2021, in the presence and absence of diagnosis and treatment disruptions from MAP's malaria mortality estimates (results not presented in the report, derived from the

[1] Dr Ric Price, Menzies School of Health Research, Australia, personal communication (November 2014).

malaria incidence estimates), with both estimates accounting for disruptions to prevention interventions. Inflation ratios were then applied to the number of malaria deaths for 2020 and 2021 to estimate the number of deaths expected, considering the reported disruptions.

Category 3 method

For the Category 3 method, the number of indigenous malaria deaths registered by NMPs is reported without further adjustments. This category was used in the following countries: Algeria, Argentina, Armenia, Azerbaijan, Belize, Bhutan, Brazil, Cabo Verde, China, Colombia, Costa Rica, the Democratic People's Republic of Korea, the Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Iran (Islamic Republic of), Iraq, Kazakhstan, Kyrgyzstan, Malaysia, Mexico, Morocco, Nicaragua, Oman, Panama, Paraguay, the Republic of Korea, Sao Tome and Principe, Saudi Arabia, South Africa, Sri Lanka, Suriname, the Syrian Arab Republic, Tajikistan, Thailand, Türkiye, Turkmenistan, the United Arab Emirates, Uzbekistan and Vanuatu (2013 to 2020).

Fig. 3.2. Global trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) distribution of malaria cases and d) deaths by country, 2021

See methods notes for **Table 3.1**.

Table 3.2. Estimated malaria cases and deaths in the WHO African Region, 2000–2021

See methods notes for **Table 3.1**.

Fig. 3.3. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO African Region, 2021

See methods notes for **Table 3.1**.

Table 3.3. Estimated malaria cases and deaths in the WHO South-East Asia Region, 2000–2021

See methods notes for **Table 3.1**.

Fig. 3.4. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO South-East Asia Region, 2021

See methods notes for **Table 3.1**.

Table 3.4. Estimated malaria cases and deaths in the WHO Eastern Mediterranean Region, 2000–2021

See methods notes for **Table 3.1**.

Fig. 3.5. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Eastern Mediterranean Region, 2021

See methods notes for **Table 3.1**.

Table 3.5. Estimated malaria cases and deaths in the WHO Western Pacific Region, 2000–2021

See methods notes for **Table 3.1**.

Fig. 3.6. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Western Pacific Region, 2021

See methods notes for **Table 3.1**.

Table 3.6. Estimated malaria cases and deaths in the WHO Region of the Americas, 2000–2021

See methods notes for **Table 3.1**.

Fig. 3.7. Trends in a) malaria case incidence (cases per 1000 population at risk) and b) mortality rate (deaths per 100 000 population at risk), 2000–2021; and c) malaria cases by country in the WHO Region of the Americas, 2021

See methods notes for **Table 3.1**.

Fig. 3.8. Cumulative number of cases and deaths averted, globally and by WHO region, 2000–2021

See methods notes for **Table 3.1** for information on estimation of cases and deaths. Estimated cases and deaths averted over the period 2000–2021 were computed by comparing current estimates for each year since 2000 with the malaria case incidence and mortality rates from 2000, assuming that they remained constant throughout the same period, adjusting for population growth.

Fig. 3.9. Percentage of a) cases and b) deaths averted, by WHO region, 2000–2021

See methods notes for **Table 3.1** for information on estimation of cases and deaths. See **Fig. 3.8** for methods used to estimate cases and deaths averted. The percentage of cases and deaths averted was estimated using overall global cases and deaths averted as the denominator, and regional cases and deaths averted as the numerator.

Fig. 3.10. Estimated prevalence of exposure to malaria infection during pregnancy, overall and by subregion in 2021, in moderate to high transmission countries in the WHO African Region

Estimates of malaria-exposed pregnancies and preventable malaria-attributable low birthweight (LBW) deliveries in the absence of pregnancy-specific malaria prevention (i.e. long-lasting insecticidal net [LLIN] delivery based on intermittent preventive treatment in pregnancy [IPTp] or antenatal care [ANC]) were obtained using a model of the relationship between these outcomes, slide microscopy prevalence in the general population, and age- and gravidity-specific fertility patterns. This model was developed by fitting an established model of the relationship between malaria transmission and malaria infection by age (*22*) to patterns of infection in placental histology (*23*) and attributable LBW risk by gravidity, in the absence of IPTp or other effective chemoprevention (*24*). The model was run across a 0.2 degree (5 km^2) longitude/latitude grid for 100 realizations of the Malaria Atlas Project (MAP) (*13*) joint posterior estimated slide prevalence in children aged 2–10 years in 2021 (*25*). Country-specific, age-specific or gravidity-specific fertility rates, stratified by urban/rural status, were obtained from demographic and health surveys (DHS) and malaria indicator surveys (MIS), where such surveys had been carried out since 2014 and were available from the DHS programme website (*26*). Countries where surveys were not available were allocated fertility patterns from a survey undertaken in another country, matched on the basis of total fertility rate (*27*) and geography. Fertility patterns of individual women within simulations at each grid-point were simulated based on the proportion of women estimated to be living in urban or rural locations. Urban or rural attribution at a 1 km^2 scale was conducted based on WorldPop 1 km^2 population estimates from 2018 (*28*) and an urban/rural threshold of 386 people per km^2 (*29*); the estimates were then aggregated to the 0.2 degree (5 km^2) resolution of the MAP surfaces. This provided a risk of malaria infection and malaria-attributable LBW in the absence of prevention during pregnancy, along with a modelled per capita pregnancy rate for each grid-point, which was aggregated to country level (using WorldPop population estimates) to provide a per-pregnancy risk of malaria infection and a per live birth estimate of malaria-attributable LBW in the absence of prevention. These were then multiplied by country-level estimates of pregnancies and malaria-attributable estimates of LBW in 2021 (**Fig. 3.11**).

Fig. 3.11. Estimated number of LBWs due to exposure to malaria infection during pregnancy (without IPTp versus at estimated levels of IPTp coverage), overall and by subregion in 2021, in moderate to high transmission countries in sub-Saharan Africa

Methods for estimating malaria infection in pregnancy and malaria-attributable LBWs are described in Walker et al. (2014) (*24*). Numbers of pregnancies were estimated from the latest UN population-estimated number of births and were adjusted for the rate of abortion, miscarriage and stillbirths (*30*, *31*). The underlying *P. falciparum* parasite prevalence estimates were from the *Pf*PR$_{2-10}$ estimates described in **Table 3.1**, using methods described in Bhatt et al. (*25*).

Fig. 3.12. Estimated number of LBWs averted if current levels of IPTp coverage are maintained, and additional number averted if coverage of IPTp1 was optimized to match levels of coverage of ANC1 in 2021 while maintaining IPTp2 and IPTp3 at current levels, in moderate to high transmission countries in the WHO African Region

Efficacy of IPTp was modelled as a per sulfadoxine-pyrimethamine (SP) dose reduction in the attributable risk of LBW, fitted to data from trials of IPTp-SP efficacy before the implementation of the intervention as policy; thus, the results reflect the impact on drug-sensitive parasites, with the central estimate being based on an assumed malaria-attributable LBW fraction of 40% within these trials. The modelling produced estimates of 48.5%, 73.5% and 86.3% efficacy in preventing malaria-attributable LBW for women receiving one, two or three doses of SP through IPTp, respectively. This analysis excluded South Sudan owing to the lack of consistent IPTp data reporting through time.

Fig. 3.13. Estimated number of LBWs averted if levels of IPTp3 coverage were optimized to match levels of coverage of ANC1 in 2021, in moderate to high transmission countries in the WHO African Region

See methods for **Fig. 3.11** and **Fig. 3.12**.

Fig. 3.14. Estimated number of LBWs averted if levels of IPTp3 were optimized to achieve 90% coverage in 2021, in moderate to high transmission countries in the WHO African Region

See methods for **Fig. 3.11** and **Fig. 3.12**.

Fig. 4.1. Number of countries that were malaria endemic in 2000 and had fewer than 10, 100, 1000 and 10 000 indigenous malaria cases between 2000 and 2021

The figure is based on the countries where malaria was endemic in 2000 that also had cases of malaria reported in 2000 (108 endemic countries, excluding Egypt, Kazakhstan and the United Arab Emirates, with zero reported cases in 2000). *P. knowlesi* cases were not included. The number of estimated cases was tabulated.

Table 4.1. Countries eliminating malaria since 2000

Countries are shown by the year in which they attained zero indigenous cases for 3 consecutive years, according to reports submitted by NMPs. Maldives was certified in 2015; however, it was already malaria free before 2000 and thus is not listed here.

Table 4.2. Number of indigenous malaria cases in E-2020 and E-2025 countries, 2010–2021

Data were derived from NMP reports. Total indigenous malaria cases are based on confirmed malaria cases reported as indigenous by all countries in the "malaria eliminating countries for 2025" (E-2025) category between 2010 and 2021. For countries where not all cases are classified, total confirmed cases minus imported and introduced cases were used. For years where no case classification was carried out, all confirmed cases were considered to be indigenous. In Costa Rica (2021) and South Africa (2018–2021), unclassified cases were reclassified as indigenous and added to reported indigenous cases. *P. knowlesi* cases were excluded from countries reporting this species (Indonesia, Malaysia, the Philippines and Thailand).

Fig. 4.2. Total indigenous malaria and *P. falciparum* indigenous cases in the GMS, 2000–2021

Data on the Greater Mekong subregion (GMS) were derived from the WHO database. The data were assembled using the following methodology:

- Total indigenous malaria cases and indigenous *P. falciparum* cases are based on confirmed cases reported as indigenous by each country for all E-2025 countries and for those GMS countries where 100% of malaria cases are investigated and classified.
- For GMS countries where not all cases are classified, total confirmed minus imported and introduced cases, and total *P. falciparum* minus imported and introduced *P. falciparum* cases were used to calculate indigenous malaria cases and indigenous *P. falciparum* cases, respectively.
- For GMS countries where cases are not classified, all confirmed cases are assumed to be indigenous.

Depending on the data that countries submit annually, the methodology used can vary by year for the same country. *P. knowlesi* cases were excluded from total indigenous cases.

Fig. 4.3. Total indigenous malaria and *P. falciparum* cases in the GMS, by country, 2012–2021

See methods notes for **Fig. 4.2**.

Fig. 4.4. Regional map of malaria incidence in the GMS, by area, 2012–2021

Data were derived from NMP reports to the GMS Malaria Elimination Database. Malaria incidence was calculated by total confirmed cases (rapid diagnostic test [RDT] + microscopy positive)/1000 population. For Viet Nam, data are shown at provincial level; for all other countries, data are shown at district level.

Fig. 4.5. Estimated malaria a) cases and b) deaths in HBHI countries, 2000–2021

These estimates were for high burden to high impact (HBHI) countries. See methods notes for **Table 3.1**.

Fig. 5.1. Implementation status of routine malaria surveillance modules

Data were compiled from the University of Oslo's country status tracker database and information gathered from direct support and communications with countries and regional focal persons.

Fig. 5.2. Overview of WHO case-based malaria elimination surveillance modules: a) malaria case notification, investigation and response, and b) foci investigation and response workflow

DHIS2 system workflow for case notification, investigation and foci investigation and response, developed in collaboration with the University of Oslo.

Table 5.1. Contents of the malaria surveillance assessment toolkit

Summarized from the WHO malaria surveillance assessment toolkit implementation reference guide (*32*).

Table 5.2. Results from the assessment of indicators for data quality and use

Data were submitted by NMPs and partners.

Table 6.1. Sources of funding data

The table describes the main sources of funding as reported by donors and countries. An additional amount for patient care (based on estimated costs of patient care delivery services at public health facilities) is calculated for each country and added to domestic funding.

Fig. 6.1. Funding for malaria control and elimination, 2010–2021 (% of total funding), by source of funds (constant 2021 US$)

Total funding for malaria control and elimination over the period 2000–2021 was estimated using available data obtained from several sources. The methodology below describes the collection and analysis for all available public sector domestic funding and international funding for **Figs. 6.1–6.6**.

Fig. 6.1 and **Fig. 6.2** reflect data for the years 2010–2021 because country-specific unit cost estimates were not available until 2010 and data from the Organisation for Economic Co-operation and Development (OECD) use of the multilateral system were not available until 2011 (whereby 2010 estimates were derived from 2011 data). **Fig. 6.5** reflects data for the years 2010–2021 because the trends in funding per person at risk before 2010 cannot be reliably interpreted owing to significant data gaps in international and domestic funding in each WHO region. **Fig. 6.3**, **Fig. 6.4** and **Fig. 6.6** reflect data for 2000–2021, where available. In the case of missing data for a specific funder, no imputation was conducted; hence, the trends presented in the main text should be interpreted carefully. Funding for malaria control and elimination is presented in constant 2021 US$ throughout the text and figures.

Contributions from governments of endemic countries were estimated as the sum of government contributions reported by NMPs for the world malaria report of the relevant year plus the estimated costs of patient care delivery services at public health facilities. NMP contributions in the form of domestic expenditures were used from 2000 through 2021. When domestic government expenditure was unavailable, budgets were used. In cases where neither domestic expenditure nor budgets were available, estimates were conducted. These estimates were either based on an average from the country reported data for the previous 2 years (i.e. 2019 and 2020), or the data reported in the previous year (i.e. 2020), based on the country's preference. The number of reported malaria cases attending public health facilities was sourced from NMP reports, adjusted for diagnosis and reporting completeness. Between 1% and 3% of uncomplicated reported malaria cases were assumed to have moved to the severe stage of disease, and 50–80% of these severe cases were assumed to have been hospitalized. Among the cases that were assumed to have been hospitalized, a 3-day average hospital stay was used. Costs of outpatient visits and inpatient bed-stays were estimated from the perspective of the public health care provider, using unit cost estimates from WHO-CHOosing Interventions that are Cost-Effective (WHO-CHOICE) (*33*). For each country, WHO-CHOICE 2010 unit cost estimates expressed in national currency were estimated for the period 2011–2021 using the gross domestic product (GDP) annual price deflator published by the World Bank (*34*) in July 2022 and converted in the base year 2010. Country-specific unit cost estimates were then converted from national currency to constant 2021 US$ for each year over the period 2010–2021. For each country, the number of adjusted reported malaria cases attending public health facilities was then multiplied by the estimated unit costs. In the absence of information on the level of care at which malaria patients attend public facilities, uncertainty around unit cost estimates was handled through probabilistic uncertainty analysis. The mean total cost of patient care service delivery was calculated from 1000 estimations.

International bilateral funding data were obtained from several sources. Data on planned funding from the government of the United States of America (USA) were sourced with the technical assistance of the Kaiser Family Foundation (*35*). Country-level funding data were available from the US Agency for International Development (USAID) for the period 2006–2021. Country-specific planned funding data from two agencies – the US Centers for Disease Control and Prevention (US CDC) and the US Department of Defense (DoD) – were not available; therefore, data on total annual planned funding from each of these two agencies were used for the period 2001–2021. Total annual planned funding from USAID was used for 2001–2005, until the introduction of country-specific funding from 2006 through 2021.

For the government of the United Kingdom of Great Britain and Northern Ireland (United Kingdom), data on funding towards malaria control since 2017 have been sourced from the *Statistics on international development: final UK aid spend* (*36*). Data from the final UK aid spend 2020 were used, with the technical assistance of the United Kingdom Foreign, Commonwealth and Development Office (FCDO). In this year's report, disbursement data were not yet finalized for 2021 at the time of publishing; therefore, with the approval of the FCDO, disbursement data for 2021 were estimated using 2020 reported figures and converted to constant 2021 US$. The final UK aid spend data do not capture all spending from the United Kingdom that may affect malaria outcomes because the country supports malaria control and elimination through a broad range of interventions – for example, via support to overall health systems in malaria endemic countries, and through research and development (R&D) – that are not included in these data. For the period 2007–2016, United Kingdom spending data were sourced from the OECD creditor reporting system (CRS) database on aid activity (*37*).

For all other donors, disbursement data were also obtained from the OECD CRS database on aid activity for the period 2002–2020. Disbursement data for 2021 were estimated using 2020 reported figures. All data were converted to constant 2021 US$. For years where no data were available for a particular funder, no imputation was conducted; hence, trends presented in the figures in the main text should be interpreted carefully.

Malaria-related annual funding from donors through multilateral agencies was estimated from data on:

i. donors' contributions published by the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) (*38*) from 2010 to 2021, and annual disbursements by the Global Fund to malaria endemic countries, as reported by the Global Fund; and
ii. donors' disbursements to malaria endemic countries published in the OECD CRS and in the OECD Development Assistance Committee (DAC) members' total use of the multilateral system from 2011 through 2020 (*37*). All funding flows were converted to constant 2021 US$.

For (i), the amount of funding contributed by each donor was estimated as the proportion of funding paid by each donor out of the total amount received by the Global Fund in a given year, multiplied by the total amount disbursed by the Global Fund in that same year.

For (ii), contributions from donors to multilateral channels were estimated by calculating the proportion of the core contributions received by a multilateral agency each year by each donor, then multiplying that amount by the multilateral agency's estimated investment in malaria control in that same year. Contributions from malaria endemic countries to multilateral agencies were allocated to governments of endemic countries under the "funding source" category.

Contributions from non-DAC countries and other sources to multilateral agencies were not available and were therefore not included. Annual estimated investments were summed to estimate the total amount each funder contributed to malaria control and elimination over the period 2010–2021, and the relative percentage of the total spending contributed by each funder was calculated for the period 2010–2021.

Fig. 6.1 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.2. Funding for malaria control and elimination, 2010–2021, by source of funds (constant 2021 US$)

See methods notes for **Fig. 6.1** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows.

Fig. 6.2 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.3. Funding for malaria control and elimination, 2000–2021, by channel (constant 2021 US$)

See methods notes for **Fig. 6.1** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the main text figures should be interpreted carefully.

Fig. 6.3 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.4. Funding for malaria control and elimination, 2000–2021, by World Bank 2021 income group and source of funding (constant 2021 US$)

See methods notes for **Fig. 6.1** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. Data on income group classification for 2021 were sourced from the World Bank (*39*). For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the main text figures should be interpreted carefully.

Fig. 6.4 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.5. Funding for malaria control and elimination per person at risk, 2010–2021, by WHO region (constant 2021 US$)

See methods notes for **Fig. 6.1** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows.

Fig. 6.5 excludes household spending on malaria prevention and treatment in malaria endemic countries.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.6. Funding for malaria control and elimination, 2000–2021, by WHO region (constant 2021 US$)

See methods notes for **Fig. 6.1** for sources of information on total funding for malaria control and elimination from governments of malaria endemic countries and on international funding flows. The "Unspecified" category in **Fig. 6.6** includes all funding data for which there was no geographical information on the recipient. For years in which no data were available for a particular funder, no imputation was conducted; hence, trends presented in the main text figures should be interpreted carefully.

The data sources, boundaries, accounting rules and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The malaria expenditure data reported here are thus not comparable with the disease expenditure data, including for malaria, that are reported in WHO's Global Health Expenditure Database.

Fig. 6.7. Real GDP growth annual per cent change, 2021, by World Bank income classification (constant 2021 US$)

Data on real GDP growth annual per cent change for 2021 were sourced directly from the International Monetary Fund data mapper (*40*). Data on income group classification for 2021 were sourced from the World Bank (*39*). This section outlines the global economic outcome in 2020 and 2021, which provides a limitation because it does not capture the differences across countries.

Fig. 6.8. Funding for malaria-related R&D, 2012–2021, by product type (constant 2021 US$)

Data on funding for malaria-related R&D for 2012–2021 were sourced directly from Policy Cures Research through the G-FINDER data portal (*41*).

Fig. 6.9. Funding for malaria-related R&D, 2012–2021, by sector (constant 2021 US$)

See methods for **Fig. 6.8**.

Fig. 7.1. Number of ITNs delivered by manufacturers and distributed by NMPs, 2010–2021

Data on the number of ITNs delivered by manufacturers to countries were provided to WHO by Milliner Global Associates. Data from NMP reports were used for the number of ITNs distributed within countries; these data include nets distributed through ANC clinics, the Expanded Programme on Immunization (EPI), mass campaigns and other distribution channels. In 2021, ITN distribution data for Botswana, Chad, Djibouti, Guinea-Bissau, Haiti, India, Myanmar and the United Republic of Tanzania were provided by the Global Fund.

Fig. 7.2. a) Indicators of population-level access to ITNs, sub-Saharan Africa, 2000–2021 and b) indicators of population-level use of ITNs, sub-Saharan Africa, 2000–2021

Estimates of ITN coverage were derived from a model developed by MAP (*13*, *42*), using a two-stage process. First, a mechanism was designed for estimating net crop (i.e. the total number of ITNs in households in a country at a given time), taking into account inputs to the system (e.g. deliveries of ITNs to a country) and outputs (e.g. loss of ITNs from households). Second, empirical modelling was used to translate estimated net crops (i.e. total number of ITNs in a country) into resulting levels of coverage (e.g. access within households, use in all ages and use among children aged under 5 years).

The model incorporates data from three sources:

- the number of ITNs delivered by manufacturers to countries, as provided to WHO by Milliner Global Associates;
- the number of ITNs distributed within countries, as reported to WHO by NMPs; and
- data from nationally representative household surveys from 40 countries in sub-Saharan Africa, from 2000 to 2021.

Countries for analysis

The main analysis covered 40 of the 46 malaria endemic countries or areas of sub-Saharan Africa. The island of Mayotte (for which no ITN delivery or distribution data were available) was excluded, as were the low transmission countries of Botswana, Eswatini, Namibia, Sao Tome and Principe and South Africa, for which ITNs comprise a small proportion of vector control. Analyses were limited to populations categorized by NMPs as being at risk.

Estimating national net crops through time

As described by Flaxman et al. (*43*), national ITN systems were represented using a discrete-time stock-and-flow model. Nets delivered to a country by manufacturers were modelled as first entering a "country stock" compartment (i.e. stored in-country but not yet distributed to households). Nets were then available from this stock for distribution to households by the NMP or through other distribution channels. To accommodate uncertainty in net distribution, the number of nets distributed in a given year was specified as a range, with all available country stock (i.e. the maximum number of nets that could be delivered) as the upper end of the range and the NMP-reported value (i.e. the assumed minimum distribution) as the lower end. The total household net crop comprised new nets reaching households plus older nets remaining from earlier times, with the duration of net retention by households governed by a loss function. However, rather than the loss function being fitted to a small external dataset – as per Flaxman et al. (*43*) – the loss function was fitted directly to the distribution and net crop data within the stock-and-flow model itself. Loss functions were fitted on a country-by-country basis, were allowed to vary through time, and were defined separately for conventional ITNs (cITNs) and LLINs. The fitted loss functions were compared with existing assumptions about rates of net loss from households. The stock-and-flow model was fitted using Bayesian inference and Markov chain Monte Carlo methods, which provided time-series estimates of national household net crop for cITNs and LLINs in each country and an evaluation of underdistribution, all with posterior credible intervals.

Estimating indicators of national ITN access and use from the net crop

Rates of ITN access within households depend not only on the total number of ITNs in a country (i.e. the net crop), but also on how those nets are distributed among households. One factor that is known to strongly influence the relationship between net crop and net distribution patterns among households is the size of households, which varies among countries, particularly across sub-Saharan Africa. Many recent national surveys report the number of ITNs observed in each household surveyed. Hence, it is possible to both estimate net crop and generate a histogram that summarizes the household net ownership pattern (i.e. the proportion of households with 0, 1, 2, etc. nets). In this way, the size of the net crop was linked to distribution patterns among households while accounting for household size, making it possible to generate ownership distributions for each stratum of household size. The bivariate histogram of net crop to distribution of nets among households by household size made it possible to calculate the proportion of households with at least one ITN. Also, because the numbers of both ITNs and people in each household were available, it was possible to directly calculate two additional indicators: the proportion of households with at least one ITN for every two people, and the proportion of the population with access to an ITN within their household. For the final ITN indicator – the proportion of the population who slept under an ITN the previous night – the relationship between ITN use and access was defined using 62 surveys in which both these indicators were available (ITN use all ages=0.8133 × ITN access all ages + 0.0026, R^2=0.773). This relationship was applied to the MAP's country–year estimates of household access, to obtain ITN use among all ages. The same method was used to obtain the country–year estimates of ITN use in children aged under 5 years (ITN use $_{\text{children under 5}}$=0.9327 x ITN access $_{\text{children under 5}}$ + 0.0282, R^2=0.754).

Fig. 7.3. Percentage of the population at risk protected by IRS, by WHO region, 2010–2021

The number of people protected by IRS was reported to WHO by NMPs. The total population of each country was taken from the 2022 revision of the *World population prospects* (*27*); the population at risk of malaria was calculated using the methods previously described for **Table 3.1**. For Ecuador, Saudi Arabia and South Africa, the number of people protected by IRS exceeded the population at risk. Hence, in Saudi Arabia, the targeted population was used as the denominator, and in Ecuador and South Africa, the reported population at risk was used as denominator.

Table 7.1. Average number of children treated with SMC per cycle, by year, in countries implementing SMC, 2012–2021

Data were provided by the London School of Hygiene & Tropical Medicine (LSHTM) and Medicines for Malaria Venture (MMV). The table shows the average number of children receiving seasonal malaria chemoprevention (SMC) for each district, regardless of the number of cycles (the average is based on 3, 4 or 5 cycles in a district where 3, 4 or 5 cycles have been done, respectively). The sum of the district averages is used to obtain the average for each country. In previous reports, the total number of children who received SMC at the country level was divided by four. The rationale for this approach was twofold. First, most countries performed four cycles in all districts up until 2021. Second, it was assumed that children receiving a fifth cycle had already received the first four cycles and were therefore de facto counted. The limitation of this approach was that it underestimated the average number of children covered by SMC in countries that performed fewer than four cycles.

Table 7.2. Number of treatment doses delivered, by year, in countries implementing SMC, 2014–2021

Data were provided by LSHTM and MMV. The number of treatments delivered is the sum of all the children who received SMC at each cycle. Previously, in the *World malaria report 2021* (*44*), the number of treatments delivered was calculated by multiplying the average number of children treated by four. This assumed that each country conducted four cycles in each district, which is not the case.

Fig. 7.4. Subnational areas where SMC was delivered, and number of treatment cycles per district, in implementing countries in sub-Saharan Africa, 2021

Data were provided by MMV and assembled through the SMC Alliance.

Fig. 7.5. Percentage of pregnant women attending an ANC clinic at least once and receiving IPTp, by number of SP doses, sub-Saharan Africa, 2010–2021

The total number of pregnant women eligible for IPTp was calculated by adding total live births calculated from UN population data and spontaneous pregnancy loss (specifically, miscarriages and stillbirths) after the first trimester (*30*). Spontaneous pregnancy loss has previously been calculated by Dellicour et al. (*31*). Country-specific estimates of IPTp coverage were calculated as the ratio of pregnant women receiving IPTp during ANC visits to the estimated number of pregnant women eligible for IPTp in a given year. ANC attendance rates were derived in the same way, using the number of initial ANC clinic visits reported through routine information systems. Local linear interpolation of information for national representative surveys was used to compute missing values. The same dose-specific IPTp and ANC coverage estimates reported in 2020 were assumed to be observed in 2020 for three countries that had incomplete information for 2021: Equatorial Guinea, Gabon and Mauritania. Annual aggregate estimates exclude countries for which a report or interpolation was not available for the specific year. Dose coverage between 2010 and 2020 was calculated for 33 of the 35 countries with an IPTp policy (the Comoros and Sao Tome and Principe were excluded because of their low malaria burden).

The coverages of at least one ANC visit were corrected in 2020 and 2021 based on the country-specific disruptions to ANC services reported per country and obtained from the national pulse surveys on continuity of EHS during the COVID-19 pandemic conducted by WHO (first round in May–July 2020, second in January–March 2021, and third in November–December 2021) (*5–7*). Disruptions were quantified by using the middle value of the disruption ranges reported by countries. A 5% reduction in ANC attendance was assumed in all countries that did not provide information on ANC service disruptions in the pulse surveys (*45–49*). The corrected number of women that attended at least one ANC visit, after adjusting for disruptions, multiplied by the operational coverage of the first IPTp dose reported in 2020 or 2021 (calculated as the number of women who received the first IPTp dose divided by the corrected number of women who attended the first ANC visit) made it possible to re-estimate the expected number of pregnant women who took the first IPTp dose, which in turn made it possible to re-estimate the population coverage of the first IPTp dose. The ratio observed among the first, second and third IPTp doses was used to calculate the corrected coverage for the second and third IPTp doses, assuming no disruptions in IPTp dose follow-up.

Indicator	Numerator	Denominator
Median prevalence of fever in the past 2 weeks	Children aged under 5 years with a history of fever in the past 2 weeks	Children aged under 5 years
Median prevalence of fever in the past 2 weeks in children for whom treatment was sought	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought	Children aged under 5 years with fever in the past 2 weeks
Median prevalence of treatment seeking by source of treatment for fever in the public sector (health facility)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the public sector (health facility)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment seeking by source of treatment for fever in the public sector (community health worker)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the public sector (community health worker)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment seeking by source of treatment for fever in the private sector (formal and informal)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought in the private sector (formal and informal)	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of receiving finger or heel prick	Children aged under 5 years with a history of fever in the past 2 weeks and who received a finger or heel prick	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment with artemisinin-based combination therapies (ACTs)	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought and who were treated with ACTs	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought
Median prevalence of treatment with ACTs among those who received a finger or heel prick	Received ACT treatment	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought and who received a finger or heel prick
Median prevalence of treatment with ACTs	Children aged under 5 years with a history of fever in the past 2 weeks for whom treatment was sought and who were treated with ACTs	Children aged under 5 years with fever in the past 2 weeks for whom treatment was sought and who were treated with antimalarials

Diagnostic testing and treatment

The analysis is based on the latest nationally representative household surveys (DHS and MIS) conducted between 2015 and 2021, and surveys (the latest from 2000–2005) that were considered as baseline surveys from sub-Saharan African countries where data on malaria case management were available. The data are only available for children aged under 5 years because DHS and MIS focus on the most vulnerable population groups. Interviewers ask caregivers whether the child has had fever in the 2 weeks preceding the interview and, if so, where care was sought; whether the child received a finger or heel prick as part of the care; what treatment was received for the fever and when; and, in particular, whether the child received an artemisinin-based combination therapy (ACT) or other antimalarial medicine. In addition to self-reported data, DHS and MIS also include biomarker testing for malaria, using RDTs that detect *P. falciparum* histidine-rich protein 2 (HRP2). Percentages and 95% CIs were calculated for each country each year, taking into account the survey design. Median values and interquartile ranges were calculated using country percentages for the latest and baseline surveys. The indicators outlined above are presented in **Table 7.3**.

The use of household survey data has several limitations. One issue is that, because of difficulty recalling past events, respondents may not provide reliable information, especially on episodes of fever and the identity of prescribed medicines, resulting in a misclassification of drugs. Also, because respondents can choose more than one source of care for one episode of fever, and because the question on diagnostic test and treatment is asked broadly and hence is not linked to any specific source of care, it has been assumed that the diagnostic test and treatment were received in all the selected sources of care. However, only a low percentage (<5%) of febrile children were brought to more than one source of care to receive care. Data may also be biased by the seasonality of survey data collection because DHS are carried out at various times during the year and MIS are usually timed to correspond with the high malaria transmission season. Another limitation, when undertaking trend analysis, is that DHS and MIS are done intermittently or not at all in some countries, resulting in a relatively small number of countries in sub-Saharan Africa or for any particular 4-year period. In addition, depending on the sample size of the survey, the denominator for some indicators can be small – countries where the number of children in the denominator was less than 30 were excluded from the calculation.

Fig. 7.6. Number of RDTs sold by manufacturers and distributed by NMPs for use in testing suspected malaria cases, 2010–2021

The numbers of RDTs distributed by WHO region are the annual totals reported as having been distributed by NMPs. In 2021, RDT distribution data for Cambodia and the Gambia were provided by the Global Fund. Numbers of RDTs sold between 2010 and 2021 reflect sales by companies eligible for procurement. From 2010 to 2017, WHO received reports from up to 44 (cumulative number; the number of eligible manufacturers and responders differed from year to year) manufacturers that participated in the RDT Product Testing Programme by WHO, the Foundation for Innovative New Diagnostics (FIND), the US CDC and the Special Programme for Research and Training in Tropical Diseases. Since WHO prequalification became a selection criterion for procurement, sales data from 2018 onwards were provided by a limited number of eligible manufacturers. For 2021, all 10 of the eligible companies reported to WHO.

Fig. 7.7. Number of ACT treatment courses delivered by manufacturers and distributed by NMPs to patients, 2010–2021

Data on ACT deliveries for 2021 were provided by 10 manufacturers eligible for procurement by WHO and the UN Children's Fund (UNICEF). ACT deliveries were categorized as being to either the public sector or the private sector, also taking into account the Affordable Medicines Facility–for malaria (AMFm) initiative and the Global Fund co-payment mechanism for the relevant years, respectively. Data on ACTs distributed within countries through the public sector were taken from NMP reports. For 2019, 2020 and 2021, missing data from NMP reports for ACT distributions were calculated based on the rate of ACT distributions to the number of patients treated with ACTs from the previous year, multiplied by the number of patients treated with ACTs in the current year. If these data were not available, the number of patients treated with ACTs was used as a proxy for ACT distributions. Please also refer to the methods described for **Annex 4-D**, found in **Annex 4-K**.

Table 7.3. Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years, from household surveys in sub-Saharan Africa, at baseline (2005–2011) and most recently (2015–2021)

See the information provided in the section titled *Diagnostic testing and treatment* (under **Fig. 7.5**).

Table 7.4. Summary of coverage of treatment seeking for fever, diagnosis and use of ACTs for children aged under 5 years from the most recent household survey for countries in sub-Saharan Africa

See the information provided in the section titled *Diagnostic testing and treatment* (under **Fig. 7.5**).

Fig. 8.1. Comparison of global progress in malaria a) case incidence and b) mortality rate, considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

The *Global technical strategy for malaria 2016–2030* (GTS) target is a 90% reduction of malaria incidence and mortality rate by 2030, with milestones of 40% and 75% reductions in both indicators for the years 2020 and 2025, respectively (*50*). A curve based on a quadratic fit is used for the malaria incidence milestones. For projection of malaria incidence under current estimated trends, the same year-on-year trend observed in the previous 10 years (2012–2021) is forecast up to 2030. The distance between the target and the observed or projected incidence or mortality estimates is calculated using the following formula: 1 minus (GTS expected value for a given year / observed or projected value for the same year).

Fig. 8.2. Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2020 malaria case incidence milestone of at least 40% reduction from a 2015 baseline

See methods notes for **Fig. 8.1**.

Fig. 8.3. Map of malaria endemic countries (including the territory of French Guiana) showing progress towards the GTS 2020 malaria mortality rate milestone of at least 40% reduction from a 2015 baseline

See methods notes for **Fig. 8.1**.

Fig. 8.4. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO African Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.5. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Region of the Americas considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.6. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Eastern Mediterranean Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.7. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO South-East Asia Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 8.8. Comparison of progress in malaria a) case incidence and b) mortality rate in the WHO Western Pacific Region considering two scenarios: current trajectory maintained (blue) and GTS targets achieved (green)

See methods notes for **Fig. 8.1**.

Fig. 9.1. Number of *P. falciparum* TES finding more or less than 10% treatment failures in the WHO African Region, by ACT (2015–2021), among studies with at least 20 patients

The bars show the number of therapeutic efficacy studies (TES) undertaken in 2015 to 2021, and which TES found more or less than 10% treatment failures for each ACT tested in the WHO African Region. Only studies with at least 20 patients were included. The data were obtained from the WHO *Global database on antimalarial drug efficacy and resistance* (*51*).

Fig. 9.2. Countries in the WHO African Region with more than 5% of parasites sampled with *PfKelch13* mutations and main mutations identified (2015–2020)

The bars show the overall proportion of samples found to have *PfKelch13* mutations and the main mutations identified. The data were summarized from data collated in the WHO *Global database on antimalarial drug efficacy and resistance* (*51*).

Fig. 9.3. Number of *P. falciparum* TES finding more or less than 10% treatment failures, a) in the WHO South-East Asia Region, b) in the WHO Eastern Mediterranean Region, c) in the WHO Western Pacific Region, by ACT (2015–2021), among studies with at least 20 patients

The bars show the number of therapeutic efficacy studies (TES) undertaken in 2015 to 2021, and which TES found more or less than 10% treatment failures for each ACT tested in the WHO South-East Asia Region, the WHO Eastern Mediterranean Region and the WHO Western Pacific Region. Only studies with at least 20 patients were included. The data were obtained from the WHO *Global database on antimalarial drug efficacy and resistance* (*51*).

Fig. 9.4. Reported insecticide resistance status as a proportion of sites for which monitoring was conducted, by WHO region, 2010–2020, for pyrethroids, organochlorines, carbamates and organophosphates

The status of resistance at each mosquito collection site for each insecticide class was assessed based on the lowest mosquito mortality reported across all standard WHO tube tests or US CDC bottle bioassays conducted at the site during 2010–2020, with validated discriminating concentrations of the insecticides in the class. If multiple insecticides and mosquito species were tested between

2010 and 2020 at the collection site, the lowest mosquito mortality was considered. If the lowest mosquito mortality was below 90%, resistance was considered to be confirmed at the site; if the lowest mosquito mortality was at least 90% but less than 98%, resistance was considered to be possible at the site; if the lowest mortality was 98% or more, vectors at the site were considered to be susceptible to the insecticide class. The figure was developed based on data in the WHO global database for insecticide resistance in malaria vectors. These data were reported to WHO by NMPs, national public health institutes, universities and research centres, the African Network for Vector Resistance, MAP (*13*), VectorBase and the US President's Malaria Initiative (PMI), or were extracted from scientific publications.

Fig. 9.5. Number of classes to which resistance was confirmed in at least one malaria vector in at least one monitoring site, 2010–2020

Resistance to an insecticide class was considered to be confirmed in a country if at least one vector species exhibited resistance to one insecticide in the class in at least one collection site in the country, as measured by standard WHO tube tests or US CDC bottle bioassays conducted with validated discriminating concentrations in 2010–2020. The map was developed based on data contained in the WHO global database for insecticide resistance in malaria vectors. These data were reported to WHO by NMPs, national public health institutes, universities and research centres, the African Network for Vector Resistance, MAP (*13*), VectorBase and PMI, or were extracted from scientific publications.

Fig. 9.6. Detections of *An. stephensi* in the Horn of Africa and Nigeria, reported to WHO (2012–2021)

Map of the invasion of *An. stephensi* was produced from data submitted to the WHO global database on invasive species (*51*) on the Malaria Threats Map (*52*).

Fig. 9.7. Median LLIN retention time by country, ordered from highest to lowest

Countries are labelled by IS03 code. Country labels are positioned at mean parameter values, while vertical bars indicate 95% CI width. Countries with fewer surveys have less stable model fits; those having fewer than three surveys are indicated in red.

Analysis was supported by the Institute for Disease Modeling and MAP (*13*). This analysis uses a Bayesian mixed modelling framework built on data from net manufacturers, NMPs and cross-sectional household surveys over the past 20 years to estimate the history of ITN coverage metrics in sub-Saharan Africa (*42*). This approach includes two main steps. First, a national-level "stock and flow" mechanistic model tracks the distribution, acquisition and loss of ITNs by triangulating data from the three sources listed above. This step estimates both ITN retention times and ITN crop, the total number of nets in the community. The previous model on retention time was bounded at 1 year, suggesting that some countries might show even shorter median retention times in an unbounded setting. However, given the small number of surveys in these countries, such results might indicate underspecified models rather than truly short retention times.

Fig. 9.8. The impact on ITN use of reducing operational and behavioural constraints in sub-Saharan Africa

Analysis was supported by the Institute for Disease Modeling and MAP (*13*). ITN time-series counterfactuals under different operational and user behaviour scenarios were estimated using the same model as **Fig. 9.5**. All results were generated using the ITN coverage model described in Bertozzi-Villa et al. (*42*), with updated data through 2021. In addition to estimating ITN access, use and nets-per-capita over time, this model estimates a single median net retention time for each country. The horizontal black line is at 80%, a common target for "universal" net coverage. The yellow curve shows estimated true net use (people sleeping under a net divided by total population) from the model. The green curve shows what net use could be if everyone with access to a net used it. The orange curve shows what net use could be if, additionally, nets were retained for a median of 3 years (with no change to the quantity of nets distributed). Finally, the blue curve shows what net use could be if, in addition to 100% use and optimized retention, nets were perfectly allocated such that net access and nets-per-capita lined up exactly.

Fig. 9.9. Sequential decomposition of LLIN effectiveness over 3 years (modelling pyrethroid-only ITNs; further details explaining different scenarios are provided in Table 9.1)

Analysis was supported by the Institute for Disease Modeling and MAP (*13*). Results were generated using a mechanistic malaria model (*53-55*) run under a range of different ITN campaign parameters. Simulations were run without seasonality, to reduce the complexity of the results, and they used a vector composition of 84% *An. arabiensis* and 16% *An. funestus*. Simulations with these less anthropophilic and endophilic vectors were selected because, owing to the lack of seasonality and extreme effectiveness of the ITN simulations shown, scenarios run with primarily *An. gambiae* reached a stable equilibrium at elimination in most cases.

The boundaries of ITN impact (0% and 100% lines on the plots) were calculated by running a simulation with no malaria interventions, as well as a simulation with idealized, near-perfect ITNs (100% coverage, no discarding of nets, 100% use rate, a constant 60% probability that a mosquito that lands on a net is killed, and a constant 90% probability that a mosquito that approaches a net does not enter it). Each coloured line of the plot represents the impact of sequentially reducing aspects of net effectiveness – first with waning insectide, then introducing vectors that are not fully susceptible, then introducing realistic net durability and so on. The palest lowest line, then, approximates the relative impact that nets today have, relative to the alternate scenarios. The 87% coverage, 83% use rate and 1.9-year retention half-life values were derived from the aggregated time series in Bertozzi-Villa et al. (*42*). The decision to reduce initial killing by 30% to approximate insecticide resistance was derived from an analysis of the WHO's insecticide resistance database via the Malaria Threats Map (*52*). The 4-year killing half-life is based on the default net calibration of the Epidemiological MODeling software (EMOD), and the 1.9-year blocking half-life is set equal to the retention half-life based on the hypothesis that net retention and durability are closely linked (*56*).

Table 9.1. Descriptions of scenarios presented in Fig. 9.9

See methods notes for **Fig. 9.9**.

Fig. 10.1. Malaria diagnostics pipeline, showing the development stage of main product types according to primary intended use-case and sample type

Information was extracted from Unitaid's diagnostic market and technology landscape report (*57*).

Table 10.1. Candidate molecules in the early development portfolio for the treatment of clinical malaria

Information shown is a list and description of candidate molecules for malaria therapy in early development. Information was assembled by MMV.

Fig. 10.2. Distribution of vector control products in the R&D pipeline by intervention type.

Information was extracted from the WHO Global Observatory on Health Research and Development (*58*).

Fig. 10.3. A roadmap of current and new vector control products

Information was assembled by the Innovative Vector Control Consortium (IVCC) from its existing portfolio of vector control products (*59*).

Table 10.2. Malaria vaccine candidates (in active development) by life cycle stage and R&D phase

A summary of the main candidates extracted from the vaccine dashboard of the WHO Global Observatory on Health Research and Development (*60*).

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ANNEX 2 – NUMBER OF ITNs DISTRIBUTED THROUGH CAMPAIGNS IN MALARIA ENDEMIC COUNTRIES, 2020–2022

Data on number of insecticide-treated mosquito nets were collected from reports from national malaria programmes and other sources by the Alliance for Malaria Prevention and RBM Partnership to End Malaria.

Country	ITNs planned for distribution in 2020	ITNs distributed in 2020	ITNs remaining for distribution in 2021	Percentage of planned ITNs distributed in 2020
Afghanistan	2 833 365	2 833 365	0	100
Bangladesh	2 014 200	1 219 329	794 871	61
Benin[1]	8 609 873	7 652 166	957 707	89
Bhutan[2]	122 670	122 670	0	100
Bolivia (Plurinational State of)[1]	88 200	81 727	6 473	93
Botswana	89 179	80 525	8 654	90
Burundi[3]	7 016 519	6 784 964	231 555	97
Cambodia	793 359	793 068	291	99.6
Cameroon[4]	2 112 900	1 980 471	132 429	94
Central African Republic	2 861 765	2 312 311	549 454	81
Chad	8 779 988	8 686 550	93 438	99
Comoros[1]	444 750	412 022	32 728	93
Côte d'Ivoire	18 991 346	0	18 991 346	0
Democratic Republic of the Congo	29 056 290	15 541 956	13 514 334	53
Eritrea[1]	1 922 249	621 094	1 301 155	32
Eswatini	10 000	0	10 000	0
Ethiopia[2]	6 517 480	6 517 480	0	100
Ghana	0	0	0	NA
Guinea-Bissau[2]	1 294 976	1 294 976	0	100
Haiti	1 216 186	971 530	244 656	80
Honduras	21 588	20 760	828	96
India	22 400 000	11 200 000	11 200 000	50
Indonesia[1]	3 632 014	3 354 382	277 632	92
Kenya	12 943 663	194 292	12 749 371	2
Liberia	0	0	0	NA
Madagascar	0	0	0	NA
Malawi[2]	0	0	0	NA
Mali[1]	7 620 011	7 479 747	140 264	98
Mauritania[2]	1 622 322	1 622 322	0	100
Mozambique[1]	17 467 640	17 255 566	212 074	99
Nicaragua	61 766	61 520	246	99.6
Niger	9 645 683	8 555 136	1 090 547	89
Nigeria	26 047 544	25 470 757	576 787	98
Pakistan	1 487 878	1 487 721	157	99.9

ITNs distributed in 2021 from 2020 campaigns	ITNs planned for distribution in 2021 (including carry-over from 2020)	ITNs distributed in 2021 (including carry-over from 2020)	ITNs remaining for distribution in 2022	Percentage of ITNs planned for distribution in 2021 distributed in 2021
NA	NA	NA	NA	NA
794 871	1 052 526	823 336	229 190	78
443 484	957 707	443 484	514 223	46
NA	NA	NA	NA	NA
6 473	6 473	6 473	0	100
0	8 654	0	8 654	0
231 555	231 555	231 555	0	100
291	829 358	559 790	269 568	67
132 429	369 000	344 763	24 237	93
0	1 626 470	0	1 626 470	0
0	93 438	0	93 438	0
30 891	32 728	30 891	1 837	94
18 509 750	18 509 750	18 509 750	0	100
13 514 334	16 717 712	16 717 712	0	100
69 347	1 301 155	69 347	1 231 808	5
8 313	10 000	8 313	1 687	83
NA	7 897 450	7 897 450	0	100
NA	18 948 893	15 976 996	2 971 897	84
NA	NA	NA	NA	NA
0	244 656	0	244 656	0
828	23 427	17 744	5 683	76
0	11 345 000	0	11 345 000	0
50 350	277 632	50 350	227 282	18
12 749 371	16 151 848	15 128 756	1 023 092	94
NA	2 783 264	2 783 264	0	100
NA	13 703 700	13 329 038	374 662	97
NA	7 357 003	7 357 003	0	100
140 264	140 264	140 264	0	100
NA	NA	NA	NA	NA
212 074	212 074	212 074	0	100
246	61 766	61 766	0	100
1 090 547	5 420 231	4 358 451	1 061 780	80
576 787	27 125 810	14 432 535	12 693 275	53
0	3 106 391	0	3 106 391	0

ANNEX 2 – NUMBER OF ITNs DISTRIBUTED THROUGH CAMPAIGNS IN MALARIA ENDEMIC COUNTRIES, 2020–2022

Data on number of insecticide-treated mosquito nets were collected from reports from national malaria programmes and other sources by the Alliance for Malaria Prevention and RBM Partnership to End Malaria.

Country	ITNs planned for distribution in 2020	ITNs distributed in 2020	ITNs remaining for distribution in 2021	Percentage of planned ITNs distributed in 2020
Papua New Guinea	1 483 074	1 183 982	299 091	80
Rwanda[2]	5 837 458	5 837 458	0	100
Sierra Leone	4 601 419	4 346 613	254 806	94
Solomon Islands	7 530	7 530	0	100
Somalia[2]	1 473 529	1 473 529	0	100
South Sudan	4 768 792	4 198 875	569 917	88
Sudan	4 625 027	4 626 027	0	100
Suriname[2]	6 864	6 864	0	100
Thailand[5]	76 865	76 865	0	100
Timor-Leste	150 652	140 878	9 774	94
Togo[2]	5 826 536	5 826 536	0	100
Uganda	29 184 557	23 728 961	5 455 596	81
United Republic of Tanzania[2]	8 728 803	8 728 803	0	100
Zanzibar[5]	205 000	205 000	0	100
Vanuatu	0	0	0	NA
Yemen	1 248 377	855 693	392 684	69
Zambia[2]	5 621 419	5 621 419	0	100
Zimbabwe[2,5]	443 231	443 231	0	100
Total	**272 014 537**	**201 916 671**	**70 098 865**	**74**

ITN: insecticide-treated mosquito net; NA: not applicable.

[1] The carry-over of ITNs from 2020 were distributed through routine channels.

[2] Planned distribution was adjusted based on ITNs distributed; where ITN distribution was more than planned, ITNs distributed = ITNs planned for distribution.

[3] The 2019 mass campaign resulted in carry-over of ITNs that were distributed in 2020 and 2021 through routine distribution channels.

[4] The 2019 mass campaign resulted in carry-over of ITNs that were distributed in 2020 and 2021.

[5] No data were reported on planned distribution; therefore adjustment was made that planned distribution = ITNs distributed.

Note: Remaining nets not distributed through mass campaigns may be distributed through other channels (e.g. antenatal care).

ITNs distributed in 2021 from 2020 campaigns	ITNs planned for distribution in 2021 (including carry-over from 2020)	ITNs distributed in 2021 (including carry-over from 2020)	ITNs remaining for distribution in 2022	Percentage of ITNs planned for distribution in 2021 distributed in 2021
299 091	1 236 059	1 071 802	164 257	87
NA	NA	NA	NA	NA
NA	254 806	0	254 806	0
NA	605 384	164 384	441 000	27
NA	NA	NA	NA	NA
569 917	1 586 285	1 586 285	0	100
NA	NA	NA	NA	NA
NA	15 000	10 059	4 941	67
NA	220 873	118 300	102 573	54
9 774	29 283	19 948	9 335	68
NA	NA	NA	NA	NA
1 410 031	5 455 596	1 410 031	4 045 565	26
NA	611 717	611 717	0	100
NA	746 420	712 872	33 548	96
NA	70 747	37 090	33 657	52
392 684	2 890 856	1 769 759	1 121 097	61
NA	NA	NA	NA	NA
NA	1 017 646	1 017 646	0	100
51 243 702	**171 286 607**	**128 020 998**	**43 265 609**	**75**

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 421 million
Parasites: *P. falciparum* (almost 100%) and other (<1%)
Vectors: *An. arabiensis, An. coluzzii, An. funestus* s.l., *An. gambiae* s.l., *An. hispaniola, An. labranchiae, An. melas, An. moucheti, An. multicolor, An. nili* s.l., *An. pharoensis* and *An. sergentii* s.l.

FUNDING (US$), 2010–2021

584.9 million (2010), 597.9 million (2015), 992.7 million (2021); 2010–2021: 70% increase
Proportion of domestic source[a] in 2021: 23%
[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Countries with ≥80% coverage with either LLINs or IRS in 2021: Côte d'Ivoire, Mali, the Niger and Togo
Countries with ≥50% coverage with either LLINs or IRS in 2021: Benin, Burkina Faso, Ghana, Liberia, Nigeria, Senegal and Sierra Leone

Countries that implemented IPTp in 2021: Benin, Burkina Faso, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, the Niger, Nigeria, Senegal and Sierra Leone
Countries with >30% IPTp3+ in 2021: Benin, Burkina Faso, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, the Niger, Senegal, Sierra Leone and Togo
Children treated with at least one dose of SMC per cycle in 2021: 40.4 million
Note: No data for Guinea-Bissau in 2021.

Percentage of suspected cases tested (reported):[a] 54% (2010), 73% (2015), 94% (2021)
Number of ACT courses distributed: 32.2 million (2010), 47.4 million (2015), 85.4 million (2021)
Number of any antimalarial treatment courses (incl. ACT) distributed: 32.2 million (2010), 49.4 million (2015), 86.5 million (2021)
[a] No data for Guinea-Bissau in 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases:[b] 30.6 million (2010), 56.8 million (2015), 68.3 million (2021)
Confirmed cases: 6.8 million (2010), 36.4 million (2015), 63.2 million (2021)
Percentage of total cases confirmed: 22.1% (2010), 64.1% (2015), 92.5% (2021)
Deaths:[c] 39 000 (2010), 30 900 (2015), 26 500 (2021)
[a] Includes malaria endemic countries only; [b] No data for Guinea-Bissau in 2021; [c] Nigeria only reports deaths in children aged under 5 years.

Children aged under 5 years, presumed and confirmed cases:[b] 11.9 million (2010), 21.0 million (2015), 25.6 million (2021)
Children aged under 5 years, percentage of total cases: 38.9% (2010), 37.0% (2015), 37.4% (2021)
Children aged under 5 years, deaths:[c] 22 900 (2010), 22 100 (2015), 21 100 (2021)
Children aged under 5 years, percentage of total deaths: 59% (2020), 72% (2015), 80% (2021)
[a] Includes malaria endemic countries only; [b] No data for Guinea-Bissau in 2021; [c] No data for Guinea-Bissau, Mauritania and Togo in 2021.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 118.0 million (2010), 108.5 million (2015), 120.1 million (2021); 2010–2021: 2% increase
Deaths: 371 700 (2010), 303 900 (2015), 328 200 (2020); 2010–2021: 12% decrease

ACCELERATION TO ELIMINATION

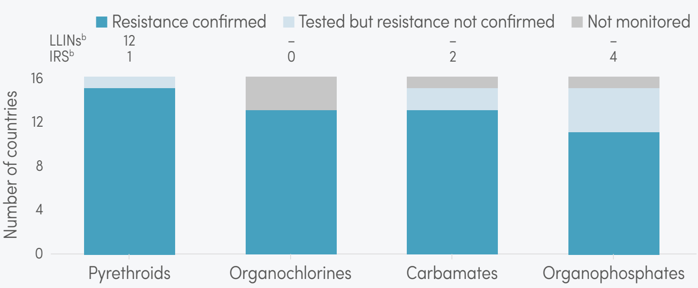
Countries with subnational/territorial elimination programme: the Gambia, Mauritania, the Niger and Senegal
Countries with nationwide elimination programme: Cabo Verde
Countries part of the E-2025 initiative: Cabo Verde
Zero indigenous cases for 3 consecutive years (2019–2021): Cabo Verde
Certification in process: Cabo Verde
Certified as malaria free since 2010: Algeria (2019)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2021	56	0.0	1.2	42.6	0.0	3.5
AS-AQ	2015–2019	46	0.0	0.0	9.8	0.0	2.0
DHA-PPQ	2016–2021	10	0.0	1.8	18.7	0.0	2.9

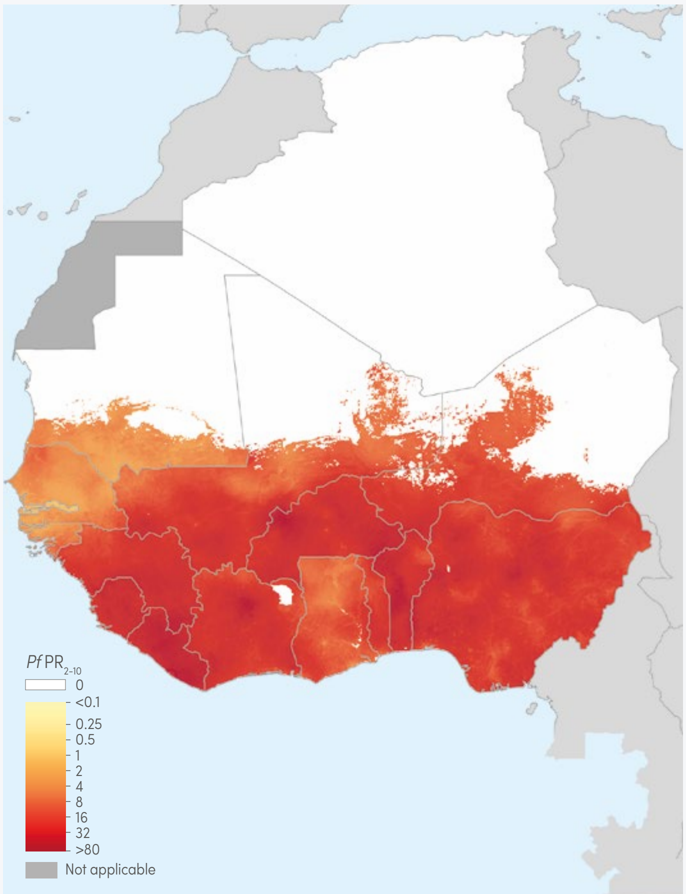
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

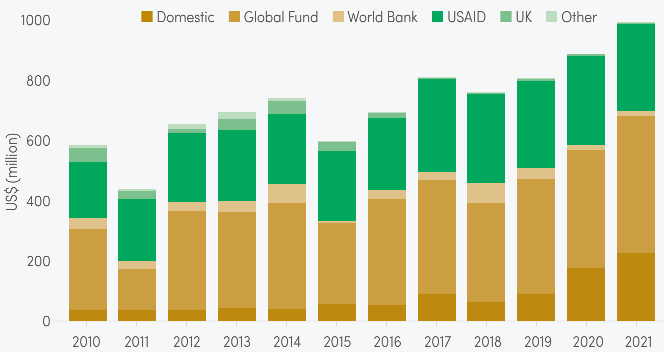


[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. *P. falciparum* parasite rate (*Pf*PR), 2021

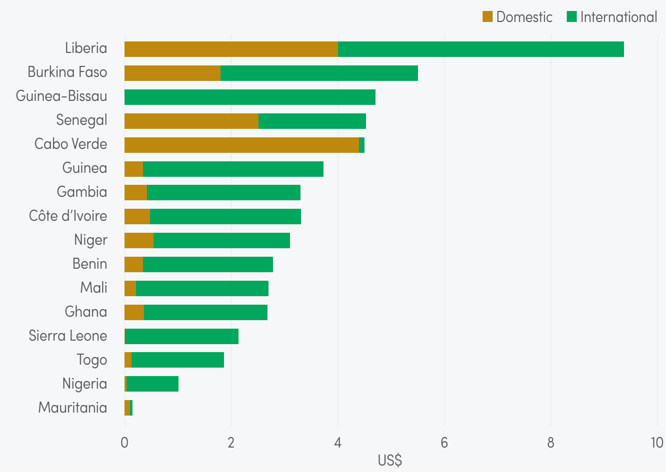


B. Malaria funding[a] by source, 2010–2021



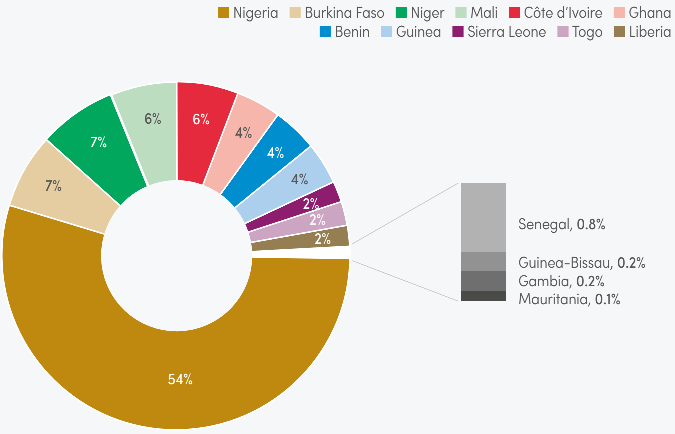
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Guinea-Bissau, Mauritania and Togo in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021

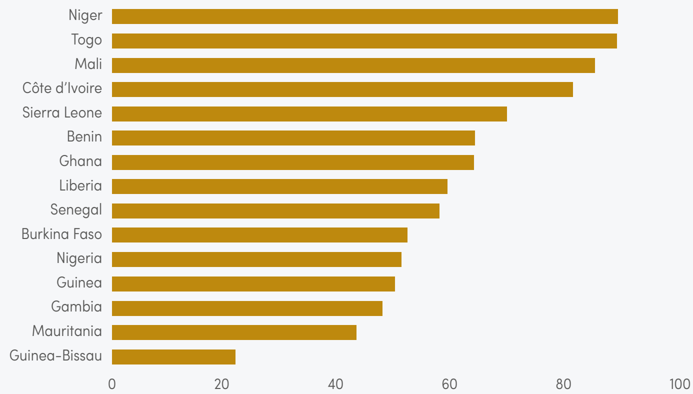


[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs.

D. Share of estimated malaria cases, 2021

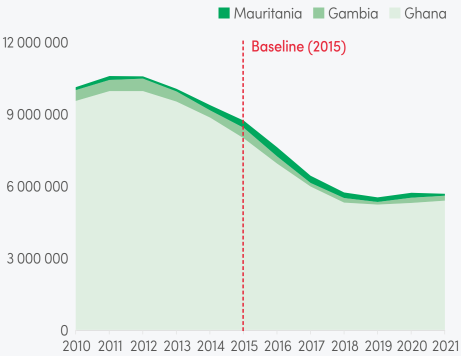


E. Percentage of population with access to either LLINs or IRS, 2021
Source: ITN coverage model from MAP



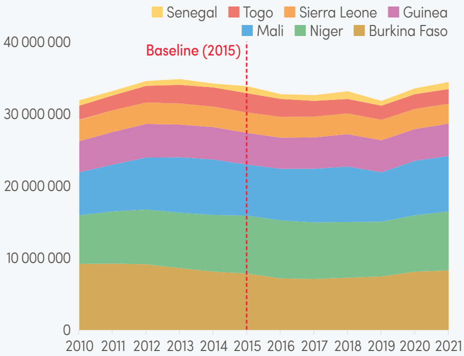
IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; MAP: Malaria Atlas Project. **Note:** Algeria was certified malaria free in 2019 and Cabo Verde is a low transmission country where vector control is targeted to foci.

F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015

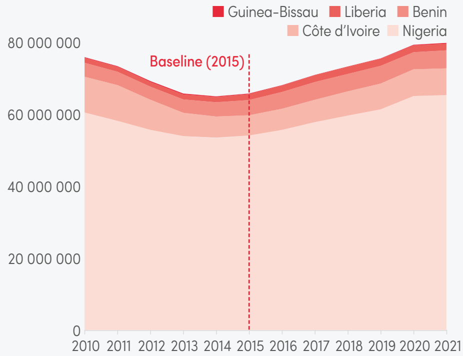


Note: Algeria was certified malaria free in 2019. Cabo Verde met the 2020 GTS milestone with zero malaria cases and had zero cases in 2021 again.

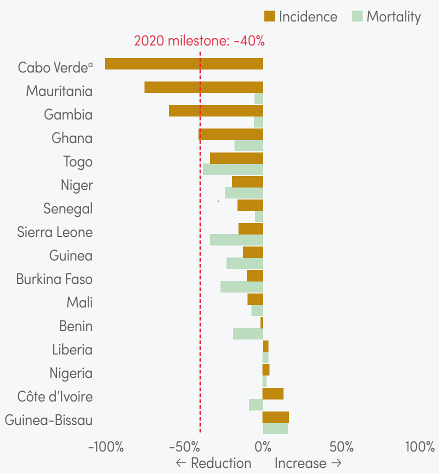
G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015



H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021

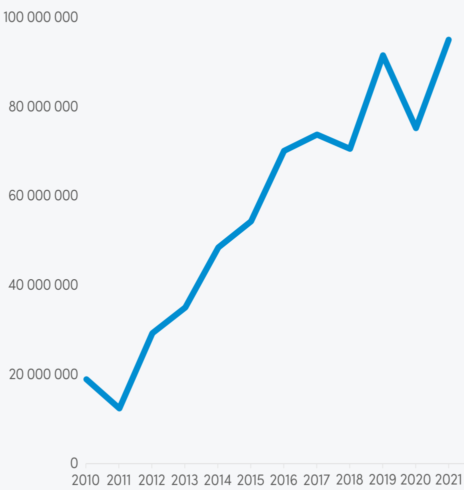


I. Change in estimated malaria incidence and mortality rates, 2015–2021

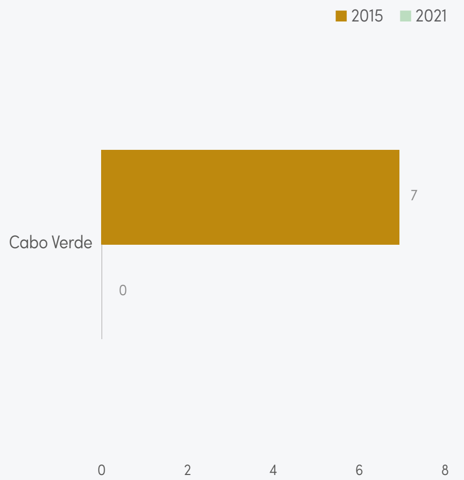


[a] This country achieved the 40% reduction in mortality rate in 2015; since then, there has been no change.

J. Total number of suspected malaria cases tested, 2010–2021



K. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- In 2021, there were 15 malaria endemic countries in west Africa. Algeria was certified malaria free in May 2019, following 3 consecutive years with zero indigenous cases. Cabo Verde has had 3 consecutive years (2019–2021) of zero indigenous cases and has started the certification process. The high burden high impact (HBHI) initiative was initiated in Burkina Faso, Ghana, the Niger and Nigeria in 2019, and in Mali in 2020, leading to evidence-based national strategic plans and funding requests. In all countries of this subregion except Algeria and Cabo Verde, malaria transmission is year round and almost exclusively due to *Plasmodium falciparum*, with strong seasonality in the Sahelian countries.
- Also in 2021, the subregion had about 120 million estimated cases and about 328 000 estimated deaths – a 2% increase and a 12% decrease compared with 2010, respectively. Five countries accounted for more than 80% of the estimated cases: Nigeria (54%), Burkina Faso (7%), the Niger (7%), Côte d'Ivoire (6%) and Mali (6%). About 68 million cases were reported in the public and private sectors and in the community, of which 37.4% were in children aged under 5 years, and 63 million (92.5%) were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 22.1% in 2010 to 92.5% in 2021. Most deaths were in children aged under 5 years (80%).
- In 11 of the 15 countries in this subregion, where routine distribution of long-lasting insecticidal nets (LLINs) or use of indoor residual spraying (IRS) are still applicable, 50% or more of the population had access to these interventions, despite country-specific variations. Eleven countries in the region implemented seasonal malaria chemoprevention (SMC), providing about 40.4 million children with at least one dose of SMC per cycle. Fifteen countries implemented intermittent preventive treatment of malaria in pregnancy (IPTp) in 2021 and 13 had more than 30% coverage with IPTp3. Eleven countries are also implementing SMC. Five countries met the *Global technical strategy for malaria 2016–2030* (GTS) target by reducing case incidence by at least 40% or reaching zero malaria cases in 2021 compared with 2015: Algeria (which is already certified malaria free), Cabo Verde (zero cases), the Gambia, Ghana and Mauritania. Hence, these countries are currently on track to achieving the GTS targets in 2025 and 2030. In seven countries, although there has been progress towards meeting the GTS target, reductions were less than 40%: Burkina Faso, Guinea, Mali, the Niger, Senegal, Sierra Leone and Togo. In Benin, Côte d'Ivoire, Guinea-Bissau, Liberia and Nigeria, incidence increased in 2021 compared with 2015. After a large increase in indigenous cases in Cabo Verde between 2016 and 2017, the country has reported zero indigenous cases since February 2018.
- Vector resistance to pyrethroids was confirmed in 91% of sites, to organochlorines in 96%, to carbamates in 43% and to organophosphates in 26%. The intensity of pyrethroid resistance in this region is high overall. Eleven countries have developed insecticide resistance monitoring and management plans.
- Total funding for malaria has continued to increase over the past decade, largely stemming from international sources. In 2021, domestic expenditures represented only 23% of total funding for malaria. From 2010 through 2021, there was a 70% increase in total funding; from 2020 to 2021, there was a 12% increase in total funding, stemming principally from increases in domestic expenditures (29%) and from the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund) (16%). Funding per person at risk ranged from US$ 0.15 in Mauritania to US$ 9.37 in Liberia over a 3-year average.
- The Nouakchott Declaration was adopted In 2013 and the new Sahel Malaria Elimination Initiative (SaME) was launched in 2018 by ministers of the eight Sahelian countries (Burkina Faso, Cabo Verde, Chad, the Gambia, Mali, Mauritania, the Niger and Senegal) to accelerate implementation of high-impact strategies towards eliminating malaria by 2030. In line with these initiatives, an action plan was adopted in 2019. In addition to Cabo Verde as an eliminating country, the Gambia, Mauritania, the Niger and Senegal have reoriented their programmes towards malaria subnational elimination.
- Challenges include inadequate political commitment and leadership, weak malaria programme management, insufficient prioritization and sustainability of interventions, inappropriate application of larviciding, inadequate domestic financing and weak surveillance systems (including a lack of well-functioning vital registration systems and shortage of human resources to carry out malaria activities). The coronavirus (COVID-19) pandemic disrupted diagnostic services, as indicated by the 18% decrease in diagnostic tests in 2020 compared with 2019; also, numbers of diagnostic tests decreased in all countries except the Niger and Senegal. In 2021, the number of suspects tested increased again as service disruptions due to the COVID-19 pandemic were resolved. Tackling the abovementioned issues could greatly improve the malaria situation in the region.

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 203 million

Parasites: *P. falciparum* (100%)

Vectors: *An. arabiensis, An. funestus* s.l., *An. gambiae* s.l., *An. melas, An. moucheti, An. nili* s.l. and *An. pharoensis.*

FUNDING (US$), 2010–2021

264.0 million (2010), 396.8 million (2015), 422.6 million (2021); 2010–2021: 60% increase

Proportion of domestic source[a] in 2021: 16%

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Countries with ≥80% coverage with either LLINs or IRS in 2021: None

Countries with ≥50% coverage with either LLINs or IRS in 2021: Burundi, Cameroon, the Central African Republic, Chad, the Congo and the Democratic Republic of the Congo

Countries that implemented IPTp in 2021: Angola, Burundi, Cameroon, the Central African Republic, Chad, the Congo, the Democratic Republic of the Congo and Sao Tome and Principe

Countries with >30% IPTp3+ in 2021: Burundi, Cameroon, the Central African Republic and the Democratic Republic of the Congo

Percentage of suspected cases tested (reported):[a] 46% (2010), 92% (2015), 92% (2021)

Number of ACT courses distributed:[a] 18.2 million (2010), 22.4 million (2015), 36.0 million (2021)

Number of any antimalarial treatment courses (incl. ACT) distributed:[a] 19.1 million (2010), 22.4 million (2015), 41.9 million (2021)

[a] No data for Equatorial Guinea in 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases:[b] 20.4 million (2010), 26.6 million (2015), 50.2 million (2021)

Confirmed cases:[b] 6.1 million (2010), 23.4 million (2015), 45.2 million (2021)

Percentage of total cases confirmed: 30.1% (2010), 87.9% (2015), 90.0% (2021)

Deaths:[b] 40 400 (2010), 58 200 (2015), 48 500 (2021)

Children aged under 5 years, presumed and confirmed cases:[b] 9.1 million (2010), 11.3 million (2015), 22.1 million (2021)

Children aged under 5 years, percentage of total cases: 44.9% (2010), 42.6% (2015), 44.1% (2021)

Children aged under 5 years, deaths:[b] 26 000 (2010), 37 100 (2015), 28 000 (2021)

Children aged under 5 years, percentage of total deaths: 64% (2010), 64% (2015), 58% (2021)

[a] Includes malaria endemic countries only; [b] No data for Equatorial Guinea in 2021.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 43.4 million (2010), 42.7 million (2015), 57.1 million (2021); 2010–2021: 32% increase

Deaths: 145 600 (2010), 109 500 (2015), 136 800 (2020); 2010–2021: 6% decrease

ACCELERATION TO ELIMINATION

Countries with nationwide elimination programme: Sao Tome and Principe

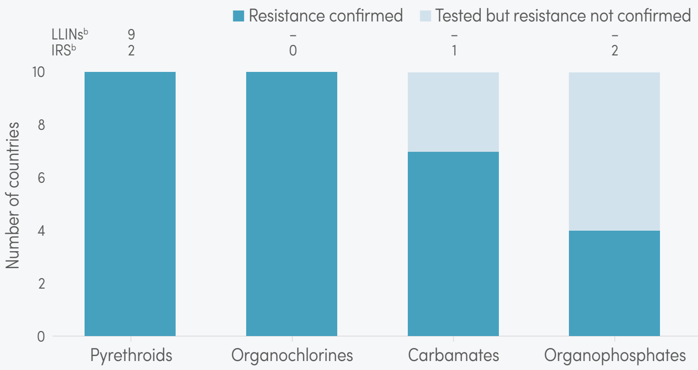
Countries part of the E-2025 initiative: Sao Tome and Principe

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2021	29	0.0	1.4	13.6	0.0	3.6
AS-AQ	2015–2021	29	0.0	0.0	7.7	0.0	4.8
DHA-PPQ	2015–2017	9	0.0	0.0	2.0	0.0	0.0

AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

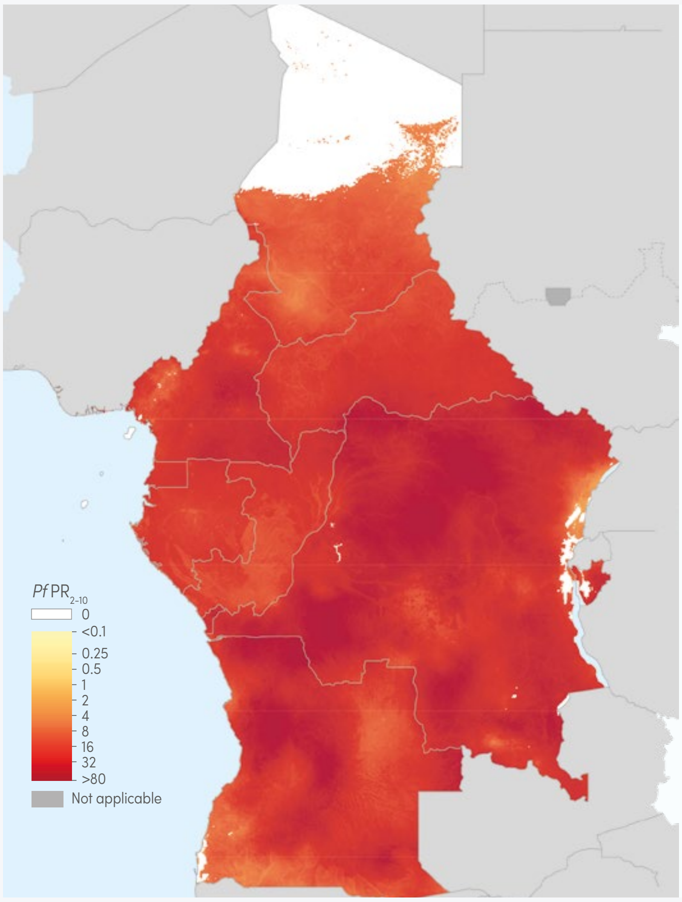
STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



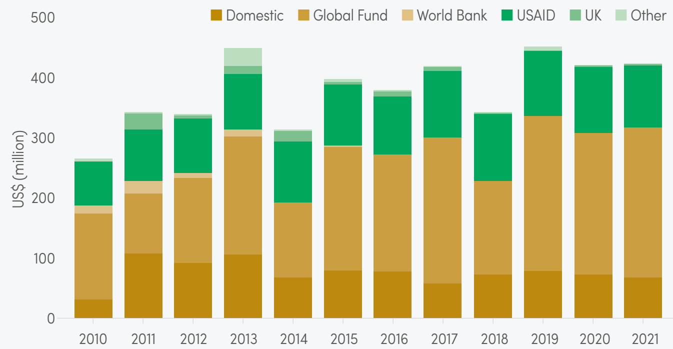
[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.

[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. *P. falciparum* parasite rate (*Pf*PR), 2021



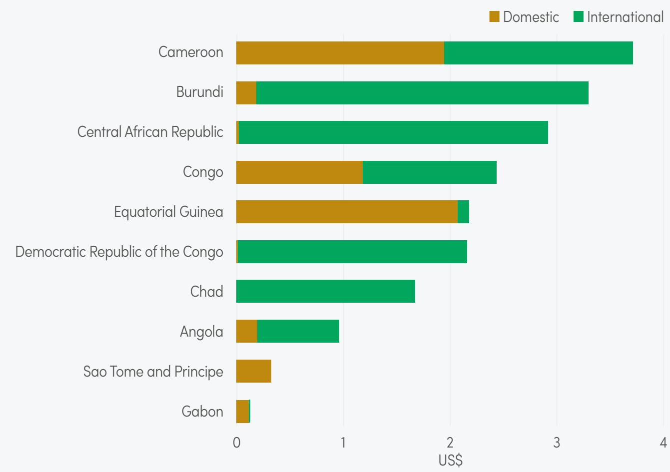
B. Malaria funding[a] by source, 2010–2021



Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.

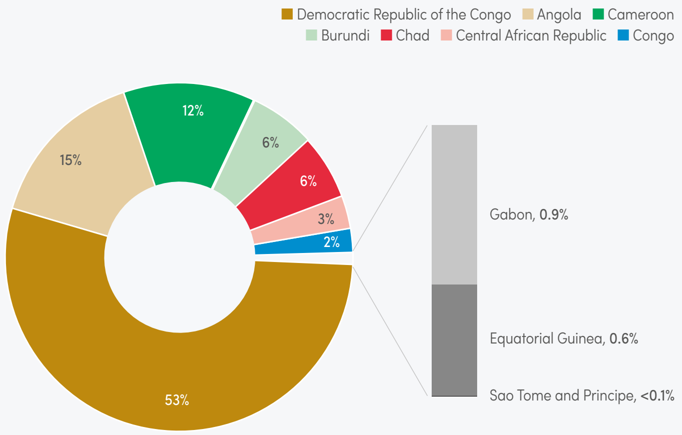
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Chad, the Congo and Sao Tome and Principe in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021

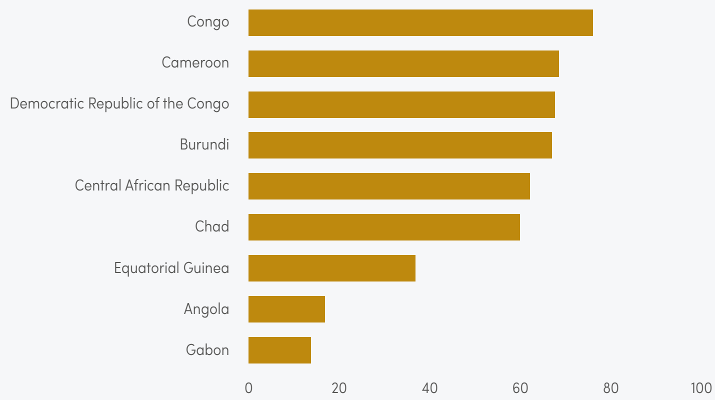


[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2021

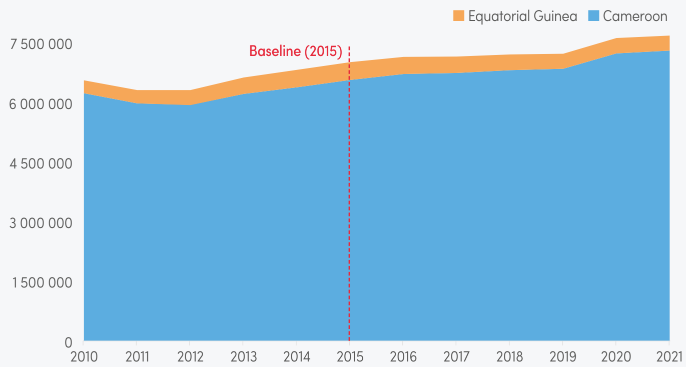


E. Percentage of population with access to either LLINs or IRS, 2021
Source: ITN coverage model from MAP

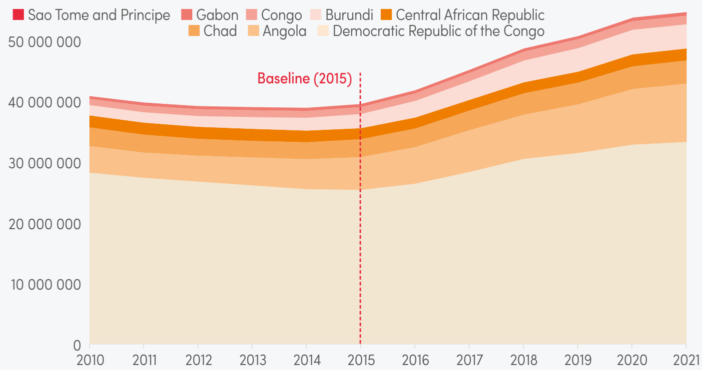


IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; MAP: Malaria Atlas Project.
Note: Sao Tome and Principe is a low transmission country where vector control is targeted to foci.

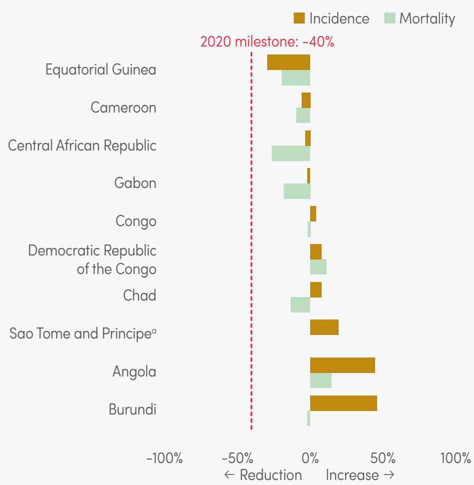
F. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015



G. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021

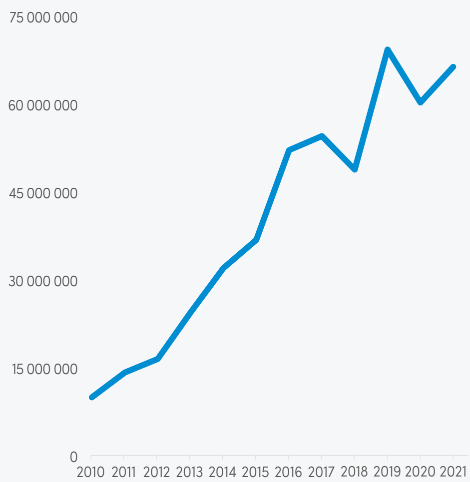


H. Change in estimated malaria incidence and mortality rates, 2015–2021

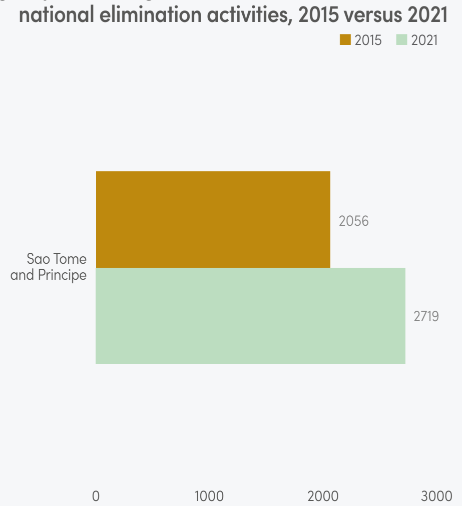


[a] This country achieved the 40% reduction in mortality rate in 2015; since then, there has been no change.

I. Total number of suspected malaria cases tested, 2010–2021



J. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- About 203 million people living in the 10 countries of central Africa are at high risk of malaria. Malaria transmission, almost exclusively due to *P. falciparum*, occurs throughout the year except in the north of Cameroon, northern Chad and the southern part of the Democratic Republic of the Congo. The HBHI initiative has been initiated in Cameroon and the Democratic Republic of the Congo.
- In 2021, the subregion had more than 57 million estimated cases and almost 137 000 estimated deaths – a 32% increase and a 6% decrease compared with 2010, respectively. Three countries in the region accounted for more than 80% of the estimated cases: the Democratic Republic of the Congo (53%), Angola (15%) and Cameroon (12%). A similar distribution was seen for estimated malaria deaths, which were mainly observed in the Democratic Republic of the Congo (58%), Angola (13%) and Cameroon (10%). More than 50 million cases were reported in the public and private sectors and in the community; of these, 44% were in children aged under 5 years and 45.2 million (90%) were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 30% in 2010.
- None of the countries in the subregion met the GTS target of a 40% reduction in estimated incidence by 2021 compared with 2015. Two countries, Cameroon and Equatorial Guinea, did reduce incidence, but by less than 40%. Five countries saw an increase of more than 5% in estimated malaria incidence between 2015 and 2021; Burundi had the largest increase (46%), followed by Angola (44%), Sao Tome and Principe (19%), Chad and the Democratic Republic of the Congo (each 8%). Hence, none of these countries is currently on track to achieving the GTS targets in 2025 and 2030. Sao Tome and Principe, which is part of the malaria eliminating countries for 2025 (E-2025) initiative for elimination, reported a 40.6% increase in the number of cases in 2021 compared with 2020. Coverage of preventive vector control measures remains low in the subregion, except in the Congo which has almost 80% coverage. In 2021, Cameroon and the Democratic Republic of the Congo conducted LLIN mass campaigns. Additionally, Cameroon and Chad are implementing SMC in targeted areas of the country, covering approximately 4.4 million children with at least one dose of SMC per cycle in 2021.
- Vector resistance to pyrethroids was confirmed in 86% of sites, to organochlorines in 90%, to carbamates in 21% and to organophosphates in 6%. Vector resistance to pyrethroids and to organochlorines was confirmed in all countries of the subregion. Six countries have developed insecticide resistance monitoring and management plans.
- Total funding has increased consistently in the subregion since 2010 (60%), with domestic expenditures representing 16% of total funding in 2021. Total funding has remained relatively stable over the past 3 years; however, since 2020, there has been a 7% decrease in domestic expenditures, which was already low as a proportion of total funding. Total funding per person at risk in 2021 ranged from US$ 0.13 in Gabon to US$ 3.70 in Cameroon over a 3-year average. These trends highlight the need for an increase in total funding and a push for more domestic funding.
- The performance of the surveillance system varies across countries in the region, as can be seen through the completeness of public sector data reported for 2021, with all countries except Burundi and Sao Tome and Principe reporting a rate of less than 100%. Reporting rates were particularly low in the Congo in 2020 and 2021, at 22% and 76%, respectively. Equatorial Guinea has not reported data for the past 2 years. Additional challenges include insufficient domestic and international funding, and frequent malaria outbreaks. The COVID-19 pandemic disrupted diagnostic services, as indicated by the 10% decrease in diagnostic tests in 2020 compared with 2019; numbers of diagnostic tests decreased in all countries except the Democratic Republic of the Congo and Gabon. In 2021, the number of suspects tested increased again as service disruptions due to the COVID-19 pandemic were resolved. Tackling the abovementioned issues could greatly improve the malaria situation in the region.

ANNEX 3 - A. WHO AFRICAN REGION, c. COUNTRIES WITH HIGH TRANSMISSION IN EAST AND SOUTHERN AFRICA

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 381 million
Parasites: *P. falciparum* (almost 100%), *P. vivax* (<1%) and other (<1%)
Vectors: *An. arabiensis, An. funestus* s.l., *An. gambiae* s.l., *An. gambiae* s.s., *An. leesoni, An. nili, An. pharoensis, An. rivulorum, An. stephensi* s.l.[a] and *An. vaneedeni.*

[a] A potential vector identified.

FUNDING (US$), 2010–2021

799.7 million (2010), 773.4 million (2015), 940.4 million (2021); 2010–2021: 18% increase
Proportion of domestic source[a] in 2021: 17%

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Countries with ≥80% coverage with either LLINs or IRS in 2021: None
Countries with ≥50% coverage with either LLINs or IRS in 2021: Kenya, Madagascar, Malawi, Mozambique, Rwanda, South Sudan, Uganda, the United Republic of Tanzania and Zambia

Countries that implemented IPTp in 2021: Kenya, Malawi, Mozambique, South Sudan, Uganda, the United Republic of Tanzania (mainland), Zambia and Zimbabwe
Countries with >30% IPTp3+ in 2021: Kenya, Madagascar, Malawi, Mozambique, Uganda and Zambia
Children treated with at least one dose of SMC per cycle in 2021: 200 000

Percentage of suspected cases tested (reported): 38% (2010), 80% (2015), 98% (2021)
Number of ACT courses distributed: 67.9 million (2010), 108.2 million (2015), 105.8 million (2021)
Number of any antimalarial treatment courses (incl. ACT) distributed: 68.0 million (2010), 109.9 million (2015), 107.4 million (2021)

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases: 53.3 million (2010), 59.0 million (2015), 56.4 million (2021)
Confirmed cases: 8.6 million (2010), 36.2 million (2015), 53.5 million (2021)
Percentage of total cases confirmed: 16.1% (2010), 61.5% (2015), 94.9% (2021)
Deaths: 70 700 (2010), 38 400 (2015), 15 200 (2021)

Children aged under 5 years, presumed and confirmed cases: 21.6 million (2010), 17.6 million (2015), 19.2 million (2021)
Children aged under 5 years, percentage of total cases: 40.5% (2010), 29.9% (2015), 34.1% (2021)
Children aged under 5 years, deaths:[b] 25 300 (2010), 10 400 (2015), 7200 (2021)
Children aged under 5 years, percentage of total deaths: 36% (2010), 27% (2015), 47% (2021)

[a] Includes malaria endemic countries only; [b] No data for Madagascar and Mozambique in 2021.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 55.1 million (2010), 59.8 million (2015), 56.4 million (2021); 2010–2021: 2% increase
Deaths: 135 300 (2010), 127 900 (2015), 128 000 (2021); 2010–2021: 5% decrease

ACCELERATION TO ELIMINATION

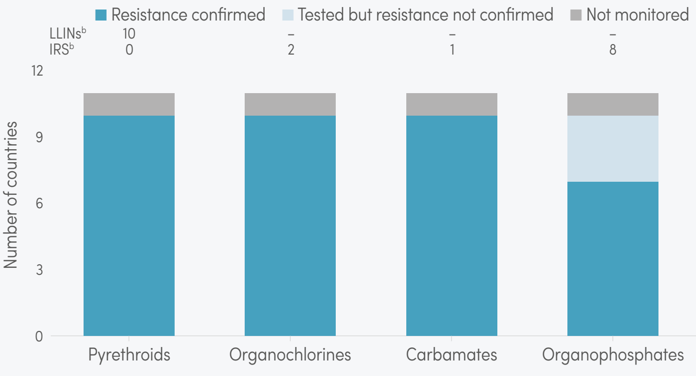
Countries with subnational/territorial elimination programme: the United Republic of Tanzania (Zanzibar)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2019	49	0.0	1.4	13.9	0.0	3.0
AS-AQ	2016–2018	14	0.0	0.0	2.0	0.0	0.6
DHA-PPQ	2015–2019	13	0.0	0.0	6.0	0.0	1.3

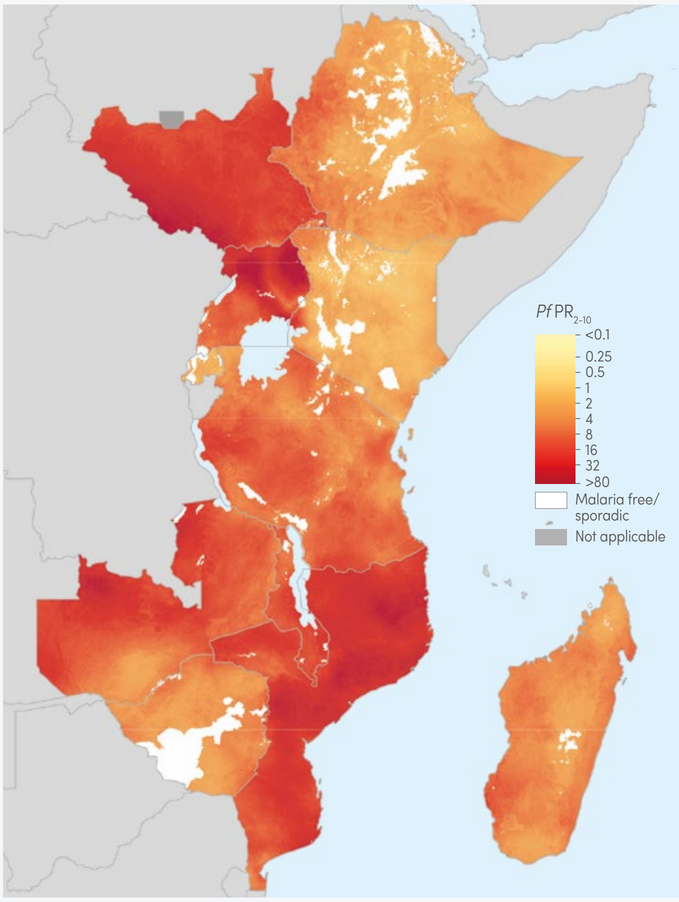
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

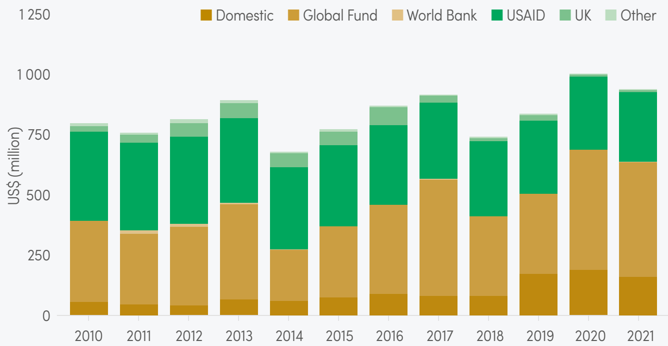


[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. *P. falciparum* parasite rate (*Pf*PR), 2021

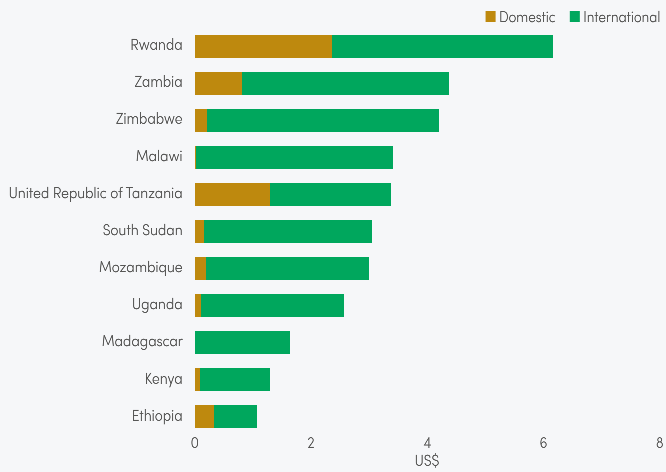


B. Malaria funding[a] by source, 2010–2021



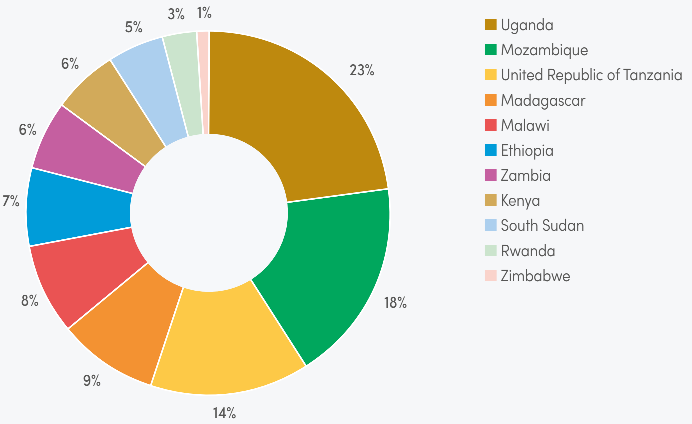
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Kenya and Uganda in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021

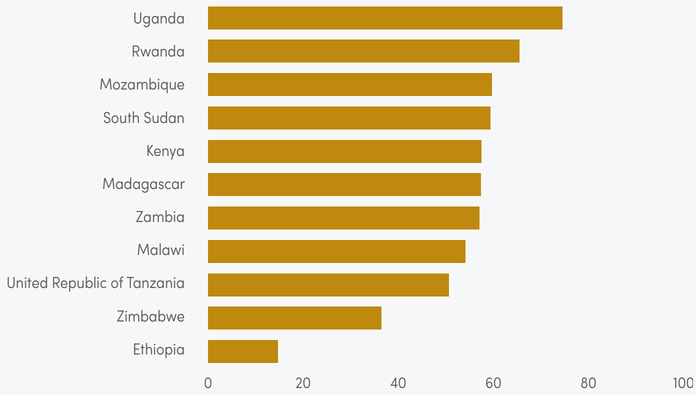


[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2021

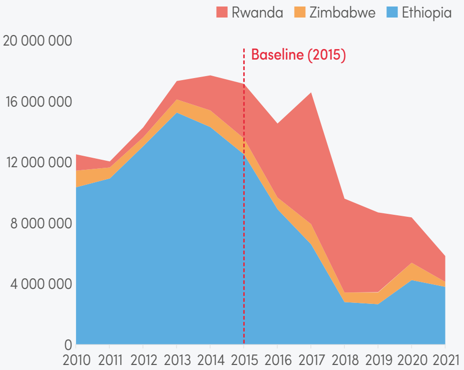


E. Percentage of population with access to either LLINs or IRS, 2021
Source: ITN coverage model from MAP

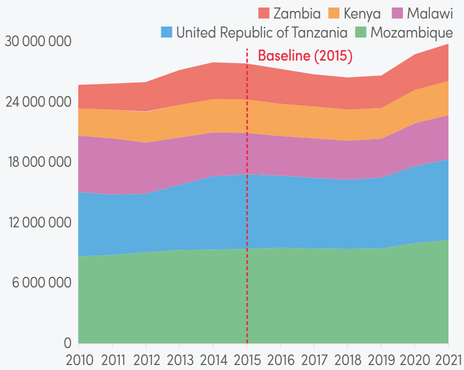


IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; MAP: Malaria Atlas Project.

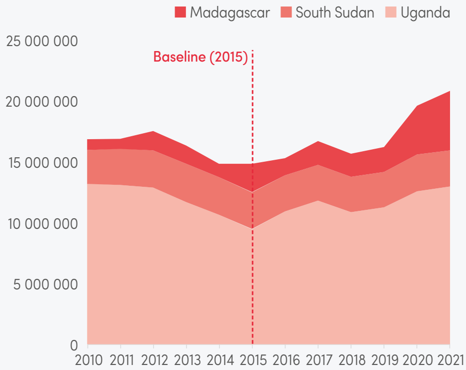
F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015



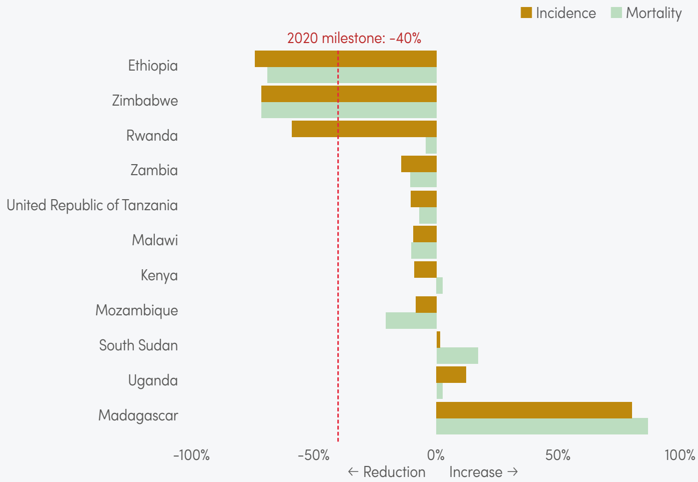
G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015



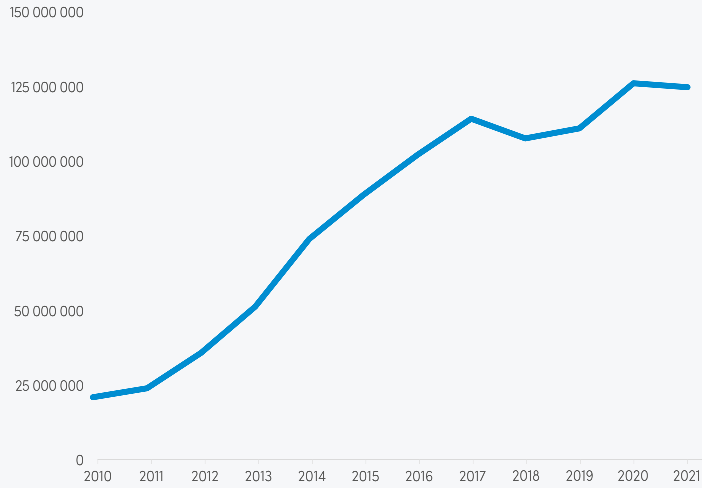
H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021



I. Change in estimated malaria incidence and mortality rates, 2015–2021



J. Total number of suspected malaria cases tested, 2010–2021



KEY MESSAGES

- About 381 million people in the 11 countries with high transmission in east and southern Africa are at high risk of malaria. Malaria transmission is almost exclusively due to *P. falciparum* (except in Ethiopia), and is highly seasonal in Ethiopia, Madagascar and Zimbabwe, and in coastal and highland areas of Kenya. Malaria transmission is stable in most of Malawi, Mozambique, South Sudan, Uganda, the United Republic of Tanzania and Zambia. The HBHI initiative has been initiated in Mozambique and Uganda.
- The subregion had almost 56 million estimated cases and about 128 000 estimated deaths, representing a 2% increase and 5% decrease compared with 2010, respectively. Three countries accounted for more than 50% of the estimated cases: Uganda (23%), Mozambique (18%) and the United Republic of Tanzania (14%). In the public and private sectors and the community, 56.4 million cases were reported, of which 34.1% were in children aged under 5 years and 53 million (94.9%) were confirmed. The proportion of total cases that were confirmed improved substantially over time, from only 16% in 2010. A significantly lower number of deaths was reported in 2021 (15 300) compared with 2010 (70 700) and 2015 (38 400).
- Ethiopia, Rwanda and Zimbabwe achieved the GTS target of a 40% reduction in incidence by 2021 compared with the GTS baseline in 2015. Hence, these countries are currently on track to achieve the GTS targets in 2025 and 2030. Although the GTS target was not met in the other countries in the subregion, Kenya, Malawi, Mozambique, the United Republic of Tanzania and Zambia did reduce incidence, but by less than 40% in 2021 compared with 2015. Increases in incidence were seen in Madagascar, South Sudan and Uganda. In nine countries, 50% or more of the population had access to LLINs or IRS in 2021 and eight countries implemented IPTp, with six countries achieving the target of more than 30% of pregnant women attending antenatal care (ANC) receiving three or more doses of IPTp. Mozambique and Uganda implemented SMC for the first time, providing about 200 000 children with at least one dose of SMC per cycle in 2021.
- Compared with 2020, in 2021, South Sudan had an increase of 74% in the number of reported malaria cases – from about 1.8 million to 3.1 million – the latter being closer to the number of cases that were reported in 2019 (4 million). The decrease in 2020 was likely due to COVID-19 related disruptions. Of concern, the reporting rate in South Sudan in 2021 was only 30%, meaning that the number of cases could be three times higher than the number reported. Reported cases more than halved in Zanzibar (United Republic of Tanzania), from about 14 100 cases in 2020 to 6000 cases in 2021, as the island strengthened and accelerated its efforts towards malaria elimination. Between 2017 and 2021, the number of reported cases in Rwanda decreased from 5.9 million to 1.2 million – a total reduction of 80%. It appears that the COVID-19 pandemic in 2020 did not affect diagnostic services, given that there was a 14% increase in diagnostic tests in 2020 compared with 2019; increases in testing were reported in all countries except Mozambique and Rwanda.
- Vector resistance to pyrethroids was confirmed in 74% of sites, to organochlorines in 40%, to carbamates in 27% and to organophosphates in 16%. Vector resistance to pyrethroids, organochlorines and carbamates was confirmed in all countries except South Sudan, which did not report resistance monitoring. Eleven countries have developed insecticide resistance monitoring and management plans.
- Total funding in the subregion has increased by 18% since 2010, showing fluctuations over the past decade. Domestic expenditure represented 17% of total funding in 2021. Funding per person at risk ranged from US$ 1.07 in Ethiopia to US$ 6.17 in Rwanda over a 3-year average.
- Challenges include frequent epidemics, humanitarian and health emergencies, inadequate response (South Sudan) due to political instability, inadequate funding for interventions and human resources, delays in delivery of critical commodities and weak surveillance systems (including lack of early warning systems for detection of outbreaks) in several countries.

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 14 million
Parasites: *P. falciparum* (92%), *P. vivax* (8%) and other (<1%)
Vectors: *An. arabiensis, An. funestus* s.l., *An. funestus* s.s., *An. gambiae* s.l. and *An. gambiae* s.s.

FUNDING (US$), 2010–2021

72.6 million (2010), 27.3 million (2015), 42.0 million (2021); 2010–2021: 42% decrease
Proportion of domestic source[a] in 2021: 82%
Regional funding mechanisms: Southern Africa Malaria Elimination Eight Initiative
[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure. No data for Botswana in 2021.

INTERVENTIONS, 2010–2021

Countries with ≥80% coverage of at-risk population with either LLINs or IRS in 2021: none
Countries with ≥50% coverage of high-risk population with either LLINs or IRS in 2021: the Comoros

Percentage of suspected cases tested (reported): 81% (2010), 99% (2015), 99.9% (2021)
Number of ACT courses distributed: 575 000 (2010), 366 000 (2015), 131 000 (2021)
Number of any antimalarial treatment courses (incl. ACT) distributed: 575 000 (2010), 366 000 (2015), 131 000 (2021)

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases: 205 300 (2010), 52 900 (2015), 75 400 (2021)
Confirmed cases: 82 500 (2010), 47 700 (2015), 74 900 (2021)
Percentage of total cases confirmed: 40.2% (2010), 90.2% (2015), 99.2% (2021)
Deaths: 242 (2010), 176 (2015), 92 (2021)

Children aged under 5 years, presumed and confirmed cases: 56 400 (2010), 7300 (2015), 8600 (2021)
Children aged under 5 years, percentage of total cases: 27.5% (2010), 13.7% (2015), 11.4% (2021)
Children aged under 5 years, deaths: 37 (2010), 13 (2015), 2 (2021)
Children aged under 5 years, percentage of total deaths: 15% (2010), 7% (2015), 2% (2021)
[a] Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 133 200 (2010), 86 100 (2015), 129 100 (2021); 2010–2021: 3% decrease
Deaths: 347 (2010), 280 (2015), 349 (2021); 2010–2021: 1% increase

ACCELERATION TO ELIMINATION

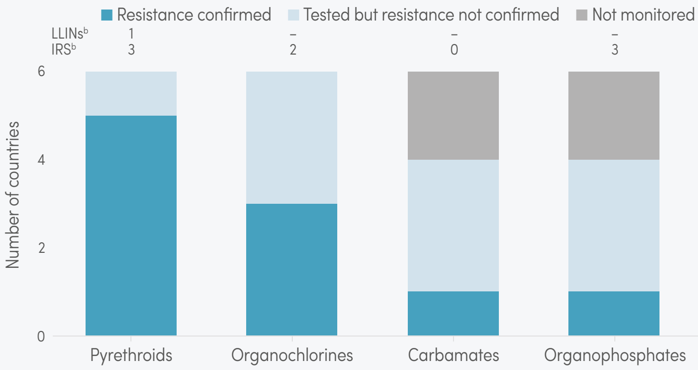
Countries with nationwide elimination programme: Botswana, the Comoros, Eswatini, Namibia and South Africa
Countries part of the E-2025 initiative: Botswana, the Comoros, Eswatini and South Africa

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2017–2017	4	0.0	0.0	0.0	0.0	0.0
AS-AQ	2016–2019	8	0.0	3.2	4.7	1.1	4.4

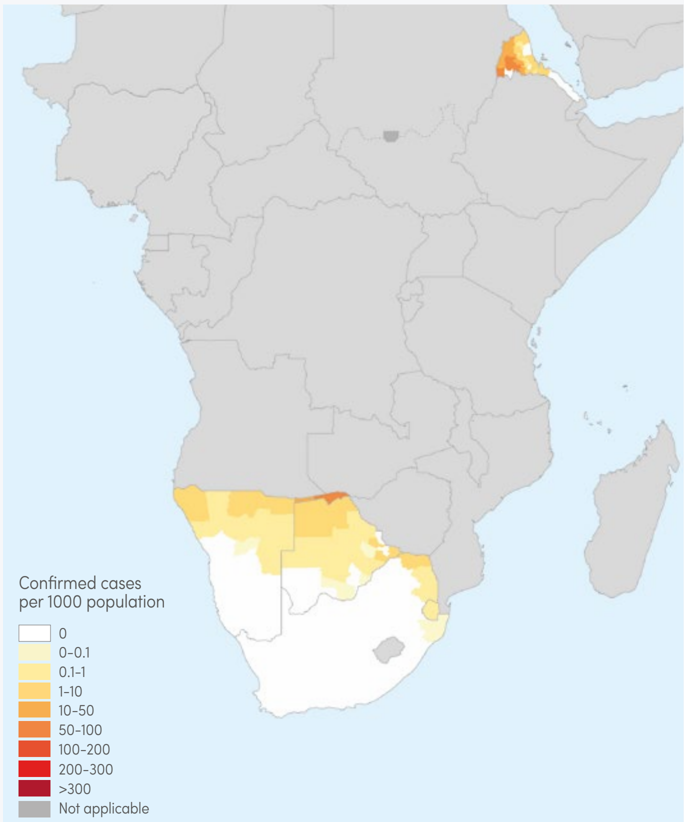
AL: artemether-lumefantrine; AS-AQ: artesunate-amodiaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



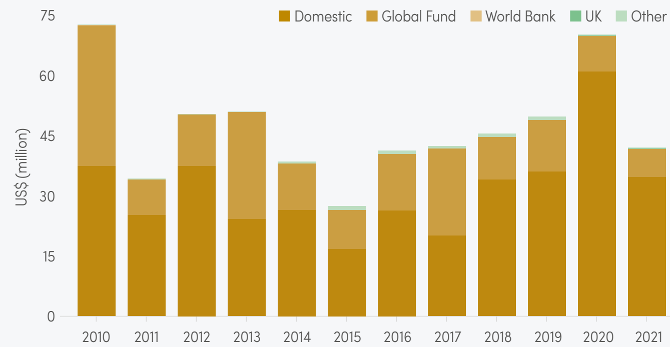
[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2021



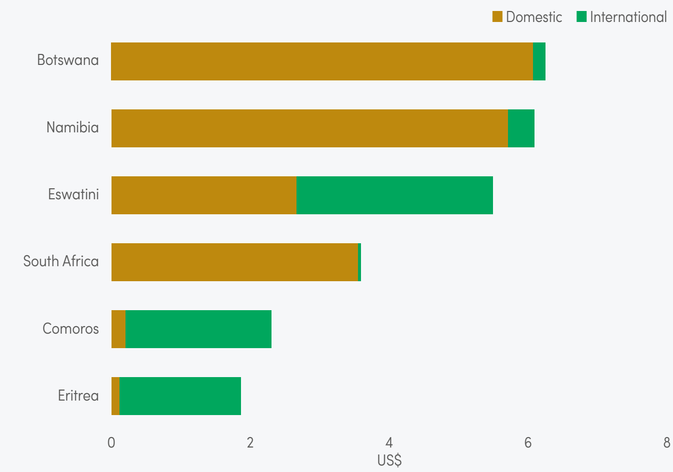
Note: In the Comoros, 2017 data were used.

B. Malaria funding[a] by source, 2010–2021



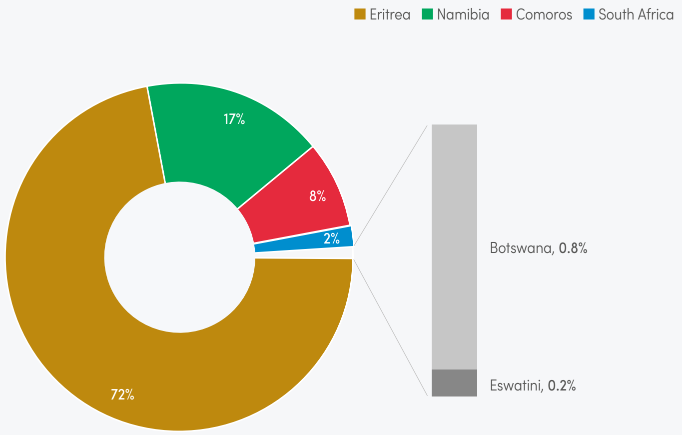
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland.
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Botswana in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021

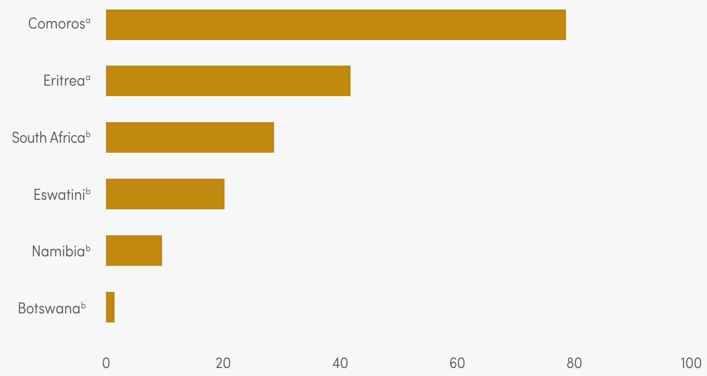


[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

D. Share of estimated malaria cases, 2021

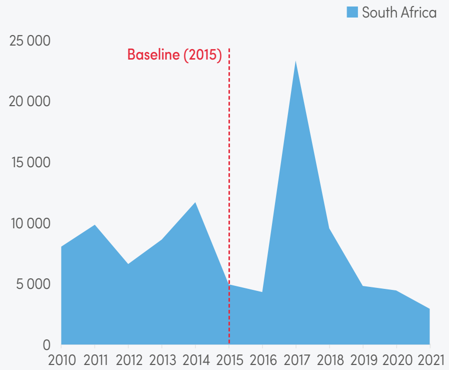


E. Percentage of population with access to either LLINs or IRS, 2021
Source: ITN coverage model from MAP

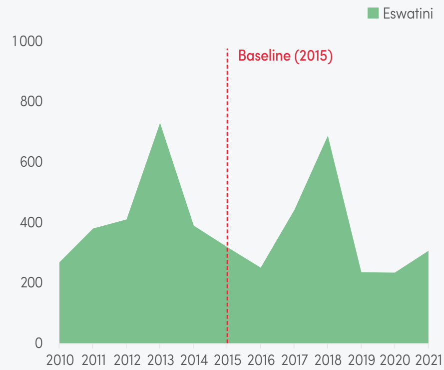


IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; MAP: Malaria Atlas Project.
[a] ITN coverage estimated by a model from MAP.
[b] IRS coverage is shown using the population to compute incidence and mortality rate as the denominator.

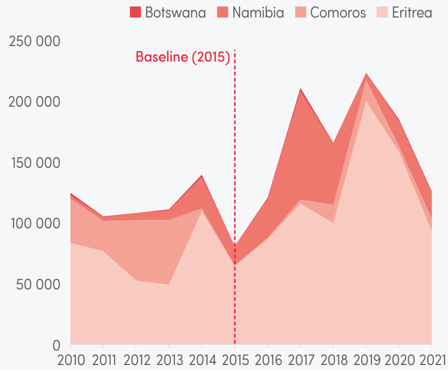
F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015



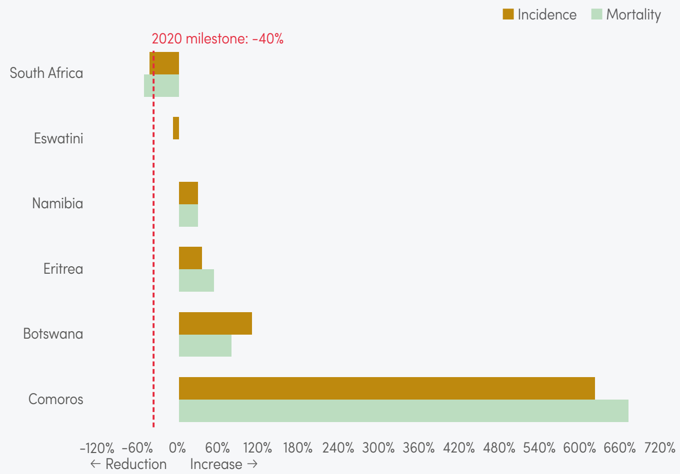
G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015



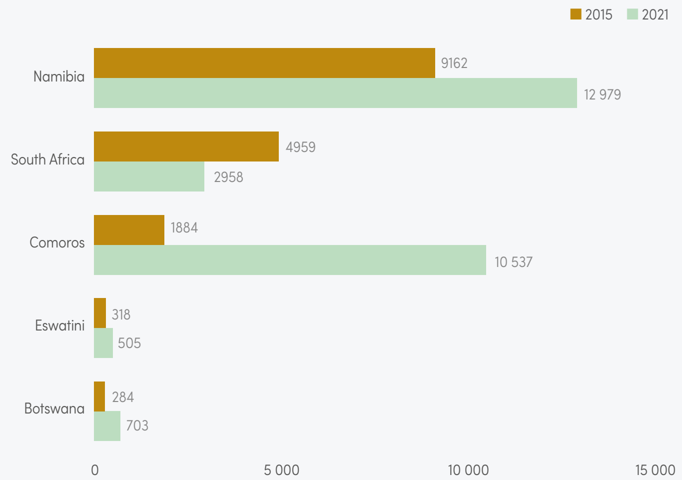
H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021



H. Change in estimated malaria incidence and mortality rates, 2015–2021



I. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- About 14 million people in the six countries with low transmission in east and southern Africa are at risk of malaria. About 75 400 cases were reported, of which 11.4% were in children aged under 5 years and 99.2% were confirmed. The proportion of total cases that were confirmed has improved substantially over time, from only 40.2% in 2010. The proportion of all malaria deaths that were in children aged under 5 years decreased significantly, from 15% in 2010 to 2% in 2021.
- In 2021, there were an estimated 129 000 cases and 349 deaths – a decrease of 3% and an increase of 1% compared with 2010. Eritrea accounted for 84% of all estimated cases in the subregion. South Africa met the GTS target of a 40% reduction in incidence by 2021 compared with the GTS baseline of 2015 as a result of strong political support and advocacy within the country, coupled with increased domestic funding. Incidence also decreased in Eswatini but by less than 40%, largely thanks to improvements in case-based surveillance and the use of data to respond to the contextual factors driving transmission. The GTS target was not met in Botswana, the Comoros, Eritrea and Namibia, where incidence increased. Despite a large decrease in the number of estimated cases in Namibia in 2019 (5705) compared with 2018 (50 217), cases significantly increased again to 20 258 in 2020 and to 21 322 in 2021. During the 2020 and 2021 malaria seasons, Namibia experienced malaria outbreaks that were detected late; the major contributor to this situation was low IRS coverage within malaria transmission zones and reported insecticide resistance to dichloro-diphenyl-trichloroethane (DDT) and deltamethrine. Botswana also had a significant increase in estimated cases in 2020 (1776), which was seven times higher than the estimated cases in 2019 (259). In 2021, estimated cases decreased again to 1067. The Comoros, however, had a 74% decrease in estimated cases in 2020 (4546) compared with 2019 (17 599) but cases increased again to 10 537 in 2021. Compared with 2019 and 2020, cases in Eritrea decreased in 2021 by 54%. In South Africa, cases also decreased by 34% in 2021 compared with 2020. In 2021, reporting completeness in Botswana and South Africa was below 90%. In South Africa during the malaria transmission season, disruptions and restrictions to movement due to multiple lockdowns related to the COVID-19 pandemic limited the ability of mobile teams to carry out case investigations at community level, resulting in low investigation and testing rates. Three countries – Botswana, Eswatini and South Africa – that are part of the E-2025 continue to lead the race towards malaria elimination within the subregion.
- Vector resistance to pyrethroids was confirmed in 55% of sites, to organochlorines in 33%, to carbamates in 7% and to organophosphates in 8%. Five countries have developed insecticide resistance monitoring and management plans.
- Funding in the subregion has decreased by 42% since 2010; however, from 2015 to 2020 there were substantial gains in funding. There was a large decrease in funding from 2020 to 2021 (40%), largely due to a 43% decrease in domestic funding, in part because Botswana did not report funding in 2021. Funding per person at risk ranged from US$ 1.86 in Eritrea to US$ 6.25 in Botswana over a 3-year average. Eritrea accounts for 84% of all cases yet has the lowest funding per person at risk in the subregion, highlighting the increasing need for domestic and international funding across all countries to achieve targets set out in the GTS.
- Challenges include reduction of malaria funding at programme level, inadequate coverage of vector control interventions, bottlenecks in procurement and supply management, high population movement between high and low endemic countries (which increases the risk of importation), insufficient human resource and logistical resources to meet the operational requirements of malaria programmes and resurgence during the past 3 years.

ANNEX 3 - B. WHO REGION OF THE AMERICAS

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 142 million
Parasites: *P. vivax* (76%), *P. falciparum* and mixed (24%) and other (<1%)
Vectors: *An. albimanus, An. albitarsis, An. aquasalis, An. argyritarsis, An. braziliensis, An. cruzii, An. darlingi, An. neivai, An. nuneztovari, An. pseudopunctipennis* and *An. punctimacula.*

FUNDING (US$), 2010–2021

234.3 million (2010), 202.7 million (2015), 137.7 million (2021); 2010–2021: 41% decrease
Proportion of domestic source[a] in 2021: 74%
Regional funding mechanisms: Regional Malaria Elimination Initiative

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Number of people protected by IRS:[a] 6.99 million (2010), 3.94 million (2015), 2.37 million (2021)
Total LLINs distributed:[b] 978 000 (2010), 1.14 million (2015), 1.11 million (2021)

Number of RDTs distributed:[c] 83 700 (2010), 533 900 (2015), 824 000 (2021)

Number of ACT courses distributed:[d] 148 400 (2010), 209 400 (2015), 134 700 (2021)
Number of any first-line antimalarial treatment courses (incl. ACT) distributed:[e] 1.14 million (2010), 652 500 (2015), 527 100 (2021)

[a] No data for Peru and the Plurinational State of Bolivia in 2021; [b] Includes piperonyl butoxide (PBO) nets, G2 nets and Royal Guard nets in 2021; [c] No data for the Dominican Republic, Haiti, Nicaragua, Peru and the Plurinational State of Bolivia in 2021; [d] No data for the Dominican Republic, French Guiana and Nicaragua in 2021; [e] No data for French Guiana in 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases:[a] 677 400 (2010), 479 000 (2015), 524 200 (2021)
Confirmed cases: 677 400 (2010), 479 000 (2015), 524 200 (2021)
Percentage of total cases confirmed: 100% (2010), 100% (2015), 100% (2021)
Indigenous cases: 677 373 (2010), 443 419 (2015), 478 470 (2021)
Imported cases: 11 (2010), 14 881 (2015), 3420 (2021)
Introduced cases: 23 (2010), 0 (2015), 4575 (2021)
Indigenous deaths: 190 (2010),169 (2015), 126 (2021)

[a] Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS,[a] 2010–2021

Cases: 818 000 (2010), 573 000 (2015), 597 000 (2021); 2010–2021: 27% decrease
Deaths: 502 (2010), 390 (2015), 334 (2021); 2010–2021: 33% decrease

[a] For Bolivia (Plurinational State of), data were submitted after the closure of data analysis (total indigenous cases: 11 017 used in burden estimation instead of 9959 in 2021).

ACCELERATION TO ELIMINATION

Countries and territories with nationwide elimination programme: Belize, Bolivia (Plurinational State of), Brazil, Colombia, Costa Rica, the Dominican Republic, Ecuador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Mexico, Nicaragua, Panama, Peru, Suriname, Venezuela (Bolivarian Republic of)
Countries and territories part of the E-2025 initiative: Belize, Costa Rica, the Dominican Republic, Ecuador, French Guiana, Guatemala, Honduras, Mexico, Panama and Suriname
Certification in process: Belize
Zero indigenous cases for 3 consecutive years (2019–2021): Belize
Certified as malaria free since 2010: Argentina (2019), El Salvador (2021) and Paraguay (2018)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2019	2	0	0	0	0	0

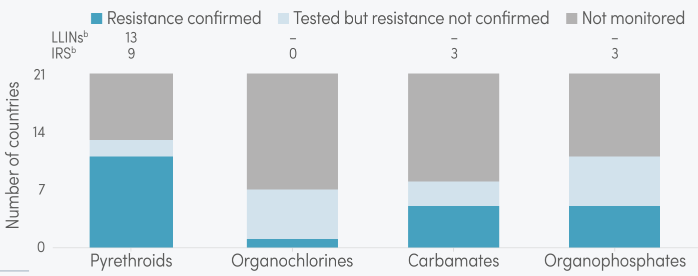
AL: artemether-lumefantrine.

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. VIVAX* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
CQ	2019–2020	1	0.0	0.0	0.0	0.0	0.0
CQ+PQ	2016–2020	3	0.0	0.0	1.2	0.0	1.2

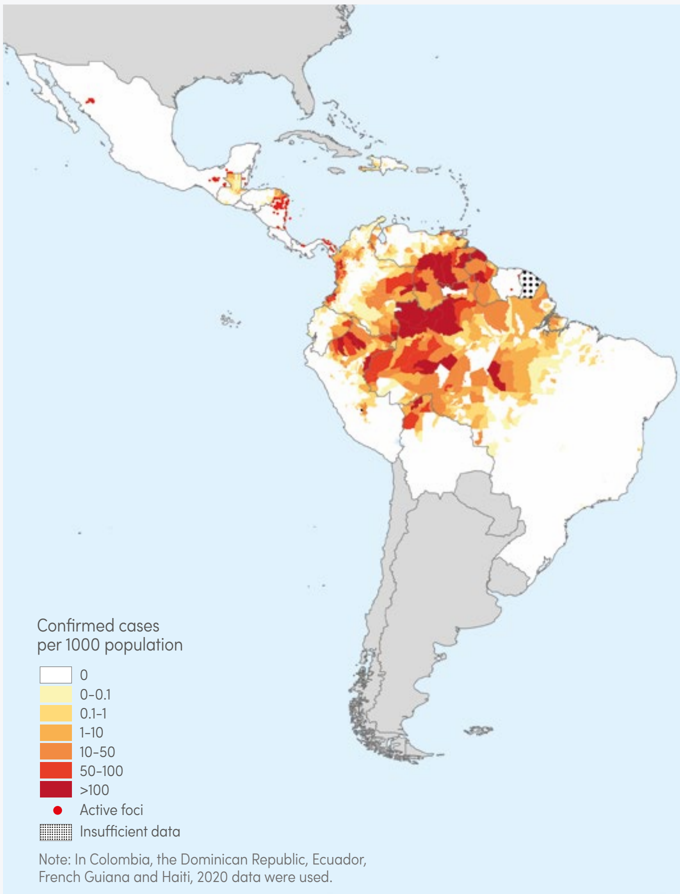
CQ: chloroquine; CQ+PQ: chloroquine+primaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

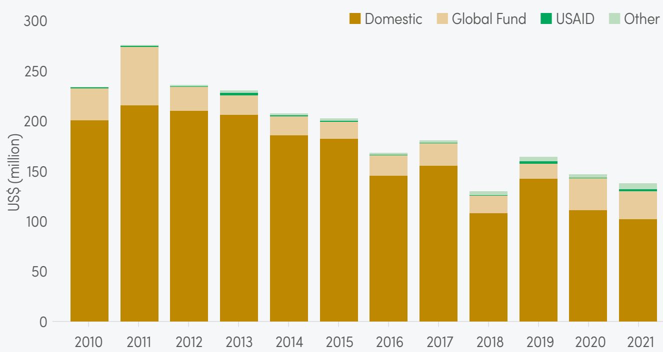


[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2021

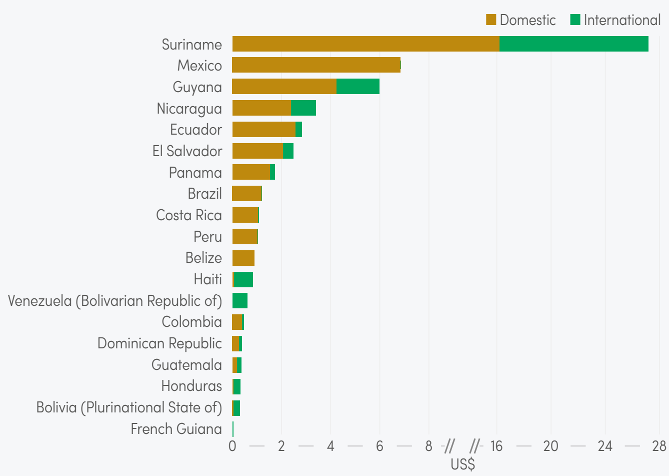


B. Malaria funding[a] by source, 2010–2021



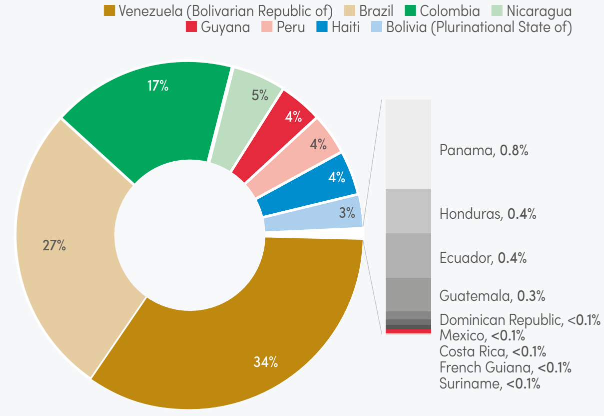
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; USAID: United States Agency for International Development.
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for the Bolivarian Republic of Venezuela, Ecuador and Haiti in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021



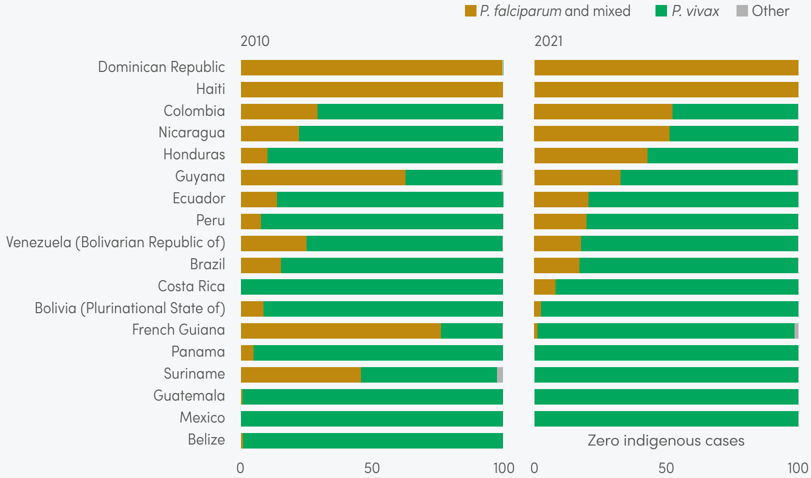
[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs.

D. Share of estimated malaria cases, 2021

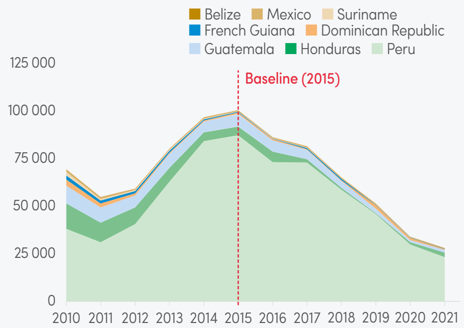


Note: for Bolivia (Plurinational State of), data were submitted after the closure of data analysis (total indigenous cases: 11 017 used in burden estimation instead of 9959 in 2021).

E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2021

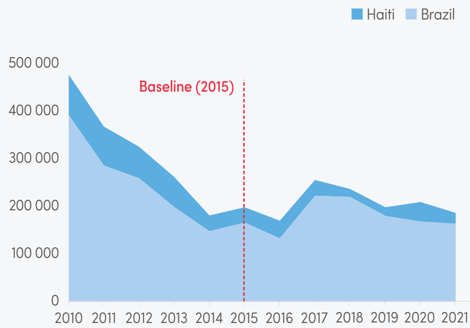


F. Estimated number of cases in countries and areas that reduced case incidence by ≥40% in 2021 compared with 2015

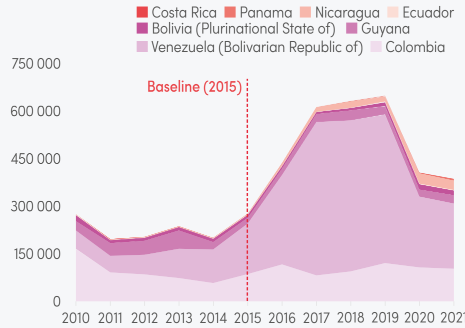


Note: El Salvador was certified as malaria free in 2021; Belize has reported zero indigenous cases since 2019.

G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015

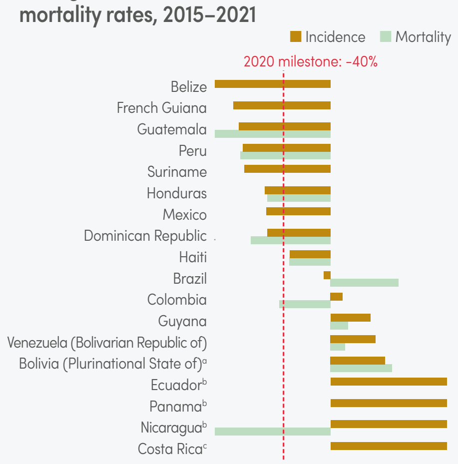


H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021



Note: for Bolivia (Plurinational State of), data were submitted after the closure of data analysis (total indigenous cases: 11 017 used in burden estimation instead of 9959 in 2021).

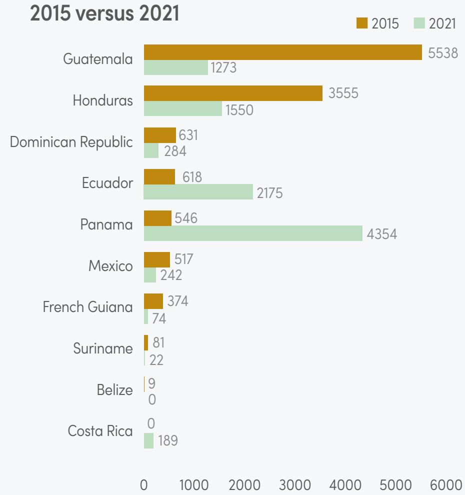
I. Change in estimated malaria incidence and mortality rates, 2015–2021



[a] Data were submitted after the closure of data analysis (total indigenous cases: 11 017 used in burden estimation instead of 9959 in 2021); [b] In these countries, change in case incidence is more than 100%; [c] This country achieved the 40% reduction in mortality rate in 2015; since then, there has been no change.

J. Total number of suspected malaria cases tested, 2010–2021

K. Number of reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- Eighteen countries including one territory in the WHO Region of the Americas are currently at risk of malaria. Paraguay, Argentina and El Salvador were certified malaria free by WHO in 2018, 2019 and 2021, respectively. Belize reported zero indigenous malaria cases for the third consecutive year in 2021. Three quarters of reported malaria cases in the region are caused by *P. vivax*. In 2021, the region reported 524 154 malaria cases and 126 indigenous deaths – decreases of 23% and 34% compared with 2010, respectively. Three countries accounted for almost 80% of all estimated cases: Venezuela (Bolivarian Republic of) (34%), Brazil (27%) and Colombia (17%).
- Ten countries and one territory experienced reductions in the number of reported cases between 2015 and 2021 (% reduction shown in brackets): Belize (100%), Brazil (2%), the Dominican Republic (56%), El Salvador (100%), French Guiana (77%), Haiti (46%), Honduras (53%), Mexico (50%), Peru (73%) and Suriname (80%). All other countries in the region experienced varying levels of increases in reported cases; such increases in 2021 are attributed to outbreaks, population dynamics within the countries and gaps in the malaria response.
- All of the indigenous cases reported by Guatemala, Mexico, Panama and Suriname were due to *P. vivax*. Additionally, between 48% and 98% of the indigenous cases were due to *P. vivax* in Bolivia (Plurinational State of), Brazil, Costa Rica, Ecuador, French Guiana, Guyana, Honduras, Nicaragua, Peru and Venezuela (Bolivarian Republic of). Conversely, all of the indigenous cases reported by the Dominican Republic and Haiti and 52% of the indigenous cases reported in Colombia in 2021 were due to *P. falciparum*.
- Nine countries including one territory in the region met the GTS target of reduced case incidence by 40% or more by 2020: Belize, the Dominican Republic, El Salvador, French Guiana, Guatemala, Honduras, Mexico, Peru and Suriname. Two countries, Brazil and Haiti, reduced case incidence but by less than 40%. Eight countries – Bolivia (Plurinational State of), Colombia, Costa Rica, Ecuador, Guyana, Nicaragua, Panama and Venezuela (Bolivarian Republic of) – saw increases in incidence in 2021 compared with 2015. All countries except Bolivia (Plurinational State of), Brazil, Guyana, Haiti and Venezuela (Bolivarian Republic of) experienced a 40% or more reduction in the number of estimated deaths. In 2021, 13 countries reported zero malaria deaths. No data on deaths were reported for French Guiana.
- Nine countries and one territory in this region are part of the E-2025 initiative: Belize, Costa Rica, the Dominican Republic, Ecuador, French Guiana, Guatemala, Honduras, Mexico, Panama and Suriname. An additional seven countries in Central America with Colombia and the Dominican Republic are taking part in a subregional initiative to eliminate malaria by 2025 (RMEI). In 2021, imported cases accounted for 69% of the cases in Suriname (53/77), 26% of the cases in French Guiana (37/143), 12% of the cases in Costa Rica (27/232), 11% of the cases in Mexico (31/275), 6.5% of the cases in Honduras (107/1657) and 3% of the cases in Ecuador (70/2436). In Brazil and Venezuela (Bolivarian Republic of), 14% and 7% of all cases were classified as relapses, respectively.
- Malaria prevention in most of the countries relies on IRS, or mass or routine distribution of insecticide-treated mosquito nets (ITNs). Bolivia (Plurinational State of) and Peru introduced the distribution of nets treated with piperonyl butoxide (PBO) in 2019 and 2020, respectively. Vector resistance to pyrethroids was confirmed in 32% of the sites, to organochlorines in 5%, to carbamates in 18% and to organophosphates in 18%. There remain significant gaps in standard resistance monitoring for the insecticide classes commonly used for vector control. Fourteen countries have developed their insecticide resistance monitoring and management plans.
- Total funding has decreased by an average of 41% since 2010; it peaked in 2011 and then gradually declined over the past decade. From 2020 to 2021, total funding decreased by 6%. The majority of funding stemmed from domestic expenditures, which represented 74% of total funding in 2021.
- Owing to the COVID-19 pandemic, diagnostic services were disrupted, as shown by the 32% decrease in malaria suspected cases tested in 2020 compared with 2019. In six countries – Brazil, Colombia, Costa Rica, Guyana, Mexico and Panama – although the test positivity rate was higher in 2020 than in 2021, the number of people tested had decreased by at least 25% in the same period. In the Dominican Republic and Mexico, available testing data showed that testing declined in March 2020 and beyond, clearly associated with lockdowns related to the COVID-19 pandemic. The reduction in testing and disruption of services may have contributed to reduction in cases reported by the region in 2020; however, restrictions in mobility seem to have had an effect on transmission. The number of suspects tested increased again in 2021.

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 534 million

Parasites: *P. falciparum* and mixed (74%), *P. vivax* (26%) and other (<1%)

Vectors: *An. annularis, An. arabiensis, An. culicifacies* s.l., *An. d'thali, An. fluviatilis* s.l., *An. funestus* s.l., *An. gambiae* s.s., *An. hyrcanus, An. maculipennis* s.l., *An. pulcherrimus, An. rhodesiensis, An. sacharovi, An. sergentii, An. stephensi* and *An. superpictus* s.l.

FUNDING (US$), 2010–2021

137.1 million (2010), 168.8 million (2015), 166.5 million (2021); 2010–2021: 21% increase

Proportion of domestic source[a,b] in 2021: 25%

Regional funding mechanism: Middle East Response (MER) Initiative is supporting malaria intervention in Yemen by Global Fund, in partnership with International Organization for Migration (IOM) as principle recipient and WHO for technical support.

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

[b] No domestic funding data reported for Afghanistan and Yemen in 2021.

INTERVENTIONS, 2010–2021

Number of people protected by IRS:[a] 6.1 million (2010), 5.1 million (2015), 6.0 million (2021)

Total LLINs distributed:[b] 2.9 million (2010), 5.9 million (2015), 3.0 million (2021)

Number of RDTs distributed:[c] 2.0 million (2010), 6.1 million (2015), 7.7 million (2021)

Number of ACT courses distributed:[d] 2.6 million (2010), 3.2 million (2015), 7.8 million (2021)

Number of any first-line antimalarial treatment courses (incl. ACT) distributed:[d] 2.6 million (2010), 4.0 million (2015), 8.1 million (2021)

[a] No IRS was implemented in Afghanistan; no data reported for Pakistan in 2010; Djibouti reported IRS data in 2021 only; [b] Includes PBO nets, G2 nets and Royal Guard nets in 2021; [c] No data reported for the Islamic Republic of Iran, Pakistan and Saudi Arabia in 2010; no data reported for Yemen in 2021; Djibouti reported RDT distributed in 2021 only; [d] No data reported for Afghanistan, Djibouti and Pakistan in 2020; no data reported for Yemen in 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases: 6.4 million (2010), 5.4 million (2015), 4.8 million (2021)

Confirmed cases: 1.2 million (2010), 1.0 million (2015), 2.4 million (2021)

Percentage of total cases confirmed: 18.3% (2010), 18.8% (2015), 49.7% (2021)

Deaths: 1145 (2010), 1016 (2015), 1725 (2021)

[a] Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2021[a]

Cases: 4.5 million (2010), 4.3 million (2015), 6.2 million (2021); 2010–2021: 38% increase

Deaths: 8630 (2010), 8210 (2015), 13 410 (2021); 2010–2021: 55% increase

[a] Estimates for global trend analysis. Country-level subnational analysis is ongoing for decision-making for strategy development for countries and the region.

ACCELERATION TO ELIMINATION

Countries with nationwide elimination programme: Islamic Republic of Iran and Saudi Arabia

Zero indigenous cases for 4 consecutive years (2018–2021): Islamic Republic of Iran

Zero indigenous cases in 2021: Saudi Arabia

Countries part of the E-2025 initiative: Islamic Republic of Iran and Saudi Arabia

Certification in process: Islamic Republic of Iran (request submitted to WHO)

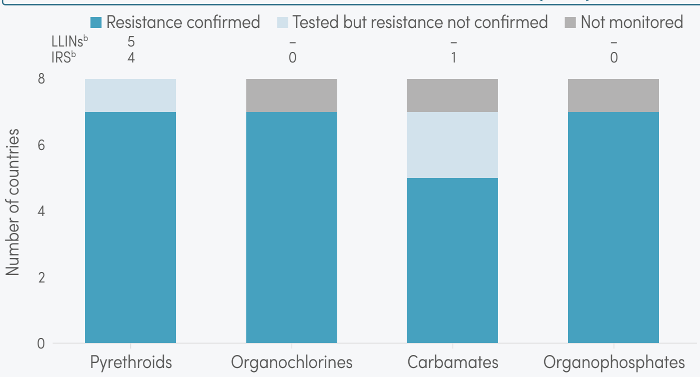
Certified as malaria free since 2010: Morocco (2010)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2020	18	0.0	0.0	7.9	0.0	2.4
AS+SP	2015–2017	7	0.0	0.0	16.4	0.0	12.3
DHA-PPQ	2015–2020	11	0.0	0.0	2.5	0.0	1.0

AL: artemether-lumefantrine; AS+SP: artesunate+sulfadoxine-pyrimethamine; DHA-PPQ: dihydroartemisinin-piperaquine.

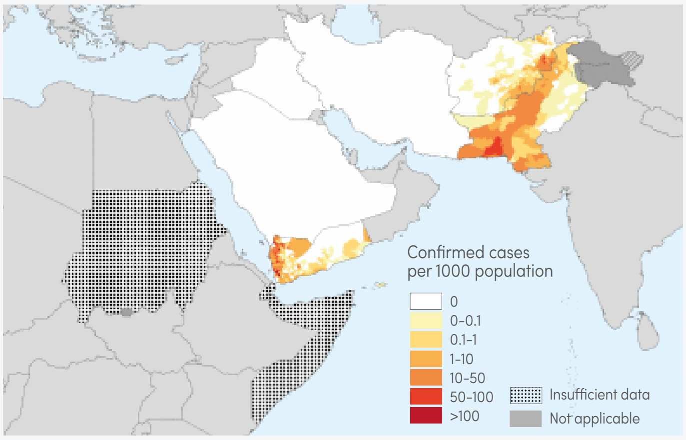
STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)



[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.

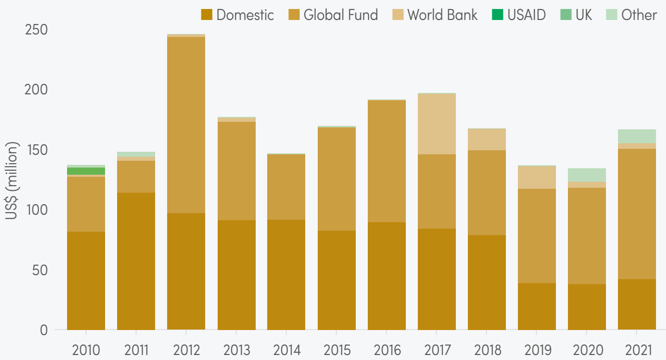
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2021



Note: Subnational estimates for Djibouti, Somalia and the Sudan are ongoing with national malaria control programmes.

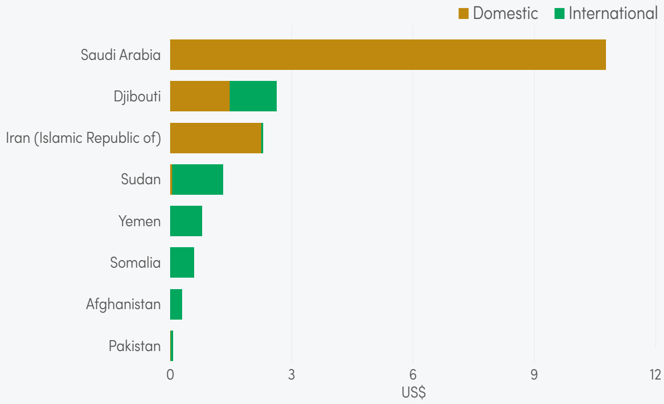
B. Malaria funding[a] by source, 2010–2021



Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.

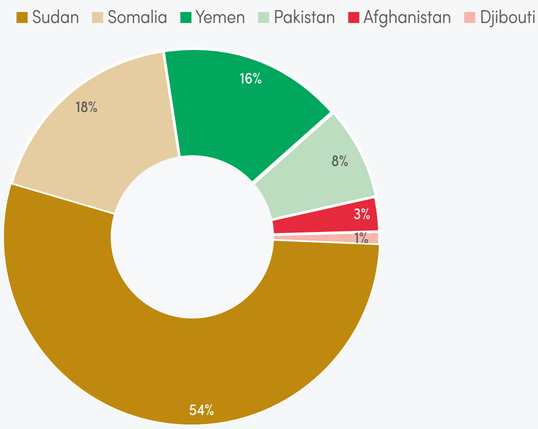
[a] Excludes patient service delivery costs and out-of-pocket expenditure; no domestic funding data were reported for Afghanistan and Yemen in 2021.

C. Malaria funding[a] per person at risk, average 2019–2021



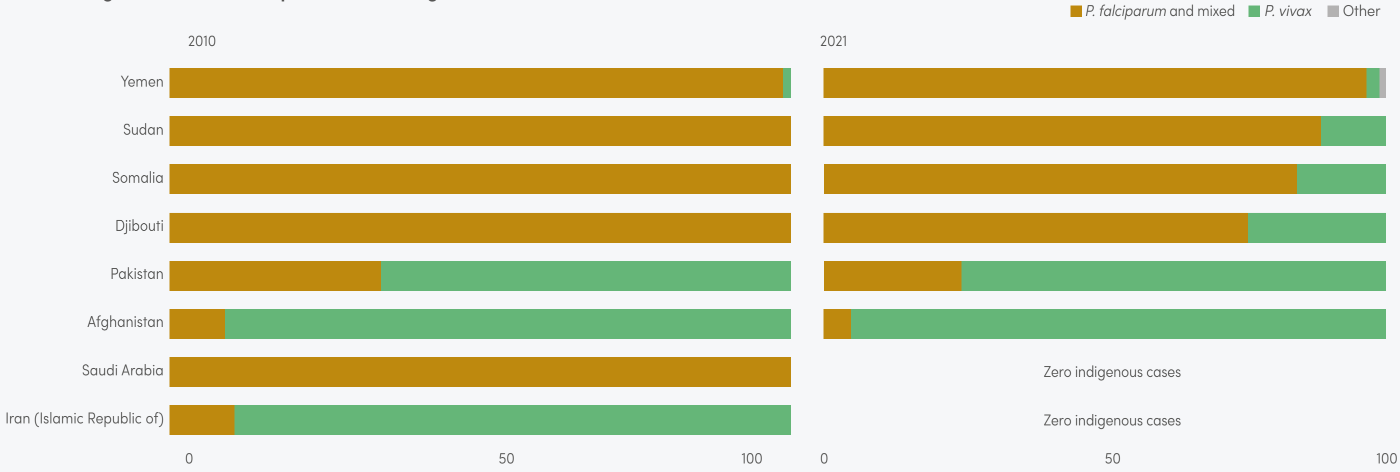
[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs.

D. Share of estimated malaria cases, 2021

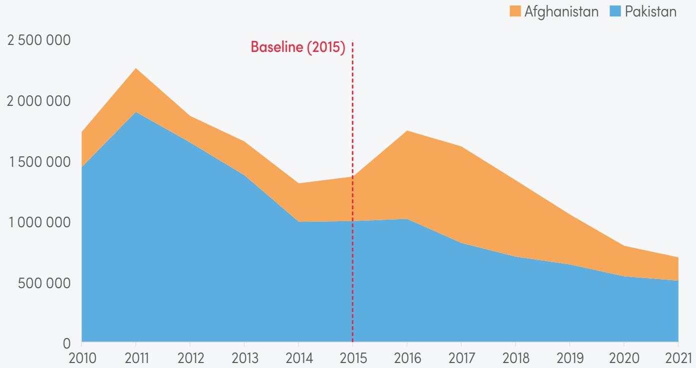


Note: Islamic Republic of Iran has had zero indigenous cases since 2018 and Saudi Arabia had zero indigenous cases in 2021.

E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2021

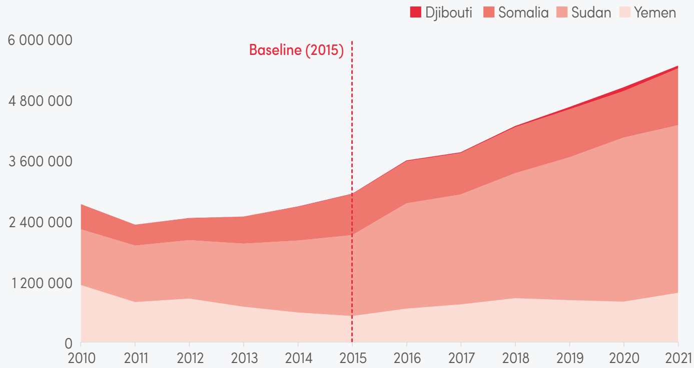


F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015



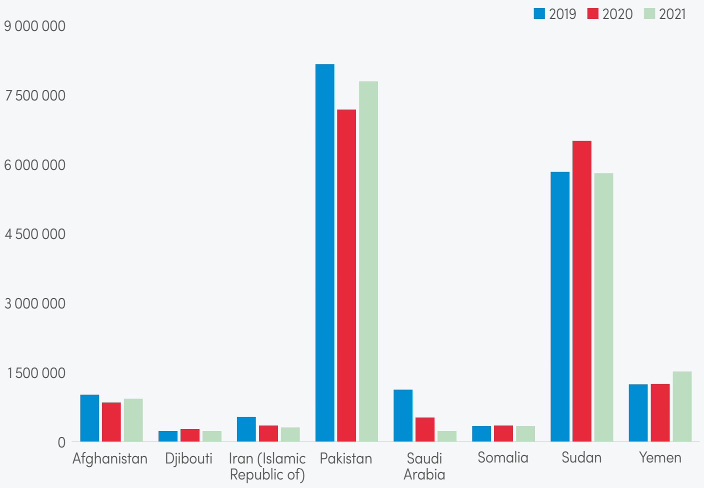
Note: These estimates need to be verified with ongoing country-level burden estimations.

G. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021

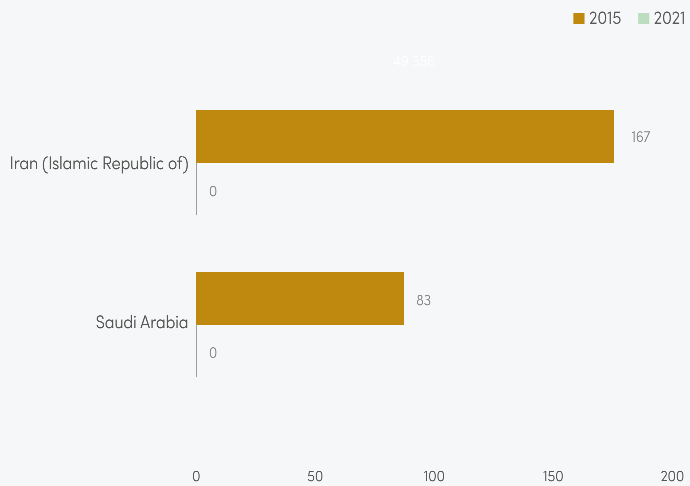


Note: These estimates need to be verified with ongoing country-level burden estimations.

H. Total number of suspected malaria cases tested, 2019–2021



I. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- Fourteen countries in the WHO Eastern Mediterranean Region are free of indigenous malaria and are at the stage of prevention of re-establishment of local transmission. There are six high malaria burden countries in the region, and *P. falciparum* is responsible for 74% of all detected infections. The Islamic Republic of Iran reported zero indigenous cases for the fourth consecutive year in 2021 and Saudi Arabia reported zero indigenous cases for the first time in 2021. These countries undertake continued vigilance for malaria in the general health services, and provide diagnosis and treatment free of charge to all imported cases.
- Estimated malaria incidence in the region declined between 2010 and 2015 but increased significantly in 2016 and then remained stable for the next 5 years, translating into a 38% increase between 2010 and 2021. The number of estimated malaria deaths shows a similar trend – in this case, an increase of 55% between 2010 and 2021.
- The Sudan accounted for more than half of the cases estimated for the region. In 2021, the region reported that only about 2.4 million of the 4.8 million cases reported were confirmed (49.7%), although this still represented a significant increase from the 18% confirmation rate reported in 2010 and in 2015. Part of this increase was due to incomplete reporting of presumed cases in Pakistan in previous years. The reported number of deaths increased from 8634 in 2010 to 13 413 in 2021, mainly due to an increase in the Sudan.
- Based on the estimates from reported figures from Afghanistan and Pakistan, these countries reduced incidence by more than 40% compared with 2015. Djibouti, Somalia, the Sudan and Yemen were off track, with malaria case incidence higher by 40% or more. These estimations need to be verified with ongoing country-level burden estimations, given the various factors that affected the data reported from both countries in recent years.
- From the latest data available, vector resistance to pyrethroids, organochlorines and organophosphates was confirmed in all countries (except for Saudi Arabia) in 76%, 65% and 44% of the sites tested, respectively. Resistance to carbamates was confirmed in all countries (except for Saudi Arabia, Somalia and Yemen) in 25% of the sites tested. All seven endemic countries developed their insecticide resistance monitoring and management plans.
- Reported funding increased in the WHO Eastern Mediterranean Region by 21% from 2010 through 2021; it has remained relatively stable since 2015. In 2021, reported domestic funding represented 25% of total funding.
- Challenges include low coverage of essential interventions in most malaria endemic countries, inadequate funding and dependence on external resources, humanitarian emergencies, difficult operational environments and population displacements, a shortage of skilled technical staff (particularly at subnational level), and weak surveillance and health information systems. Frequent floods – particularly in Pakistan, the Sudan and Yemen – and the increasing spread of *An. stephensi* in Djibouti, Somalia, the Sudan and Yemen have increased the risk of malaria, particularly in urban and suburban areas. The confirmed presence of HRP2/3 gene deletions in Djibouti and Somalia, and the high probability of the presence of this mutation in the Sudan and possibly in Yemen, is another threat for the region. The confirmed insecticide resistance in many countries to multiple classes of insecticides is another challenge that has increased the cost of vector control interventions. These challenges may have led to an overall increase in cases during the period 2015–2021 in some countries in the region. There is some evidence to suggest that the COVID-19 pandemic had an impact on diagnostic services in endemic countries in 2020 and 2021 compared with 2019. The poor data quality and reporting issues in some countries in the region make it difficult to accurately quantify the impact on diagnostic and treatment services of the COVID-19 pandemic, and of additional political and security challenges that occurred during the same period.

ANNEX 3 - D. WHO SOUTH-EAST ASIA REGION

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 1.68 billion

Parasites: *P. falciparum* and mixed (55%), *P. vivax* (44%) and other (1%)

Vectors: *An. albimanus, An. annularis, An. balabacensis, An. barbirostris, An. culicifacies* s.l., *An. dirus* s.l., *An. farauti* s.l., *An. fluviatilis, An. leteri, An. maculatus* s.l., *An. minimus* s.l., *An. peditaeniatus, An. philippinensis, An. pseudowillmori, An. punctulatus* s.l., *An. sinensis* s.l., *An. stephensi* s.l., *An. subpictus* s.l., *An. sundaicus* s.l., *An. tessellatus, An. vagus, An. varuna* and *An. yatsushiroensis.*

FUNDING (US$), 2010–2021

264.5 million (2010), 212.8 million (2015), 169.1 million (2021); 2010–2021: 36% decrease

Proportion of domestic source[a] in 2021: 65%

Regional funding mechanisms: Mekong Malaria Elimination (MME) initiative in the Greater Mekong subregion: Myanmar and Thailand

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Number of people protected by IRS:[a] 57.0 million (2010), 44.0 million (2015), 16.7 million (2021)

Total LLINs distributed:[b] 8.1 million (2010), 14.5 million (2015), 17.7 million (2021)

Number of RDTs distributed:[c] 11.4 million (2010), 23.5 million (2015), 4.3 million (2021)

Number of ACT courses distributed:[d] 3.5 million (2010), 2.8 million (2015), 4.0 million (2021)

Number of any first-line antimalarial treatment courses (incl. ACT) distributed: 2.9 million (2010), 2.9 million (2015), 4.3 million (2021)

[a] Data for Bangladesh, the Democratic People's Republic of Korea and Myanmar were not available for 2021; [b] Includes PBO nets, G2 nets and Royal Guards nets in 2021; data for the Democratic People's Republic of Korea were not available for 2021; [c] Data for the Democratic People's Republic of Korea, India and Myanmar were not available for 2021; [d] Data for the Democratic People's Republic of Korea were not available for 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases: 3.1 million (2010), 1.7 million (2015), 559 000 (2021)
Confirmed cases: 2.6 million (2010), 1.6 million (2015), 559 000 (2021)
Percentage of total cases confirmed: 85.6% (2010), 98.9% (2015), 99.9% (2021)
Indigenous cases: 2 640 900 (2010), 1 630 325 (2015), 557 444 (2021)
Imported cases: 0 (2010), 10 610 (2015), 1206 (2021)
Deaths: 2421 (2010), 620 (2015), 159 (2021)

[a] Includes malaria endemic countries only.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 24.0 million (2010), 13.2 million (2015), 5.4 million (2021); 2010–2021: 78% decrease
Deaths: 38 000 (2010), 24 000 (2015), 9100 (2021); 2010–2021: 76% decrease

ACCELERATION TO ELIMINATION

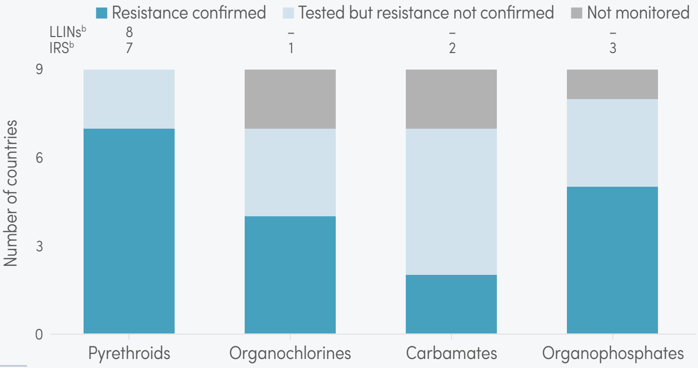
Countries with subnational/territorial elimination programme: Bangladesh, India, Indonesia and Myanmar
Countries with nationwide elimination programme: Bhutan, the Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste
Zero indigenous cases in 2021: Timor-Leste
Countries part of the E-2025 initiative: Bhutan, the Democratic People's Republic of Korea, Nepal, Thailand and Timor-Leste
Certified as malaria free since 2010: Maldives (2015) and Sri Lanka (2016)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2020	36	0.0	0.0	3.8	0.0	1.9
AS+SP	2015–2017	14	0.0	0.0	5.6	0.0	1.5
DHA-PPQ	2015–2020	12	0.0	0.0	3.9	0.0	2.0

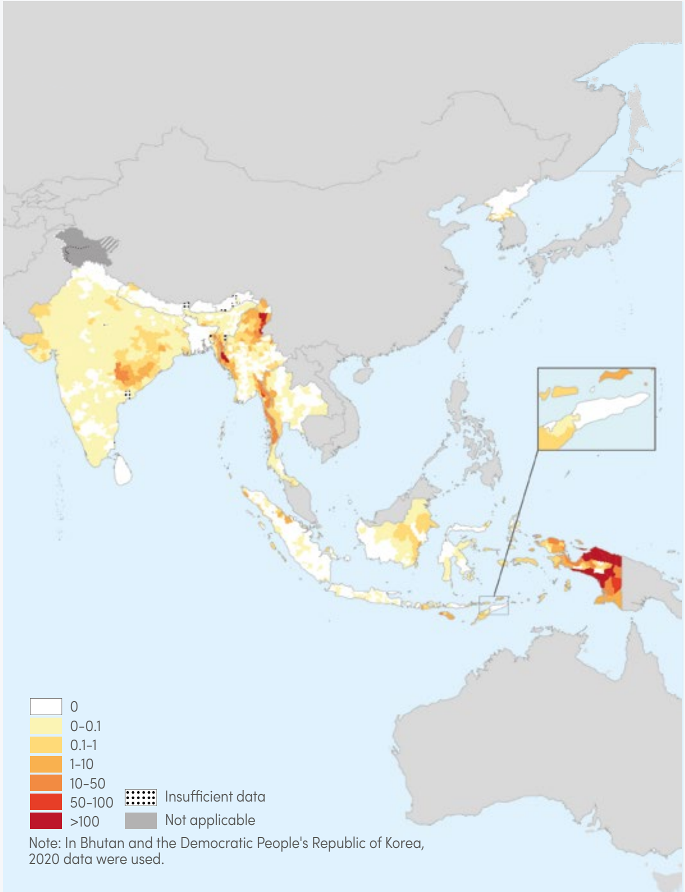
AL: artemether-lumefantrine; AS+SP: artesunate+sulfadoxine-pyrimethamine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

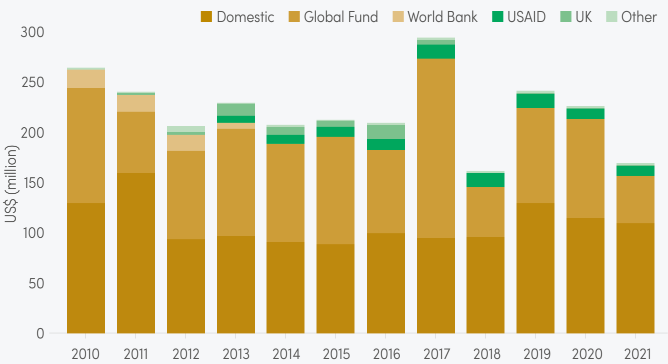


[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2021

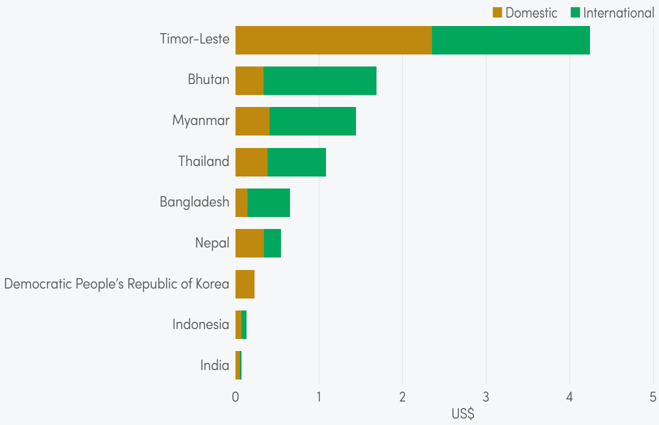


B. Malaria funding[a] by source, 2010–2021



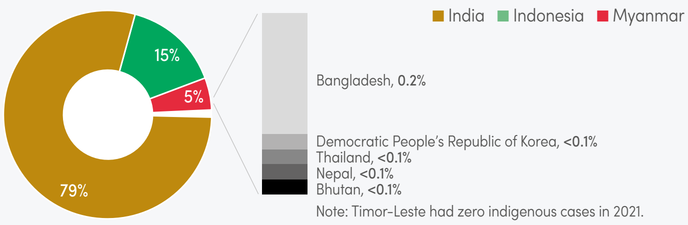
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
[a] Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding[a] per person at risk, average 2019–2021

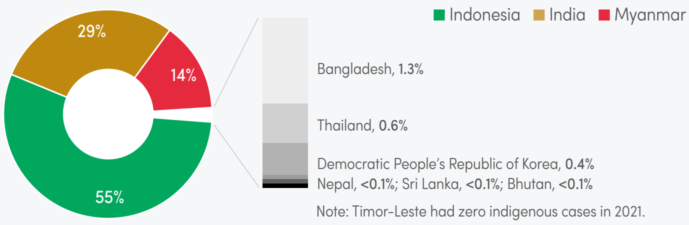


[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs; total funding includes negative disbursements due to under expenditure of international funding.

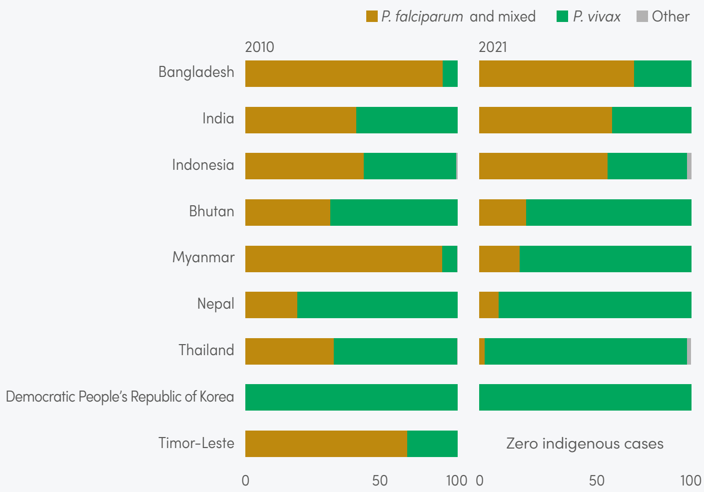
Da. Share of estimated malaria cases, 2021



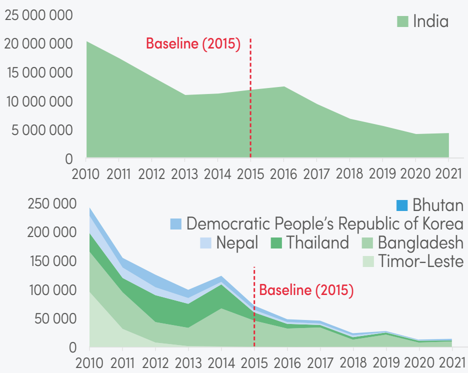
Db. Share of reported confirmed cases, 2021



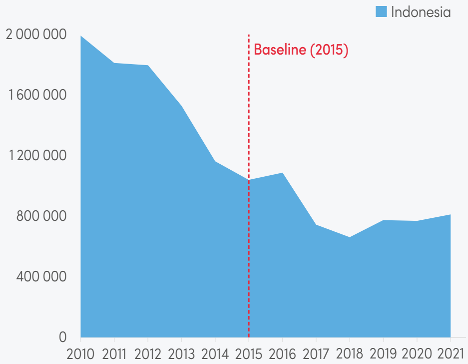
E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2021



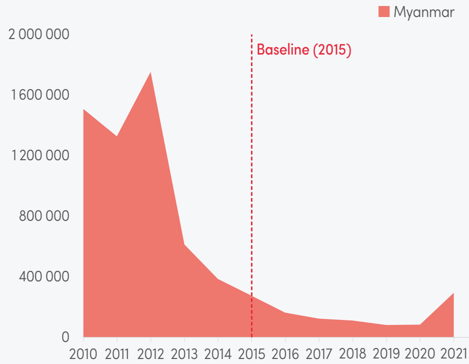
F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015



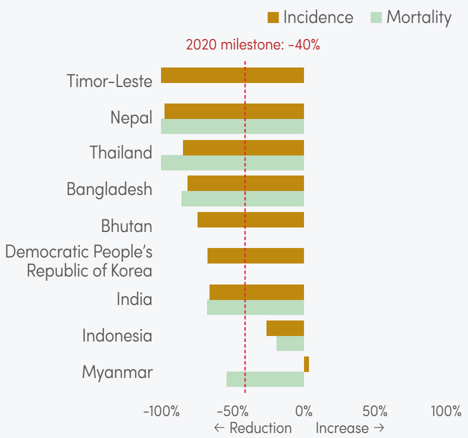
G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015



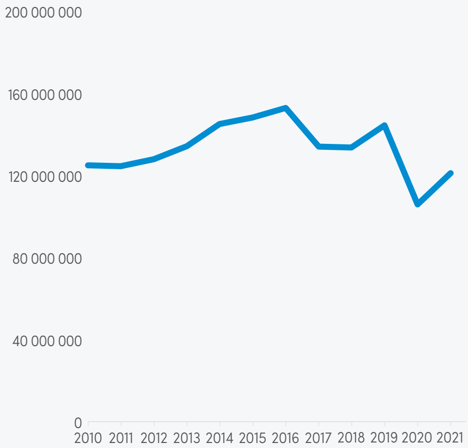
H. Estimated number of cases in countries with no change in case incidence, 2015–2021



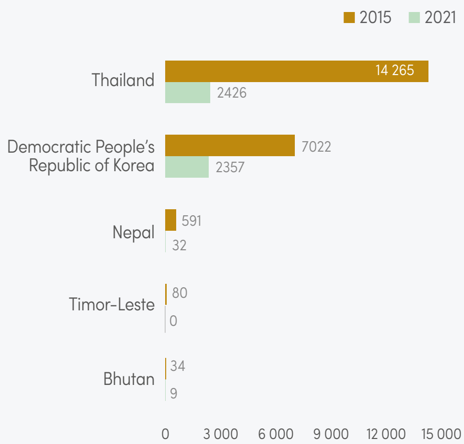
I. Change in estimated malaria incidence and mortality rates, 2015–2021



J. Total number of suspected malaria cases tested, 2010–2021



K. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



KEY MESSAGES

- Malaria is endemic in nine of the WHO South-East Asia Region's 11 countries, accounting for 42% of the estimated burden of malaria outside the African Region. In 2021, the region had 5.3 million estimated cases and 9100 estimated deaths – reductions of 78% and 76%, respectively, compared with 2010; these reductions represented the largest decline among all WHO regions. All countries met the GTS 2021 target of a reduction in case incidence of at least 40% compared with 2015, except for Indonesia, where the case incidence reduced by 26%. All countries also met the GTS 2021 target for a reduction in mortality rate of at least 40% compared with 2015, except for Indonesia, where the mortality rate reduced by 19%. Four countries – Bhutan, the Democratic People's Republic of Korea, Thailand and Timor-Leste – reported zero indigenous deaths. The Maldives and Sri Lanka were certified malaria free in 2015 and 2016, respectively, and continue to maintain their malaria free status.
- Three countries accounted for 99.7% of the estimated cases in the region, with India being the largest contributor (79%), followed by Indonesia (15%) and Myanmar (5%). Compared with 2020, Myanmar had a significant increase in estimated cases (210 000). In 2021, there were 558 964 cases reported, of which 99.9% were confirmed. Indonesia accounted for the highest proportion of reported cases in the region (55%), followed by India (29%). The gap between reported cases and estimated cases in India in 2021 is due to adjustments made for care seeking and diagnostic testing rates, which were affected in some states as a result of disruption of services due to the COVID-19 pandemic. More than 40% of reported cases in the region are due to *P. vivax*. In 2021, *P. vivax* was the dominant species (>50% of local cases) in Bhutan, the Democratic People's Republic of Korea (100%), Myanmar, Nepal and Thailand, whereas *P. falciparum* was the dominant species in Bangladesh, India and Indonesia. In Myanmar, the proportion of local cases due to *P. falciparum* decreased from 93% in 2010 to 19% in 2021.
- Continuing the declining trend, reported malaria deaths in the region fell to 159 in 2021 – a 93% reduction compared with 2010. India, Indonesia and Myanmar accounted for 57%, 30% and 7% of the total reported deaths in the region, respectively.
- Three countries – Bhutan, Nepal and Timor-Leste – were identified as having the potential to eliminate malaria by 2020. Among these countries, Timor-Leste almost completed 3 consecutive years of malaria free status, reporting zero indigenous cases in 2018 and 2019, but experiencing a small malaria outbreak in 2020. In 2021, Timor-Leste again reported zero indigenous cases. Bhutan reported six indigenous cases in 2018, followed by just two in 2019, but had an increase in cases to 22 in 2020. In 2021, Bhutan reported nine indigenous cases. Nepal reported 73 indigenous cases in 2020 and 32 indigenous cases in 2021. About half of the reported cases in Nepal were classified as imported. There were no imported cases in the Democratic People's Republic of Korea and Timor-Leste in 2021, owing to border restrictions as a result of the COVID-19 pandemic. Sri Lanka reported 26 cases in 2021, of which 25 were imported and one was induced.
- Vector resistance to pyrethroids was confirmed in 49% of the sites, to organochlorines in 80%, to carbamates in 49% and to organophosphates in 62%. Seven countries have developed insecticide resistance monitoring and management plans.
- Overall funding in the region has decreased by 36% since 2010. Between 2020 and 2021, overall funding decreased by 25%, largely as a result of decreased funding by the Global Fund (52%). In 2021, domestic expenditures made up 65% of total funding. Malaria funding per person at risk ranged from US$ 0.07 in India to US$ 4.24 in Malaysia over a 3-year average, raising concerns because India is the largest contributor to the estimated cases in the region but also receives the lowest amount of funding per person at risk.
- The COVID-19 pandemic affected all countries in the region in 2020. Owing to the pandemic, diagnostic services were disrupted, shown by the 27% decrease in malaria suspects tested in 2020 compared with 2019. The number of suspects tested increased again in 2020. Similarly, there was evidence of disruption in malaria preventive services of varying degrees across the region. Promisingly, several countries creatively integrated their malaria services with those of the COVID-19 response activities (e.g. screening for both malaria and COVID-19 using an integrated surveillance approach), to the benefit of both programmes.
- Challenges include decreased funding, the continuing threat of multiple artemisinin-based combination therapy (ACT) failures in the countries of the Greater Mekong subregion (GMS) and vector resistance to pyrethroids. In recent years, Myanmar has had some setbacks with the increase in the number of both *P. falciparum* and *P. vivax* cases owing to continued political instability in the area.

EPIDEMIOLOGY

Population denominator used to compute incidence and mortality rate: 766 million
Parasites: *P. falciparum* and mixed (68%), *P. vivax* (32%) and other (<1%)
Vectors: *An. anthropophagus, An. balabacensis, An. barbirostris* s.l., *An. dirus* s.l., *An. donaldi, An. epirotivulus, An. farauti* s.l., *An. flavirostris, An. jeyporiensis, An. koliensis, An. litoralis, An. maculatus* s.l., *An. mangyanus, An. minimus* s.l., *An. punctulatus* s.l., *An. sinensis* s.l. and *An. sundaicus* s.l.

FUNDING (US$), 2010–2021

223.0 million (2010), 154.2 million (2015), 89.5 million (2021); 2010–2021: 60% decrease
Proportion of domestic source[a] in 2021: 65%
Regional funding mechanisms: Mekong Malaria Elimination (MME) initiative in the Greater Mekong subregion: Cambodia, China (Yunnan), the Lao People's Democratic Republic and Viet Nam (supported by RAI3e Global Fund)

[a] Domestic source excludes patient service delivery costs and out-of-pocket expenditure.

INTERVENTIONS, 2010–2021

Number of people protected by IRS: 2.8 million (2010), 1.6 million (2015), 765 000 (2021)
Total LLINs distributed:[a] 4.4 million (2010), 4.3 million (2015), 4.2 million (2021)
Number of RDTs distributed:[b] 1.6 million (2010), 2.5 million (2015), 5.7 million (2021)
Number of ACT courses distributed:[c] 591 000 (2010), 1.3 million (2015), 2.7 million (2021)
Number of any antimalarial treatment courses (incl. ACT) distributed: 963 000 (2010), 1.3 million (2015), 1.9 million (2021)

[a] Includes PBO nets, G2 nets and Royal Guard nets in 2021; [b] Data were not available for the Solomon Islands in 2021; [c] Data were not available for the Republic of Korea in 2021.

REPORTED CASES AND DEATHS,[a] 2010–2021

Total (presumed and confirmed) cases: 1.8 million (2010), 810 000 (2015), 903 000 (2021)
Confirmed cases: 308 000 (2010), 499 000 (2015), 753 000 (2021)
Percentage of total cases confirmed: 17.3% (2010), 61.6% (2015), 83.5% (2021)
Indigenous cases: 305 898 (2010), 496 712 (2015), 749 606 (2021)
Imported cases: 887 (2010), 599 (2015), 294 (2021)
Introduced cases: 108 (2010), 0 (2015), 3 (2021)
Deaths:[b] 912 (2010), 215 (2015), 227 (2021)
Indigenous deaths: 891 (2010), 215 (2015), 211 (2021)

[a] Includes malaria endemic countries only; [b] Includes *P. knowlesi* deaths.

ESTIMATED CASES AND DEATHS, 2010–2021

Cases: 1.7 million (2010), 1.2 million (2015), 1.4 million (2021); 2010–2021: 15% decrease
Deaths: 3488 (2010), 2454 (2015), 2649 (2021); 2010–2021: 24% decrease

ACCELERATION TO ELIMINATION

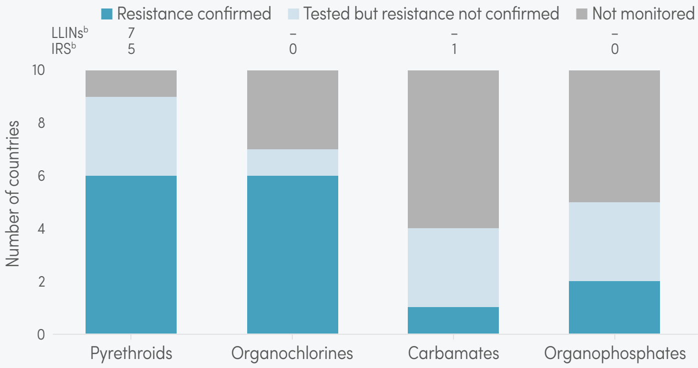
Countries with subnational/territorial elimination programme: the Philippines
Countries with nationwide elimination programme: Cambodia, the Lao People's Democratic Republic, Malaysia, the Republic of Korea, Vanuatu and Viet Nam
Zero indigenous cases for 3 consecutive years (2019, 2020 and 2021): Malaysia
Countries part of the E-2025 initiative: Malaysia, the Republic of Korea and Vanuatu
Certified as malaria free since 2010: China (2021)

THERAPEUTIC EFFICACY STUDIES (CLINICAL AND PARASITOLOGICAL FAILURE AMONG PATIENTS WITH *P. FALCIPARUM* MALARIA, %)

Medicine	Study years	No. of studies	Min.	Median	Max.	Percentile 25	Percentile 75
AL	2015–2020	12	0.0	0.0	17.2	0.0	0.7
AS-MQ	2015–2020	19	0.0	0.0	1.9	0.0	0.0
AS-PY	2017–2019	8	0.0	1.7	5.1	0.0	2.5
DHA-PPQ	2015–2019	22	0.0	11.8	68.1	0.0	32.4

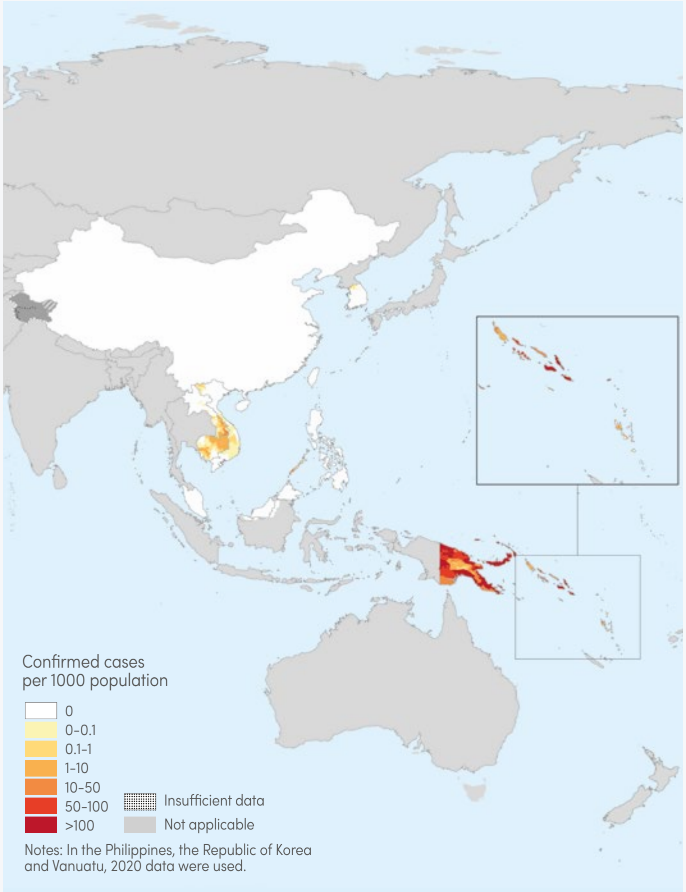
AL: artemether-lumefantrine; AS-MQ: artesunate-mefloquine; AS-PY: artesunate-pyronaridine; DHA-PPQ: dihydroartemisinin-piperaquine.

STATUS OF INSECTICIDE RESISTANCE[a] PER INSECTICIDE CLASS (2010–2020) AND USE OF EACH CLASS FOR MALARIA VECTOR CONTROL (2020)

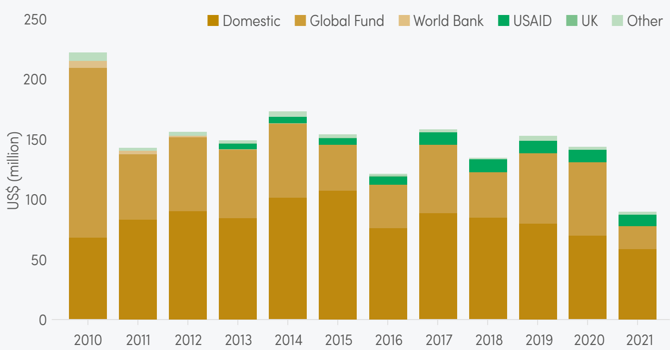


[a] Resistance is considered confirmed when it was detected to one insecticide in the class, in at least one malaria vector from one collection site.
[b] Number of countries that reported using the insecticide class for malaria vector control (2020).

A. Confirmed malaria cases per 1000 population, 2021

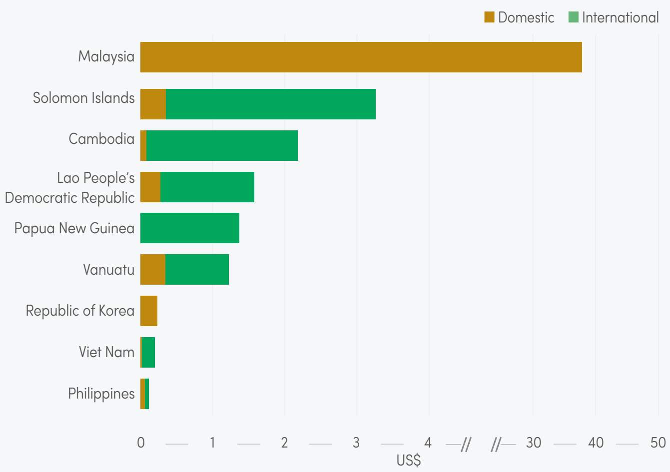


B. Malaria funding[a] by source, 2010–2021



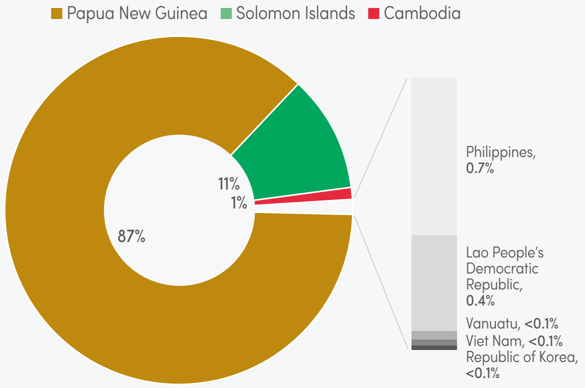
Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; UK: United Kingdom of Great Britain and Northern Ireland; USAID: United States Agency for International Development.
[a] Excludes patient service delivery costs and out-of-pocket expenditure.

C. Malaria funding[a] per person at risk, average 2019–2021



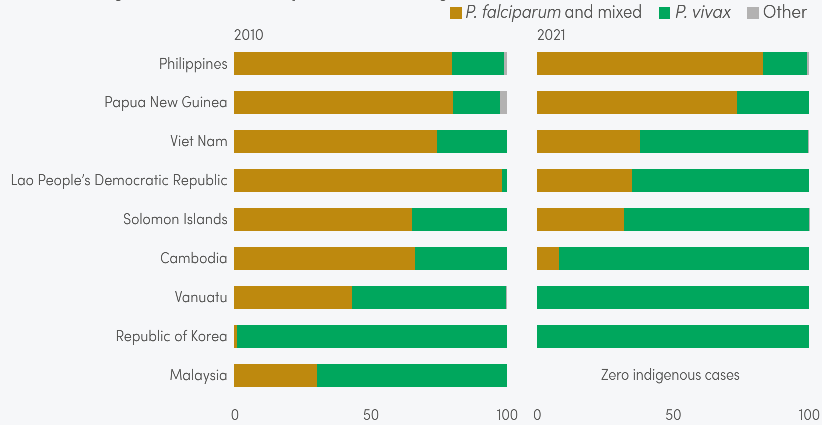
[a] Data are not collected on out-of-pocket expenditure and excluded patient service delivery costs

D. Share of estimated malaria cases, 2021

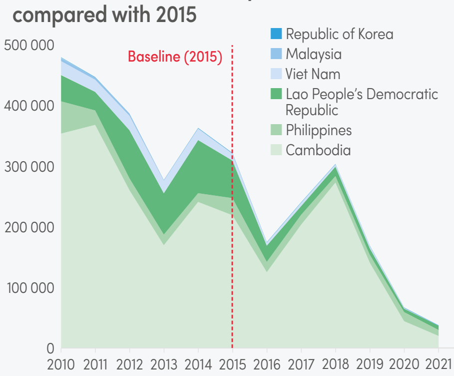


Note: Countries with zero cases: China and Malaysia.

E. Percentage of *Plasmodium* species from indigenous cases, 2010 and 2021

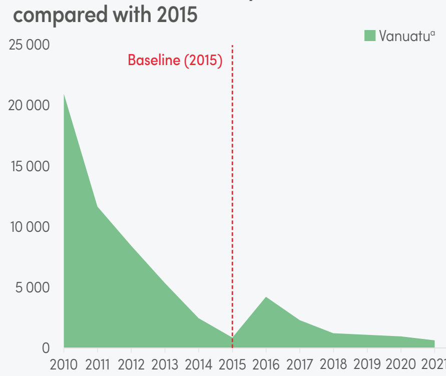


F. Estimated number of cases in countries that reduced case incidence by ≥40% in 2021 compared with 2015



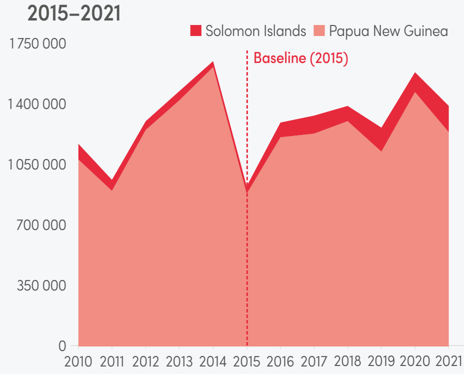
Note: China was certified malaria free in 2021.

G. Estimated number of cases in countries that reduced case incidence by <40% in 2021 compared with 2015

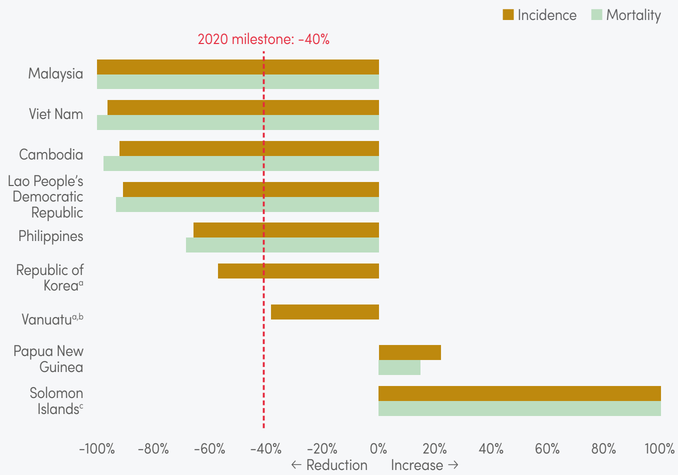


[a] Malaria cases in 2015 are likely to be underestimated; this confounds assessment of progress towards the 2020 GTS target relative to a 2015 baseline.

H. Estimated number of cases in countries with an increase or no change in case incidence, 2015–2021

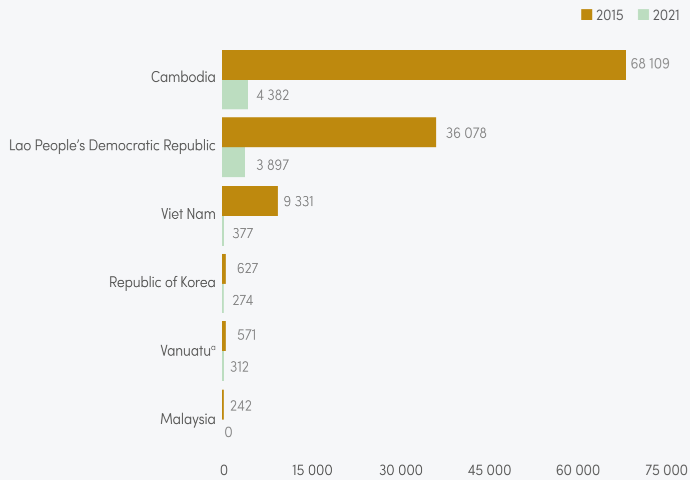


I. Change in estimated malaria incidence and mortality rates, 2015–2021



[a] There have been no estimated indigenous deaths between 2015 and 2020 in these countries; [b] Malaria cases in 2015 are likely to be underestimated; this confounds assessment of progress towards the 2020 GTS target relative to a 2015 baseline; [c] Change in estimated incidence is more than 100%.

J. Reported indigenous cases in countries with national elimination activities, 2015 versus 2021



[a] Malaria cases in 2015 are likely to be underestimated; this confounds assessment of progress towards the 2020 GTS target relative to a 2015 baseline.

KEY MESSAGES

- Nine countries in the WHO Western Pacific Region are at risk of malaria, which is predominantly caused by *P. falciparum* (68%), with *P. vivax* accounting for just under a third of all reported cases (32%). In 2021, the region had more than 1.4 million estimated malaria cases and 2649 estimated deaths – a 15% and 24% reduction from 2010, respectively. Most cases occurred in Papua New Guinea (87%) which, together with Solomon Islands (11%), comprised 98% of the estimated cases in the region. About 900 000 cases were reported in the public and private sectors and in the community, of which almost 84% were confirmed. This was a significant improvement over 2015, when only 61.6% of cases were confirmed. There were 227 malaria deaths reported in the region in 2021 (with 211 being indigenous); most were in Papua New Guinea.
- Seven of the 10 malaria endemic countries in the region in 2015 achieved the GTS 2021 target of a 40% or more reduction in case incidence or zero malaria cases compared with 2015: Cambodia, China, the Lao People's Democratic Republic, Malaysia, the Philippines, the Republic of Korea and Viet Nam. China was certified as malaria free in early 2021 and Malaysia reported zero indigenous cases for the fourth consecutive year in 2021. Countries that have experienced an increase in estimated cases since 2015 are Papua New Guinea and Solomon Islands. There was no change in estimated case incidence in Vanuatu when compared with 2015, when the country was affected by a major cyclone that severely disrupted malaria diagnostic services and care seeking. As a result, malaria cases in 2015 are likely to be underestimated, which confounds assessment of progress towards the GTS targets relative to a 2015 baseline for Vanuatu. In 2016, there was a large increase in reported malaria cases as a result of increased transmission but since then case incidence has decreased significantly (by 87%). All countries reduced the malaria mortality rate by at least 40% by 2021, except Papua New Guinea and Solomon Islands.
- Malaysia has reported zero indigenous non-zoonotic malaria cases since 2018. However, Malaysia is facing increasing cases of zoonotic malaria due to *P. knowlesi*, which increased from 1600 cases to over 4000 between 2016 and 2018. Although there have been no indigenous human malaria cases or deaths in Malaysia for the past 4 years, since 2017 a total of 17 125 *P. knowlesi* cases and 48 deaths have been reported; in 2021 alone, 3575 cases were reported and these cases resulted in 13 deaths. The Republic of Korea continues to face the challenge of malaria transmission among military personnel along the northern border. The Philippines has continued its subnational elimination efforts, having declared 62 provinces out of 81 provinces as malaria free, as of 2021.
- In the GMS, three countries – Cambodia, the Lao People's Democratic Republic and Viet Nam – aim to eliminate *P. falciparum* by 2023, with support from a regional artemisinin-resistance initiative financed by the Global Fund. Two countries in the GMS – Cambodia and Thailand – aim to eliminate all species of malaria by 2025. The remaining GMS countries aim to eliminate all species of malaria by 2030. The percentage of reported indigenous cases in Cambodia due to *P. falciparum* has fallen significantly, from 55% in 2015 to 8% in 2021, owing to intensified efforts in community outreach and active case detection.
- Vector resistance to pyrethroids was confirmed in 49% of the sites tested, to organochlorines in 63%, to carbamates in 17% and to organophosphates in 56%. Six malaria endemic countries have developed insecticide resistance monitoring and management plans.
- Challenges include resurgence of malaria in Solomon Islands and sustained high levels of malaria in Papua New Guinea owing to challenges in health system strengthening and often inadequate surveillance and response activities to halt transmission in the highest burden provinces. Recent efforts are underway to improve access to services and case-based surveillance in the Pacific Island countries, and intensified community efforts to halt malaria transmission in the GMS countries, particularly in Cambodia and the Lao People's Democratic Republic. Although all countries have reported minor disruptions to implementing malaria interventions due to the COVID-19 pandemic, no major delays to service delivery were reported.

ANNEX 4 – A. POLICY ADOPTION, 2021

WHO region Country/area	Insecticide-treated mosquito nets				Indoor residual spraying		Chemoprevention	
	ITNs/LLINs are distributed free of charge	ITNs/LLINs are distributed through ANC	ITNs/LLINs are distributed through EPI/well baby clinic	ITNs/LLINs are distributed through mass campaigns	IRS is recommended by malaria control programme	DDT is used for IRS	IPTp is used to prevent malaria during pregnancy	SMC or IPTc is used
AFRICAN								
Angola	⚫	⚫	⚫	⚪	⚫	🔴	⚫	🔴
Benin	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Botswana	⚪	⚪	⚪	⚪	⚫	⚪	NA	NA
Burkina Faso	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Burundi	⚫	⚫	⚫	⚪	⚫	🔴	⚫	🔴
Cabo Verde	NA	NA	NA	NA	⚫	🔴	NA	NA
Cameroon	⚫	⚫	🔴	⚫	🔴	🔴	⚫	⚫
Central African Republic	⚫	⚫	⚫	⚪	🔴	🔴	⚫	⚪
Chad	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Comoros	⚫	⚫	⚫	⚪	⚫	🔴	⚫	NA
Congo	⚫	⚫	⚫	⚪	⚪	🔴	⚫	🔴
Côte d'Ivoire	⚫	⚫	⚫	⚫	⚪	🔴	⚫	🔴
Democratic Republic of the Congo	⚫	⚫	⚫	⚫	🔴	🔴	⚫	🔴
Equatorial Guinea	⚪	⚪	🔴	⚪	⚪	🔴	⚪	🔴
Eritrea	⚫	⚫	🔴	⚪	⚫	🟡	🔴	NA
Eswatini	NA	NA	NA	⚪	⚫	⚪	NA	NA
Ethiopia	⚫	🔴	🔴	⚫	⚫	🔴	🔴	NA
Gabon	⚪	⚪	⚪	🔴	🔴	🔴	⚪	🔴
Gambia	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Ghana	⚫	⚫	⚫	⚫	⚫	🟡	⚫	⚫
Guinea	⚫	⚫	⚫	⚪	🔴	🔴	⚫	⚫
Guinea-Bissau	⚫	⚫	⚫	⚪	⚪	🔴	⚫	⚫
Kenya	⚫	⚫	⚫	⚫	⚫	🔴	⚫	🔴
Liberia	⚫	⚫	🔴	⚫	⚪	🔴	⚫	🔴
Madagascar	⚫	⚫	⚫	⚫	⚫	🔴	⚫	NA
Malawi	⚫	⚪	⚪	⚫	⚫	🔴	⚫	🔴
Mali	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Mauritania	⚫	⚫	🟡	⚪	🟡	🔴	⚫	🔴
Mayotte	–	–	–	–	–	–	NA	NA
Mozambique	⚫	⚫	🔴	⚪	⚫	⚪	⚫	⚫
Namibia	⚪	NA	NA	⚪	⚫	⚫	NA	NA
Niger	⚫	⚫	⚫	⚫	🔴	🔴	⚫	⚫
Nigeria	⚫	⚫	⚫	⚫	⚪	🔴	⚫	⚫
Rwanda	⚫	⚫	⚫	⚪	⚫	🔴	NA	NA
Sao Tome and Principe	⚫	⚫	⚫	⚪	⚫	🔴	⚫	NA
Senegal	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
Sierra Leone	⚫	⚫	⚫	⚪	⚫	🔴	⚫	🔴
South Africa	🔴	🔴	🔴	⚪	⚫	⚫	🔴	NA
South Sudan[2]	⚫	⚫	⚫	⚫	⚫	🔴	⚫	⚫
Togo	⚫	⚫	⚫	⚪	⚪	🔴	⚫	⚫
Uganda	⚫	⚫	⚫	⚪	⚫	🔴	⚫	⚫
United Republic of Tanzania[3]								
Mainland	⚫	⚫	⚫	⚫	⚫	🔴	⚫	🔴
Zanzibar	🟡	⚫	⚫	⚫	⚫	🔴	NA	🔴
Zambia	⚫	⚫	⚫	⚫	⚫	⚪	⚫	🔴
Zimbabwe	⚫	⚫	⚫	⚫	⚫	⚫	⚫	NA
AMERICAS								
Belize	⚫	⚪	🔴	⚫	⚫	🟡	NA	NA
Bolivia (Plurinational State of)	⚫	⚪	🔴	⚪	⚪	🔴	NA	NA
Brazil	⚫	🔴	🔴	⚫	⚫	🟡	NA	NA
Colombia	⚫	🔴	🔴	⚫	⚫	🔴	NA	NA
Costa Rica	⚫	🟡	🔴	⚪	⚫	🔴	NA	NA
Dominican Republic	⚫	🔴	🔴	⚫	⚫	🔴	NA	NA
Ecuador	⚫	🔴	🔴	⚫	⚫	🟡	NA	NA

Testing				Treatment				
Malaria diagnosis is free of charge in the private sector	Malaria diagnosis is free of charge in the public sector	RDTs are used at community level	G6PD test is recommended before treatment with primaquine	ACT for treatment of *P. falciparum*	Pre-referral treatment with quinine or artemether IM or artesunate suppositories	Single low dose of primaquine with ACT to reduce transmissibility of *P. falciparum*[1]	Primaquine is used for radical treatment of *P. vivax* cases	Directly observed treatment with primaquine is undertaken
black	green	black	black	black	black	red	grey	grey
black	green	black	red	black	yellow	red	red	red
black	green	red	NA	grey	black	grey	grey	grey
red	light blue	black	NA	black	black	NA	NA	NA
red	green	black	red	black	black	red	red	red
–	light green	grey	NA	grey	red	grey	red	grey
red	orange	black	red	black	red	black	red	red
black	light blue	black	red	black	black	red	red	red
black	green	black	red	black	black	red	red	red
–	light green	black	NA	grey	grey	black	red	red
red	orange	red	NA	grey	black	NA	NA	NA
yellow	green	black	red	black	black	red	red	red
red	light blue	grey	NA	grey	black	NA	NA	NA
–	light green	grey	red	grey	red	red	red	red
NA	green	black	red	grey	black	grey	grey	grey
black	green	black	yellow	grey	black	grey	grey	grey
red	green	grey	grey	black	red	grey	black	red
red	orange	red	NA	grey	black	NA	NA	NA
red	green	black	NA	grey	black	NA	NA	NA
NA	green	black	grey	black	black	red	red	NA
black	green	black	NA	grey	black	red	NA	NA
–	green	grey	red	grey	grey	red	red	red
red	green	grey	NA	black	grey	red	red	NA
–	green	black	red	black	grey	red	red	red
red	green	grey	red	black	black	grey	grey	grey
black	green	black	NA	black	red	red	NA	red
red	green	black	NA	black	black	black	NA	NA
red	light blue	grey	red	grey	black	grey	grey	grey
–	green	grey	grey	grey	grey	grey	red	grey
–	green	black	red	black	black	red	red	red
–	green	black	red	grey	grey	grey	grey	grey
red	light blue	grey	grey	black	black	grey	grey	grey
–	red	grey	red	black	black	red	NA	NA
black	green	black	NA	grey	black	grey	red	NA
black	green	black	grey	grey	grey	grey	grey	grey
black	green	black	NA	black	black	black	NA	NA
black	green	black	red	grey	black	red	red	red
red	green	grey	red	grey	red	grey	grey	grey
NA	green	black	NA	black	black	NA	NA	NA
–	light green	black	–	grey	grey	red	red	red
red	green	black	red	grey	black	red	grey	red
red	light blue	grey	NA	black	black	grey	NA	NA
red	green	grey	red	grey	red	grey	grey	grey
black	green	black	NA	grey	black	NA	NA	NA
red	green	black	red	grey	black	grey	grey	grey
red	green	black	red	black	red	black	black	black
–	green	black	red	black	–	black	black	grey
red	green	red	red	black	red	black	black	red
black	green	grey	red	black	grey	black	black	grey
red	green	red	red	black	red	black	black	grey
black	green	grey	red	grey	NA	grey	black	black
red	green	black	red	black	black	black	black	red

ANNEX 4 – A. POLICY ADOPTION, 2021

WHO region Country/area	Insecticide-treated mosquito nets				Indoor residual spraying		Chemoprevention	
	ITNs/LLINs are distributed free of charge	ITNs/LLINs are distributed through ANC	ITNs/LLINs are distributed through EPI/well baby clinic	ITNs/LLINs are distributed through mass campaigns	IRS is recommended by malaria control programme	DDT is used for IRS	IPTp is used to prevent malaria during pregnancy	SMC or IPTc is used
AMERICAS								
French Guiana	⚪	⚪	🔴	⚪	⚪	🔴	NA	NA
Guatemala	⚫	🔴	🔴	⚫	⚫	🔴	NA	NA
Guyana	⚫	⚪	⚪	⚫	⚪	🔴	NA	NA
Haiti	⚫	⚪	🔴	⚫	⚪	🔴	NA	NA
Honduras	⚫	⚪	🔴	⚫	⚫	🔴	NA	NA
Mexico	⚫	🔴	🔴	⚫	⚫	🔴	NA	NA
Nicaragua	⚫	⚪	⚪	⚫	⚫	🔴	NA	NA
Panama	⚪	🔴	🔴	⚪	⚫	🔴	NA	NA
Peru	⚫	🔴	🔴	⚫	⚪	🔴	NA	NA
Suriname	⚫	⚪	🔴	⚫	🔴	🔴	NA	NA
Venezuela (Bolivarian Republic of)	⚫	⚪	🔴	⚫	⚪	🔴	NA	NA
EASTERN MEDITERRANEAN								
Afghanistan	⚫	⚫	🟡	⚪	🔴	🔴	NA	NA
Djibouti	⚫	⚫	⚫	⚪	⚫	🔴	NA	NA
Iran (Islamic Republic of)	⚫	⚪	⚪	⚫	⚫	🔴	NA	NA
Pakistan	⚫	⚫	🔴	⚪	⚫	🔴	NA	NA
Saudi Arabia	⚪	⚪	🔴	⚪	⚫	🔴	NA	NA
Somalia	⚫	⚫	🔴	⚪	⚫	🔴	⚫	🔴
Sudan	⚫	⚫	⚫	⚪	⚫	🟡	⚪	NA
Yemen	⚫	🟡	🟡	⚫	⚫	🔴	NA	NA
SOUTH-EAST ASIA								
Bangladesh	⚫	🔴	🔴	⚫	⚪	🟡	NA	NA
Bhutan	⚫	🔴	🔴	⚪	⚫	🔴	NA	NA
Democratic People's Republic of Korea	⚪	🔴	🔴	⚪	⚪	🟡	NA	NA
India	⚫	⚪	⚪	⚪	⚫	⚫	NA	NA
Indonesia	⚫	⚫	🔴	⚫	⚫	🔴	NA	NA
Myanmar	⚪	⚪	🔴	⚪	⚪	🔴	NA	NA
Nepal	⚫	⚫	🔴	⚫	⚫	🔴	NA	NA
Thailand	⚫	🔴	NA	⚫	⚫	🟡	NA	NA
Timor-Leste	⚫	⚫	🔴	⚫	⚫	🔴	NA	NA
WESTERN PACIFIC								
Cambodia	⚫	🔴	🔴	⚫	🔴	🔴	NA	NA
Lao People's Democratic Republic	⚫	⚫	🔴	⚪	⚫	🔴	NA	NA
Malaysia	⚫	🔴	🔴	⚫	⚫	🟡	NA	NA
Papua New Guinea	⚫	⚫	🔴	⚫	⚪	🔴	⚪	NA
Philippines	⚫	⚪	🔴	⚪	⚫	🔴	NA	NA
Republic of Korea	⚪	NA	NA	⚪	⚪	🟡	NA	NA
Solomon Islands	⚫	⚫	⚪	⚫	⚪	🔴	NA	NA
Vanuatu	⚫	⚪	🔴	⚫	⚪	🔴	NA	NA
Viet Nam	⚫	NA	NA	⚫	⚫	🔴	NA	NA

ACT: artemisinin-based combination therapy; ANC: antenatal care; DDT: dichloro-diphenyl-trichloroethane; EPI: Expanded Programme on Immunization; G6PD: glucose-6-phosphate dehydrogenase; IM: intramuscular; IPTc: intermittent preventive treatment of malaria in children; IPTp: intermittent preventive treatment of malaria in pregnancy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; *P.*: *Plasmodium*; RDT: rapid diagnostic test; SMC: seasonal malaria chemoprevention; WHO: World Health Organization.

[1] Single dose of primaquine (0.75 mg base/kg) for countries in the WHO Region of the Americas.

[2] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

[3] Where national data for the United Republic of Tanzania are unavailable, refer to Mainland and Zanzibar.

Testing				Treatment				
Malaria diagnosis is free of charge in the private sector	Malaria diagnosis is free of charge in the public sector	RDTs are used at community level	G6PD test is recommended before treatment with primaquine	ACT for treatment of *P. falciparum*	Pre-referral treatment with quinine or artemether IM or artesunate suppositories	Single low dose of primaquine with ACT to reduce transmissibility of *P. falciparum*[1]	Primaquine is used for radical treatment of *P. vivax* cases	Directly observed treatment with primaquine is undertaken
–	green	red	grey	grey	red	grey	black	red
black	green	grey	red	grey	red	grey	black	grey
red	green	grey	red	black	black	black	black	black
black	green	black	red	grey	NA	grey	grey	grey
red	green	black	grey	black	black	grey	black	grey
black	green	grey	red	black	red	grey	black	black
grey	green	grey	red	black	grey	grey	black	black
red	green	black	grey	grey	grey	grey	black	grey
–	green	grey	red	black	red	black	black	grey
black	green	black	red	black	black	black	black	grey
black	green	grey	red	black	red	black	black	grey
black	green	black	black	grey	red	grey	grey	red
–	green	red	grey	grey	red	grey	grey	grey
–	light green	grey	grey	black	red	grey	black	grey
NA	green	NA	grey	black	NA	black	black	red
black	green	red	black	black	black	black	black	black
red	green	grey	grey	grey	black	grey	grey	grey
red	light blue	black	red	black	grey	red	grey	red
NA	green	black	grey	grey	red	grey	grey	red
red	green	grey	red	black	grey	black	black	red
red	green	grey	black	black	red	grey	black	black
NA	green	NA	red	NA	NA	NA	grey	grey
NA	green	grey	red	black	black	grey	black	NA
grey	green	black	red	black	red	black	black	grey
black	green	black	NA	black	black	grey	black	red
grey	green	black	black	black	black	black	black	red
red	green	black	black	black	red	black	black	black
–	green	black	grey	grey	grey	grey	grey	grey
–	green	black	black	grey	red	grey	grey	grey
black	green	black	black	black	red	black	black	red
red	blue	NA	NA	black	black	black	black	black
red	green	grey	red	grey	grey	grey	grey	red
black	green	black	NA	grey	grey	grey	grey	grey
NA	green	grey	grey	black	NA	NA	grey	grey
red	light green	red	grey	black	grey	black	black	NA
red	green	grey	black	black	grey	grey	grey	grey
NA	green	black	black	grey	red	grey	grey	grey

Data as of 24 November 2022

- black = Policy exists and has been implemented this year.
- grey = Policy exists but is not implemented this year or no data exist to support implementation.
- red = Policy does not exist.
- yellow = Policy discontinued.
- green = Both microscopy and RDT are free.
- light green = Diagnosis is free but diagnostic test was not specified.
- blue = Only microscopy is free.
- light blue = Only RDT is free.
- purple = Neither microscopy nor RDT are free.
- NA = Policy not applicable.
- – = Question not answered and there is no information from previous years.

ANNEX 4 – B. ANTIMALARIAL DRUG POLICY, 2021

WHO region Country/area	*P. falciparum*				*P. vivax*
	Uncomplicated unconfirmed	Uncomplicated confirmed	Severe	Prevention during pregnancy	Treatment
AFRICAN					
Angola	AL	AL	AS	SP(IPT)	AL+PQ
Benin	–	AL	AS	SP(IPT)	NA
Botswana	–	AL+PQ	AS	NA	AL+PQ
Burkina Faso	AL	AL	AS	SP(IPT)	NA
Burundi	AL	AL	ART; AS	SP(IPT)	NA
Cabo Verde	–	AL+PQ; AS+AQ+PQ	QN	NA	–
Cameroon	NA	AL; AS-PYR; AS+AQ; DHA-PPQ	AM; AS; QN	SP(IPT)	NA
Central African Republic	AL	AL	AS	SP(IPT)	NA
Chad	AL; AS+AQ	AL; AS+AQ	ART; AS; QN	SP(IPT)	NA
Comoros	AL	AL; AL+PQ	AS	SP(IPT)	NA
Congo	AS+AQ	AS+AQ	AS	SP(IPT)	NA
Côte d'Ivoire	AL; AS+AQ	AL; AS+AQ	QN	SP(IPT)	NA
Democratic Republic of the Congo	AS+AQ	AL; AS-PYR; AS+AQ	AS; QN	SP(IPT)	NA
Equatorial Guinea	AS+AQ	AL; AS+AQ	AS	SP(IPT)	NA
Eritrea	AS+AQ	AS+AQ+PQ	AS	–	AS+AQ+PQ
Eswatini	–	AL-PQ	AS	NA	PQ
Ethiopia	AL+PQ	AL-PQ	AS+AL+PQ	CQ	CQ+PQ
Gabon	AL; AS+AQ	AL; AS+AQ	AS	SP(IPT)	NA
Gambia	AL	AL	AS	SP(IPT)	NA
Ghana	AL; AS+AQ; DHA-PPQ	AL; AS+AQ	AM; AS; QN	SP(IPT)	AL+PQ; AS+AQ+PQ; DHA-PPQ+PQ
Guinea	AL	AL	AS-QN; AS+AL	SP(IPT)	NA
Guinea-Bissau	AL	AL	QN	SP(IPT)	NA
Kenya	AL	AL	AS	SP(IPT)	AL-PQ
Liberia	AL; AS+AQ	AL; AS+AQ	AM; AS; QN	SP(IPT)	NA
Madagascar	AS+AQ	AS+AQ+PQ	ART	SP(IPT)	AS+AQ
Malawi	AL	AL	AS	SP(IPT)	NA
Mali	AL	AL-PQ	AS	SP(IPT)	AL
Mauritania	AS+AQ	AS+AQ+PQ	AS	SP(IPT)	AS+AQ+PQ
Mayotte	–	–	–	–	–
Mozambique	AL	AS+AQ	AS	SP(IPT)	NA
Namibia	AL	AL-PQ	QN	NA	AL-PQ
Niger	AL	AL-PQ	AS; QN	SP(IPT)	NA
Nigeria	AL; AS+AQ	AL; AS-PYR; AS+AQ; DHA-PPQ	AS	SP(IPT)	NA
Rwanda	AL	AL	AS; QN	NA	ACT+PQ
Sao Tome and Principe	–	AS+MQ+PQ	AS	SP(IPT)	NA
Senegal	NA	AL; AS+AQ+PQ	AS	SP(IPT)	NA
Sierra Leone	AL	AL; AS+AQ	AM; AS; QN	SP(IPT)	NA
South Africa	AL	AL-PQ	AS; QN	–	AL-PQ
South Sudan[1]	AS+AQ	AS+AQ	AM; AS; QN	SP(IPT)	AS+AQ+PQ
Togo	AL; AS+AQ	AL; AS+AQ	AS; AM; QN	SP(IPT)	NA
Uganda	–	AL	AS	SP(IPT)	AL-PQ
United Republic of Tanzania	–	–	–	–	–
Mainland	AL	AL-PQ	AM; AS; QN	SP(IPT)	NA
Zanzibar	NA	AS+AQ+PQ	AS	NA	PQ
Zambia	AL	AL	AS	SP(IPT)	NA
Zimbabwe	–	AL-PQ	AS	SP(IPT)	NA
AMERICAS					
Belize	–	–	–	NA	–
Bolivia (Plurinational State of)	–	AL+PQ	AS	NA	CQ+PQ
Brazil	–	AL+PQ; AS+MQ+PQ	AS	CQ	CQ+PQ
Colombia	AL+PQ	AL; AL-PQ	AS	CQ	CQ+PQ
Costa Rica	CQ+PQ	CQ+PQ	AS	CQ	CQ+PQ

ANNEX 4 – B. ANTIMALARIAL DRUG POLICY, 2021

WHO region Country/area	*P. falciparum*				*P. vivax*
	Uncomplicated unconfirmed	Uncomplicated confirmed	Severe	Prevention during pregnancy	Treatment
AMERICAS					
Dominican Republic	–	CQ+PQ	AS	NA	CQ+PQ
Ecuador	AL+AM	AL+AM+PQ	AS	NA	CQ+PQ
French Guiana	–	AL+PQ	AS	QN	CQ+PQ
Guatemala	–	CQ+PQ	AL; CQ; QN	NA	CQ+PQ
Guyana	–	AL+PQ	AM; AS-QN; QN+CL	NA	CQ+PQ
Haiti	–	CQ+PQ	AS	NA	CQ+PQ
Honduras	–	CQ+PQ	AS	NA	CQ+PQ
Mexico	NA	AL; AL-PQ	AL; AL+PQ; AS	NA	CQ+PQ
Nicaragua	–	CQ+PQ	AS	NA	CQ+PQ
Panama	AL-PQ	AL+PQ	AS	CQ	CQ+PQ
Peru	–	AS+MQ+PQ	AS	NA	CQ+PQ
Suriname	–	AL+PQ	AS	NA	CQ+PQ
Venezuela (Bolivarian Republic of)	–	AL+PQ	–	NA	CQ+PQ
EASTERN MEDITERRANEAN					
Afghanistan	CQ	AL+PQ	AM; AS; QN	NA	CQ+PQ
Djibouti	AL	AL+PQ	AS	NA	AL+PQ
Iran (Islamic Republic of)	–	AS+SP+PQ	AS; QN	NA	CQ+PQ
Pakistan	CQ	AL-PQ	AS	NA	CQ+PQ
Saudi Arabia	NA	AS+SP+PQ	AS+AM+QN	NA	CQ+PQ
Somalia	AL	AL-PQ	AS	SP(IPT)	AL+PQ
Sudan	–	AL	QN+AS	SP(IPT)	AL+PQ
Yemen	AS+SP	AS+SP+PQ	AS; QN	NA	CQ+PQ
SOUTH-EAST ASIA					
Bangladesh	NA	AL+PQ	AS+AL+PQ	NA	CQ+PQ
Bhutan	AL-PQ	AL-PQ	AM; AS; QN	NA	CQ+PQ
Democratic People's Republic of Korea	NA	NA	NA	NA	CQ+PQ
India	NA	AL+PQ; AS+SP+PQ	AM; AS; QN	NA	CQ+PQ
Indonesia	–	DHA-PPQ	AS	NA	DHA+PPQ+PQ
Myanmar	AL+PQ	AL+PQ	AM; AS; QN	NA	CQ+PQ
Nepal	AL	AL-PQ	AS	NA	CQ+PQ
Thailand	–	DHA-PPQ+PQ	AS; QN	NA	CQ+PQ
Timor-Leste	AL+PQ	AL+PQ	AS; QN	NA	AL+PQ
WESTERN PACIFIC					
Cambodia	AS+MQ	AS+MQ+PQ	AM; AS	NA	AS+MQ+PQ
Lao People's Democratic Republic	–	AL+PQ	AS	NA	AL-PQ
Malaysia	NA	AL-PQ	AS	NA	AL+PQ
Papua New Guinea	AL	AL-PQ	AM; AS	SP(IPT)	AL+PQ
Philippines	–	AL+PQ	AS	NA	AL+PQ
Republic of Korea	AL	AL	AL	NA	CQ+PQ
Solomon Islands	AL+PQ	AL; AL+PQ	AS+AL+PQ	CQ	AL+PQ
Vanuatu	–	AL-PQ	AS	CQ	PQ
Viet Nam	AS-PYR; DHA-PPQ	DHA-PPQ	AS	NA	CQ+PQ

Data as of 28 October 2022

ACT: artemisinin-based combination therapy; AL: artemether-lumefantrine; AM: artemether; AQ: amodiaquine; ART: artemisinin; AS: artesunate; CL: clindamycin; CQ: chloroquine; DHA: dihydroartemisinin; IPT: intermittent preventive treatment of malaria; MQ: mefloquine; NA: not applicable; *P.*: *Plasmodium*; PPQ: piperaquine; PQ: primaquine; PYR: pyronaridine; QN: quinine; SP: sulfadoxine-pyrimethamine; WHO: World Health Organization.

"–" refers to data not available.

[1] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
AFRICAN					
Angola	2019	5 300 409	23 191 738	–	–
	2020	6 170 967	19 789 520	–	–
	2021	2 328 851	19 000 000	–	–
Benin	2019	14 939 190	17 920 889	–	–
	2020	12 917 281	17 706 413	–	–
	2021	12 141 226	16 500 000	–	–
Botswana	2019	285 055	–	–	–
	2020	138 958	–	–	–
	2021	347 610	–	–	–
Burkina Faso	2019	35 071 984	26 354 248	12 370 892	–
	2020	40 459 954	27 080 396	1 409 246	–
	2021	66 757 381	27 500 000	1 409 246	–
Burundi	2019	32 833 267	8 433 359	–	–
	2020	21 644 596	8 332 430	–	–
	2021	34 574 830	7 500 000	–	–
Cabo Verde	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Cameroon	2019	33 082 524	23 718 823	–	–
	2020	15 509 982	24 476 512	–	152 394
	2021	19 899 167	22 500 000	–	152 394
Central African Republic	2019	11 855 065	–	–	–
	2020	14 599 693	–	–	–
	2021	19 395 525	–	–	–
Chad	2019	40 139 163	–	–	–
	2020	13 717 911	–	–	–
	2021	24 286 670	–	–	–
Comoros	2019	1 592 918	–	–	–
	2020	2 007 101	–	–	–
	2021	1 256 457	–	–	–
Congo	2019	10 841 019	–	–	–
	2020	5 373 274	–	–	–
	2021	5 077 624	–	–	–
Côte d'Ivoire	2019	60 074 073	26 354 248	–	–
	2020	47 183 774	26 038 843	–	–
	2021	42 348 291	25 000 000	–	–
Democratic Republic of the Congo	2019	124 338 786	52 708 496	–	788 010
	2020	158 030 595	57 285 454	–	1 842 905
	2021	143 878 029	54 500 000	–	1 842 905
Equatorial Guinea	2019	-230 482	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Eritrea	2019	9 427 262	–	–	–
	2020	4 649 703	–	–	–
	2021	4 210 626	–	–	–
Eswatini	2019	881 581	–	–	–
	2020	589 281	–	–	–
	2021	1 260 814	–	–	–
Ethiopia	2019	28 113 549	37 950 117	–	–
	2020	15 193 760	37 495 933	–	–
	2021	23 136 737	36 000 000	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
1 850 026	2 864 156	–	20 000 000	–	–	–	–
2 496 965	–	–	22 000 000	–	–	–	–
15 437 196	–	–	19 000 000	–	–	–	–
11 479 489	15 167 653	0	2 435 941	0	0	0	0
217 252	19 234 523	0	3 267 868	0	0	0	0
1 475 597	6 969 348	–	13 915 191	–	65 372	–	43 978
2 580 459	219 328	0	0	0	–	0	0
28 180 263	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
12 571 349 [5]	66 864 802	6 473 917	20 960 657	–	107 706	546 944	–
57 406 172	27 553 483	42 623	18 844 577	–	52 206	333 334	8 289 677
46 732 479	23 061 297	0	14 739 304	–	17 066	331 713	7 443 864
4 563 477	24 301 509	–	4 734 719	–	159 500	372 925	–
10 230	986 489	–	–	–	11 959	75 337	–
2 395 043	532 091	–	–	–	185 887	82 603	–
547 281	116 809	–	–	–	82 598	–	–
630 624	182 196	–	–	–	11 497	–	–
823 803	305 597	–	–	–	7 747	–	841 304
64 509 432 [6]	33 828 144	0	21 148 951	0	0	0	0
45 529 320	24 499 314	0	27 157 756	0	0	0	0
44 171 440	27 717 241	0	22 434 482	0	0	0	0
162 822 [6]	16 631 715	–	–	–	199 800	656 890	–
172 846	15 452 952	–	–	–	50 000	–	1 273 044
51 960	15 068	–	–	–	20 000	–	–
0	–	–	–	–	–	–	–
0	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
120 896 [5]	824 954	–	–	–	–	–	–
50 278	1 968 573	–	–	–	–	1 932	–
322 003	1 658 731	0	0	38 604	15 627	–	–
1 360 219	6 689 800	0	0	0	67 741	0	15 000
18 826 146 [6]	12 660 948	0	7 200	0	0	0	15 000
–	–	–	–	–	–	–	–
6 428 287	60 947 905	–	21 342 862	–	5 984	60 980	2 500 000
18 144 667	33 908 462	–	25 000 000	–	–	–	–
13 921 781	22 074 036	0	25 000 000	0	8 211	5 076 318	0
1 504 555	112 504 296	0	41 897 052	–	148 208	802 250	–
1 486 548	141 146 584	0	39 293 479	0	412 688	0	32 000 000
1 427 241	104 336 236	0	70 289 620	0	328 000	0	32 000 000
3 324 311 [5]	–	–	–	–	–	–	–
3 353 293 [5]	–	–	–	–	–	–	–
3 219 511 [5]	–	–	–	–	–	–	–
423 307 [5]	4 788 233	0	0	0	120 000	0	0
426 998 [5]	12 302 113	–	–	–	0	–	–
409 962 [5]	3 133 493	–	–	–	–	–	–
883 848	1 005 542	0	0	0	10 613	0	0
916 776	736 128	0	0	0	10 613	0	0
841 829	1 434 576	0	0	0	–	0	0
24 148 647	26 083 562	–	18 000 000	–	–	–	122 344 828
27 736 303	27 356 758	–	32 000 000	–	–	–	–
26 856 645	22 014 812	–	36 000 000	–	–	–	–

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
AFRICAN					
Gabon	2019	0	–	–	–
	2020	-28 247	–	–	–
	2021	–	–	–	–
Gambia	2019	3 596 861	–	–	–
	2020	5 849 843	–	–	–
	2021	12 725 069	–	–	–
Ghana	2019	37 709 188	29 516 758	–	1 541 341
	2020	37 953 867	29 163 504	–	768 125
	2021	57 828 600	28 000 000	–	768 125
Guinea	2019	30 552 991	15 812 549	541 430	–
	2020	16 545 338	16 664 859	237 996	–
	2021	38 261 447	15 000 000	237 996	–
Guinea-Bissau	2019	5 075 144	–	–	–
	2020	20 940 261	–	–	–
	2021	2 410 409	–	–	–
Kenya	2019	35 235 911	36 895 947	–	–
	2020	17 075 208	34 892 049	–	253 730
	2021	28 871 917	33 500 000	–	253 730
Liberia	2019	6 740 547	14 758 379	–	–
	2020	9 639 183	14 581 752	–	–
	2021	21 895 302	14 000 000	–	–
Madagascar	2019	6 746 680	27 408 418	–	–
	2020	34 982 363	27 080 396	–	–
	2021	16 146 415	26 000 000	–	–
Malawi	2019	15 247 795	25 300 078	–	–
	2020	41 672 855	24 997 289	–	–
	2021	65 321 494	24 000 000	–	–
Mali	2019	22 239 041	26 354 248	11 392 131	–
	2020	28 102 642	26 038 843	2 082 893	–
	2021	10 908 873	26 500 000	2 082 893	–
Mauritania	2019	77 186	–	–	–
	2020	513 030	–	–	–
	2021	–	–	–	–
Mozambique	2019	53 652 975	30 570 928	–	–
	2020	92 398 106	30 205 057	–	–
	2021	26 216 859	29 000 000	–	–
Namibia	2019	651 913	–	–	–
	2020	1 400 924	–	–	–
	2021	-3 350	–	–	–
Niger	2019	22 171 167	18 975 058	8 053 102	–
	2020	38 684 153	18 747 967	8 231 430	–
	2021	44 490 085	19 000 000	8 231 430	–
Nigeria	2019	121 528 650	73 791 894	4 121 091	2 658 598
	2020	106 146 698	80 199 635	5 413 630	4 365 830
	2021	126 299 731	74 000 000	5 413 630	4 365 830
Rwanda	2019	36 398 537	18 975 058	–	–
	2020	25 008 985	20 831 074	–	–
	2021	29 320 994	19 500 000	–	–
Sao Tome and Principe	2019	-537 155	0	–	–
	2020	0	0	–	–
	2021	–	0	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
420 789 [5]	0	–	–	1 885 319	–	–	–
83 574 [5]	–	–	–	–	2 000	–	6 000
314 372	0	0	0	44 064	24 141	15 195	–
1 268 631 [6]	3 940 063	–	–	–	68 000	90 000	288 646
961 649 [5]	–	–	–	–	–	–	–
1 100 546	15 802 151	–	–	–	–	–	–
11 350 527 [5]	28 442 224	0	22 448 510	0	300 000	0	0
11 350 527 [5]	60 415 856	0	28 000 000	0	300 000	0	0
11 980 643	35 593 618	0	28 000 000	0	300 000	0	0
1 002 595	25 261 667	0	15 000 000	0	39 000	0	–
4 584 656	0	0	15 000 000	0	0	0	–
8 242 874	0	0	15 000 000	0	0	0	–
0	540 184 296	–	–	–	–	–	–
0	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
6 924 320	14 497 642	–	34 000 000	–	–	–	–
6 230 802 [6]	48 427 650	0	34 000 000	0	0	0	0
–	–	–	–	–	–	–	–
20 684 910	11 500 991	0	12 000 000	0	0	0	0
20 684 910 [5]	–	–	–	–	–	–	–
19 859 668 [5]	–	–	–	–	–	–	–
0	18 378 714	–	26 000 000	–	50 000	–	–
7 674	17 500 000	0	26 000 000	–	40 000	–	–
6 998	30 712 141	–	–	–	45 200	–	–
334 921	12 768 682	–	–	–	150 000	–	–
292 899	162 082 558	0	24 000 000	–	0	300 000	–
130 047	16 143 765	0	24 000 000	0	0	300 000	0
1 342 820	19 414 667	1 085 642	25 000 000	0	24 083	2 420	7 224
6 613 663	9 401 568	3 682 999	25 000 000	–	103 223	4 356 515	5 579
6 226 039	16 113 605	0	25 000 000	0	33 766	1 588 792	0
131 548	175 296	–	–	–	–	–	–
1 241 048 [5]	3 172 626	–	–	–	–	–	–
–	–	–	–	–	–	–	–
1 948 730	62 708 218	–	29 000 000	39 548 431	414 944	1 102 707	17 667 110
14 352 922	84 260 635	–	29 000 000	1 102 477	67 741	2 051 725	–
1 470 927	15 473 237	–	29 000 000	1 138 630	–	–	2 525 488
11 725 576	3 377 753	0	0	0	100 000	0	150 000
10 750 723	1 055 154	–	–	–	100 000	–	150 000
11 353 994	1 160 669	–	–	–	–	–	–
1 404 583 [6]	16 329 651	6 319 943	18 000 000	0	86 206	693 054	0
2 533 067	42 538 813	5 666 648	18 000 000	–	372 600	382 247	20 000
35 781 195	28 962 663	0	18 000 000	0	68 000	0	0
10 313 996 [5]	131 373 863	–	70 000 000	–	–	–	–
6 354 340 [5]	116 796 451	–	70 000 000	–	–	–	–
6 100 829 [5]	11 464 767	–	–	–	–	–	–
30 472 953	18 517 439	–	18 000 000	–	–	–	–
32 139 073	29 647 540	–	18 000 000	–	–	–	–
30 547 621	22 490 626	–	18 000 000	–	–	–	–
123 550	517 594	0	0	3 322 449	126 121	52 141	0
89 918	164 173	–	–	–	75 939	4 186	0
–	–	–	–	–	–	–	–

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
AFRICAN					
Senegal	2019	12 198 895	25 300 078	–	–
	2020	10 932 309	23 434 958	–	–
	2021	943 823	25 500 000	–	–
Sierra Leone	2019	1 282 546	15 812 549	–	–
	2020	828 004	15 623 306	–	–
	2021	2 434 083	16 000 000	–	–
South Africa	2019	–	–	–	–
	2020	–	–	–	161 901
	2021	–	–	–	161 901
South Sudan[8]	2019	13 056 781	0	–	12 706 586
	2020	14 541 849	0	–	5 600 052
	2021	38 956 168	0	–	5 600 052
Togo	2019	9 133 478	–	788 396	–
	2020	17 028 218	–	–	–
	2021	16 885 154	–	–	–
Uganda	2019	41 431 927	34 787 607	–	12 448 819
	2020	89 670 942	36 454 380	–	6 019 790
	2021	63 840 992	34 000 000	–	6 019 790
United Republic of Tanzania	2019	57 839 973	46 383 476	–	97 938
	2020	91 283 184	43 745 255	–	–
	2021	98 361 078	42 000 000	–	–
Mainland	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Zanzibar	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Zambia	2019	25 007 812	31 625 097	367 255	199 103
	2020	42 667 131	31 246 611	540 211	–
	2021	38 647 166	30 000 000	540 211	–
Zimbabwe	2019	18 240 345	15 812 549	–	–
	2020	33 410 312	15 623 306	–	–
	2021	49 085 307	15 000 000	–	–
AMERICAS					
Belize	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Bolivia (Plurinational State of)	2019	867 337	–	–	–
	2020	1 928 329	–	–	–
	2021	1 316 081	–	–	–
Brazil	2019	0	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Colombia	2019	0	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Costa Rica	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
9 930 281	9 005 006	0	24 000 000	0	0	0	14 567 962
41 130 896	11 880 855	0	21 818 182	1 478 320	0	0	6 246 030
73 322 881	16 233 123	0	22 500 000	0	0	0	37 370 100
135 588	7 522 931	–	15 000 000	–	70 000	2 059	4 779
102 753 [5]	–	–	15 000 000	–	–	–	–
98 654 [5]	–	–	14 500 000	–	–	–	–
20 294 067	6 591 498	0	0	0	45 000	0	1 132 611
20 633 960	624 227	0	0	0	0	0	0
21 644 538 [5]	5 504 950	0	0	0	0	0	0
1 127 852	17 047 017	3 124 679	0	3 755 637	0	–	–
1 989 688 [5]	8 131 978	–	–	–	–	–	–
1 910 308 [5]	5 044 295	–	–	–	–	–	–
381 822	–	–	–	–	–	–	–
2 897 413	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–
7 678 069	58 333 000	0	33 000 000	14 389 262	–	1 254 438	705 940
7 586 178	76 941 854	0	33 000 000	6 014 987	–	–	–
–	–	–	33 000 000	–	–	–	–
78 220 595	27 145 381	0	9 871 122	10 000	57 875	0	0
80 526 713	–	0	1 034 687	0	0	0	10 000
81 266 372	2 569 360	0	1 180 198	0	0	0	6 883
78 114 720	25 110 093	0	8 774 918	0	57 875	0	0
80 444 879	–	0	–	0	0	0	0
81 215 121	–	0	–	0	0	0	0
105 875	2 035 288	0	1 096 204	10 000	0	0	0
81 834	0	0	1 034 687	0	0	0	10 000
51 251	2 569 360	0	1 180 198	0	0	0	6 883
16 171 488	17 019 922	–	30 000 000	–	300 000	–	5 330 000
15 977 949	47 613 297	–	30 000 000	–	300 000	–	–
14 094 553	29 446 626	–	30 000 000	–	250 000	–	–
3 969 213	25 931 599	–	11 208 498	–	140 000	–	–
1 856 205	12 796 329	–	12 000 000	–	–	–	–
1 750 520	42 425 446	–	11 208 490	–	–	–	–
265 651	0	0	11 058	0	0	0	0
253 993	20 554	0	0	0	0	0	0
209 639	41 109	–	–	–	–	–	–
308 716	1 191 940	0	0	0	27 891	0	0
156 233	1 269 187	–	–	–	–	–	–
336 667	–	–	–	–	–	–	–
58 448 223 [6]	0	0	154 641	–	–	–	–
55 558 301 [6]	–	–	13 000	–	–	–	–
41 066 648 [6]	–	–	40 000	–	–	–	–
6 324 464	0	0	269 661	0	–	0	–
5 550 166	0	0	–	0	–	0	1 066 811
2 036 333	–	–	84 662	–	–	–	795 345
5 270 850 [6]	0	0	7 991	0	22 842	0	0
208 687	0	0	0	0	56 000	0	8 000
106 406	0	0	83 093	0	14 000	0	24 577

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
AMERICAS					
Dominican Republic	2019	0	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Ecuador	2019	0	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
French Guiana	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Guatemala	2019	653 275	–	–	–
	2020	2 941 532	–	–	–
	2021	1 454 733	–	–	–
Guyana	2019	79 794	–	–	–
	2020	311 162	–	–	–
	2021	1 508 692	–	–	–
Haiti	2019	6 365 257	–	–	–
	2020	8 032 623	–	–	–
	2021	7 984 314	–	–	–
Honduras	2019	1 628 562	–	–	–
	2020	2 016 988	–	–	–
	2021	683 331	–	–	–
Mexico	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Nicaragua	2019	3 135 894	–	–	–
	2020	1 665 930	–	–	–
	2021	1 681 870	–	–	–
Panama	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Peru	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Suriname	2019	690 835	–	–	–
	2020	951 828	–	–	–
	2021	975 225	–	–	–
Venezuela (Bolivarian Republic of)	2019	–	–	–	–
	2020	13 250 391	–	–	–
	2021	12 515 489	–	–	–
EASTERN MEDITERRANEAN					
Afghanistan	2019	10 751 612	–	–	–
	2020	6 501 085	–	–	–
	2021	9 312 416	–	–	–
Djibouti	2019	1 112 797	–	27 103	–
	2020	1 130 197	–	240 660	–
	2021	–	–	240 660	–
Iran (Islamic Republic of)	2019	-110 959	–	–	–
	2020	0	–	–	–
	2021	–	–	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
2 699 469	0	0	313 661	0	322 922	0	186 078
1 254 339	0	0	0	0	10 440	0	415 233
919 887	–	–	67 380	–	10 000	–	621 664
2 820 454 [6]	0	0	71 420	0	76 400	0	0
1 153 024	0	0	40 000	0	31 000	–	33 000
–	–	–	68 178	–	55 000	–	–
–	0	0	0	0	–	0	–
–	0	0	0	0	–	0	–
–	0	0	0	0	16 340	0	–
1 347 222	520 837	–	76 014	–	110 535	–	–
3 300 192	2 984 711	–	–	–	11 122	–	1 025 373
3 433 146	–	–	–	–	–	–	236 936
771 827	299 843	0	1 000 000	0	140 000	0	0
637 049	421 050	0	28 415	0	0	0	0
8 830 132 [6]	485 999	–	901 000	–	–	–	207 741
2 408 523 [6]	6 006 513	0	10 445	0	266 004	–	203 638
0	–	0	131 147	0	75 612	–	123 742
–	3 590 047	–	144 000	–	–	–	–
572 743	1 511 759	0	67 612	595 460	2 613	0	621 496
565 889	926 108	0	0	0	45 451	0	–
543 312	1 438 564	–	–	–	100 000	–	1 903 289
39 029 833	0	0	41 177	0	59 429	0	0
8 449 764	0	0	0	0	0	0	0
7 465 765	0	0	0	0	20 100	0	0
6 487 924	2 313 411	–	100	400 000	13 408	–	15 020
7 193 840	1 607 911	–	–	–	15 235	–	444 514
7 659 140	1 722 062	–	–	–	–	–	1 474 595
6 729 161	475 156	0	32 085	668 596	62 342	0	79 896
6 041 011	418 786	0	9 058	0	–	0	44 949
6 236 013	198 000	0	20 930	0	99 636	0	179 472
3 912 630 [6]	0	0	193 079	0	–	0	0
15 237 676	–	–	51 143	–	–	–	–
21 730 670	–	–	35 661	–	–	–	–
1 356 092	695 291	–	46 808	–	5 000	–	30 000
1 533 114	849 957	–	–	15 000	–	–	65 000
1 471 949	849 957	–	76 565	15 000	–	–	63 835
0	–	–	–	–	147 419	–	–
0	–	–	–	–	39 384	–	–
–	–	–	–	–	–	–	–
0	7 759 216	–	–	–	80 885	–	–
0	11 733 984	–	–	–	19 367	–	–
–	12 150 115	–	–	–	46 378	–	–
1 536 115 [6]	171 627	–	–	–	406 776	–	–
507 285 [6]	–	0	0	0	0	0	–
1 545 223 [6]	1 349 614	0	–	0	153 658	0	–
3 088 718	0	0	0	0	38 000	0	0
2 812 195	0	0	0	0	156 373	–	–
112 000	0	0	0	0	923 878	0	85 000

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
EASTERN MEDITERRANEAN					
Pakistan	2019	15 689 389	–	–	–
	2020	12 419 596	–	–	–
	2021	13 354 832	–	–	–
Saudi Arabia	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Somalia	2019	4 476 727	–	–	–
	2020	10 720 350	–	–	–
	2021	13 499 724	–	–	–
Sudan	2019	46 691 035	0	–	–
	2020	49 457 120	0	–	–
	2021	72 118 821	0	–	–
Yemen	2019	-59 460	–	18 722 777	–
	2020	0	–	4 374 526	–
	2021	–	–	4 374 526	–
SOUTH-EAST ASIA					
Bangladesh	2019	5 698 899	–	–	–
	2020	14 163 659	–	–	–
	2021	6 724 656	–	–	–
Bhutan	2019	404 334	–	–	–
	2020	1 365 552	–	–	–
	2021	461 051	–	–	–
Democratic People's Republic of Korea	2019	0	–	–	–
	2020	-937 319	–	–	–
	2021	–	–	–	–
India	2019	23 239 183	–	–	–
	2020	17 887 121	–	–	–
	2021	26 086 463	–	–	–
Indonesia	2019	18 437 183	–	–	–
	2020	14 638 310	–	–	–
	2021	11 689 248	–	–	–
Myanmar	2019	31 025 213	10 541 699	–	565 217
	2020	33 283 346	10 415 537	–	369 356
	2021	–	10 000 000	–	369 356
Nepal	2019	1 608 903	–	–	–
	2020	1 689 666	–	–	–
	2021	1 275 647	–	–	–
Thailand	2019	12 148 078	3 162 510	–	–
	2020	12 943 523	–	–	–
	2021	–	–	–	–
Timor-Leste	2019	2 431 858	0	–	–
	2020	3 117 505	0	–	–
	2021	1 115 703	0	–	–

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
2 575 963	14 600 000	–	–	–	296 000	–	–
3 337 764	11 858 304	–	–	–	149 566	–	–
3 384 559	13 601 348	0	0	0	–	0	0
31 625 097	0	0	0	0	0	0	0
31 246 611	0	0	0	0	0	0	0
30 000 000	0	0	0	0	0	0	0
126 606	9 474 797	0	0	0	73 840	0	0
168 872	9 515 651	0	0	0	12 450	0	–
243 202	21 735 290	0	0	0	28 680	0	0
0	–	–	–	–	–	–	–
0	51 917 466	–	–	–	50 000	–	–
6 976 922	12 748 399	–	–	–	1 249 098	–	–
0	6 123 238	–	–	–	–	–	–
0	7 203 048	–	–	–	–	–	–
–	2 162 232	–	–	–	–	–	–
2 777 488	7 082 673	0	0	0	100 000	0	0
2 570 721 [6]	15 561 791	0	0	0	44 600	0	0
2 468 160 [5]	22 847	944 146	0	0	78 781	0	0
265 503	418 069	0	0	0	40 391	0	121 212
180 189	530 814	0	0	0	31 728	0	114 285
131 396	397 061	–	–	–	–	–	94 108
2 330 875	0	0	0	0	700 000	0	0
2 333 393	0	0	0	0	–	434 830	–
2 269 000	513 556	–	–	–	–	–	–
77 632 329	31 242 857	0	0	0	–	0	–
65 819 304	22 618 171	0	0	0	–	0	–
63 193 385 [5]	35 570 992	–	–	–	–	–	–
25 926 315 [6]	25 652 637	–	–	–	100 000	782 076	–
17 800 386 [6]	21 448 055	–	–	–	100 000	234 343	12 687 804
17 090 224 [5]	14 063 928	–	–	–	100 000	234 343	–
11 726 459 [6]	40 110 516	–	10 000 000	610 000	50 000	–	–
13 903 341 [6]	28 727 247	–	10 000 000	3 367 484	50 000	–	–
13 348 655 [5]	–	–	–	–	5 000	–	–
647 126	2 727 909	0	621 652	0	40 000	0	0
3 713 285	1 862 647	0	0	0	40 000	0	0
4 461 471	1 485 187	0	0	0	40 000	0	0
6 096 378	8 872 808	–	1 047 408	–	70 000	–	37 710
6 013 838	8 247 913	0	885 845	0	87 663	0	27 514
3 666 021	8 379 275	–	1 156 640	–	15 362	–	347 033
2 405 053 [5]	2 281 466	–	–	–	40 000	–	256 000
3 171 788	–	–	–	–	60 000	–	21 340
3 045 247 [5]	–	–	–	–	40 000	–	10 414

ANNEX 4 – C. FUNDING FOR MALARIA CONTROL, 2019–2021

WHO region Country/area	Year	Contributions reported by donors			
		Global Fund[1]	PMI/USAID[2]	World Bank[3]	United Kingdom[4]
WESTERN PACIFIC					
Cambodia	2019	19 089 838	10 541 699	–	–
	2020	20 339 822	10 415 537	–	–
	2021	–	10 000 000	–	–
Lao People's Democratic Republic	2019	6 485 880	–	–	–
	2020	7 390 821	–	–	–
	2021	–	–	–	–
Malaysia	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Papua New Guinea	2019	10 755 826	–	–	–
	2020	9 892 594	–	–	–
	2021	14 973 712	–	–	–
Philippines	2019	3 228 103	–	–	–
	2020	4 651 619	–	–	–
	2021	1 855 744	–	–	–
Republic of Korea	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Solomon Islands	2019	2 065 385	–	–	–
	2020	539 463	–	–	–
	2021	2 171 036	–	–	–
Vanuatu	2019	–	–	–	–
	2020	–	–	–	–
	2021	–	–	–	–
Viet Nam	2019	17 354 398	–	–	–
	2020	18 490 748	–	–	–
	2021	–	–	–	–

Global Fund: Global Fund to Fight AIDS, Tuberculosis and Malaria; NGO: nongovernmental organization; NMP: national malaria programme; PMI: United States President's Malaria Initiative; United Kingdom: United Kingdom of Great Britain and Northern Ireland government; UNICEF: United Nations Children's Fund; USAID: United States Agency for International Development; WHO: World Health Organization.

"–" refers to data not available.

[1] Source: Global Fund.

[2] Source: www.foreignassistance.gov.

[3] Source: Organisation for Economic Co-operation and Development (OECD) creditor reporting system (CRS) database.

[4] Source: Final UK aid spend.

[5] WHO NMP funding estimates.

Contributions reported by countries							
Government (NMP)	Global Fund	World Bank	PMI/USAID	Other bilaterals	WHO	UNICEF	Other contributions[7]
957 972	5 108 350	–	8 714 000	420 000	–	–	0
979 633	4 690 075	–	8 649 000	520 000	–	–	5 633
930 575	5 000 100	–	8 034 662	520 000	246 523	–	0
979 276	5 327 000	0	686 183	0	1 039 774	0	1 301 618
500 779	5 157 000	0	903 988	0	–	0	551 020
1 645 898	3 718 049	0	859 788	0	711 542	0	1 278 402
51 461 892	0	0	0	0	0	0	0
50 249 077	0	0	0	0	0	0	0
48 770 844	0	0	0	0	0	0	0
51 233	8 831 155	–	–	1 474 700	95 000	–	–
52 078	94 632 334	–	–	–	52 000	–	–
55 500	11 996 849	–	–	–	45 000	–	–
2 586 685	3 412 622	0	0	0	0	0	0
5 102 712	5 150 000	0	0	0	0	0	0
4 392 228	3 918 641	–	–	–	–	–	–
758 994	0	0	0	0	0	0	0
840 265	0	0	0	0	0	0	0
850 719	0	0	0	0	0	0	0
316 166	717 728	0	0	455 000	37 607	0	0
116 143	121 522	–	–	578 144	23 400	–	–
276 950	1 227 347	–	–	13 600	14 025	–	–
191 174	182 877	0	0	0	178 245	0	0
109 890	218 935	–	–	–	166 293	–	–
17 400 [6]	329 022	0	0	0	–	0	–
1 708 089	10 221 830	0	0	0	333 000	0	385 000
2 018 602	9 366 317	–	–	–	–	–	858 369
1 542 014	2 418 471	–	–	–	–	–	755 652

Data as of 24 November 2022

[6] Budget not expenditure.

[7] Other contributions as reported by countries: NGOs, foundations, etc.

[8] South Sudan became an independent state on 9 July 2011 and a Member State of WHO on 27 September 2011. South Sudan and the Sudan have distinct epidemiological profiles comprising high transmission and low transmission areas, respectively. For this reason, data up to June 2011 from the Sudanese high transmission areas (10 southern states which correspond to contemporary South Sudan) and low transmission areas (15 northern states which correspond to contemporary Sudan) are reported separately.

Note: Negative disbursements reflect recovery of funds on behalf of the financing organization.

Note: All contributions reported by donors are displayed in US 2021 constant dollars.

ANNEX 4 – D. COMMODITIES DISTRIBUTION AND COVERAGE, 2019–2021

WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first-line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
AFRICAN									
Angola	2019	15 293 686	27.5	–	–	2 477 124	5 575 259	2 477 124	5 575 259
	2020	528 563	15.5	44 633	7 570 498	2 575 738*	5 797 209	2 575 738+	5 797 209
	2021	875 247	16.8	620 815	6 481 900	4 215 061	7 793 251	4 215 061	7 793 251
Benin	2019	505 670	29.9	1 077 411	3 984 677	4 455 581	2 353 657	4 455 581	2 353 657
	2020	13 103 447	68.5	1 104 928	4 202 384	3 966 505*	2 095 303	3 966 505+	2 095 303
	2021	662 290	64.0	927 007	2 298 798	2 985 960	2 985 960	2 985 960	2 985 960
Botswana	2019	19 932	–	154 663	2 526	3 198	272	3 198	272
	2020	80 525	–	152 560	–	11 205*	953	11 205+	953
	2021	–	–	24 620	–	–	–	–	–
Burkina Faso	2019	1 145 782	66.5	587 248	–	12 428 300	11 223 002	12 428 300	11 223 002
	2020	1 017 084	69.4	508 017	12 936 865	11 336 876*	10 237 424	11 336 876+	10 237 424
	2021	1 353 233	52.0	591 249	9 794 711	8 892 174	11 030 942	8 892 174	11 030 942
Burundi	2019	7 528 556	50.0	725 449	–	9 338 611	8 444 710	9 271 032	8 444 710
	2020	729 431	65.2	1 243 848	7 773 268	4 743 324*	4 289 288	4 708 998+	4 289 288
	2021	802 309	66.9	914 778	9 563 340	11 404 672	5 953 811	5 693 645	5 693 645
Cabo Verde	2019	–	–	302 520	7 867	40	40	40	40
	2020	–	–	233 171	4 399	10	10	10#	10
	2021	–	–	241 552	–	21	21	21	21
Cameroon	2019	8 860 653	69.3	–	2 082 527	1 905 965	1 834 114	1 905 965	1 157 011
	2020	2 270 567	73.5	–	2 840 269	1 849 716$	1 433 934	1 849 716+	1 122 865
	2021	1 024 236	68.4	–	2 027 275	1 816 440	1 439 118	1 816 440	1 359 417
Central African Republic	2019	103 848	74.7	–	2 764 293	5 753 501	2 654 215	5 640 687	2 602 171
	2020	2 635 388	69.1	–	–	4 293 758*	1 980 804	3 773 875+	1 740 970
	2021	121 607	62.0	–	2 736 457	3 753 972	2 223 562	3 753 972	2 223 562
Chad	2019	613 700	19.4	–	1 788 730	1 665 212	1 665 212	1 595 351	1 595 351
	2020	9 138 032	50.2	1 707 286	2 340 650	1 806 225^	1 806 225	1 452 420#	1 452 420
	2021	731 254	59.8	613 037	–	1 012 958	1 012 958	1 012 958	1 012 958
Comoros	2019	16 244	47.3	–	–	11 593	11 593	11 593	11 593
	2020	462 154	71.6	57 658	–	4 546$	4 546	4 546#	4 546
	2021	30 891	78.5	127 487	31 467	10 547	9 609	10 547	9 609
Congo	2019	2 648 456	74.8	–	–	200 000	427 959	200 000	233 389
	2020	1 488	86.3	–	–	48 459	103 692	48 459#	103 692
	2021	36 873	76.0	–	–	187 940	161 693	187 940	161 693
Côte d'Ivoire	2019	1 410 391	60.6	–	6 456 625	4 657 570	5 200 350	4 657 570	5 200 350
	2020	1 579 505	54.9	193 935	4 837 781	4 365 387	4 469 333	4 365 387	4 365 387
	2021	21 733 998	81.2	–	7 338 750	7 073 535	6 422 581	7 073 535	6 234 917
Democratic Republic of the Congo	2019	20 710 146	65.8	–	26 963 687	18 853 210	18 853 210	18 853 209	18 853 209
	2020	20 620 187	65.8	–	28 054 832	19 192 708	19 192 708	19 192 707#	19 192 707
	2021	22 579 391	67.5	–	26 740 915	19 260 604	18 535 664	19 260 604	18 535 664
Equatorial Guinea	2019	14 843	47.4	61 561	54 340	15 769	–	15 769	–
	2020	–	42.5	–	–	–	–	–	–
	2021	–	36.8	–	–	–	–	–	–
Eritrea	2019	124 225	55.8	437 194	388 395	207 150	65 697	207 150	65 697
	2020	621 094	48.3	466 238	505 675	118 350	73 419	118 350+	73 419
	2021	69 347	41.8	444 318	437 525	89 680	42 056	89 680	42 056
Eswatini	2019	–	–	15 066	72 369	586	586	516	580
	2020	–	–	53 517	104 325	279	316	270	316
	2021	–	–	67 346	52 400	484	606	474	606
Ethiopia	2019	15 754 582	26.2	7 782 034	8 190 815	11 931 656	1 015 792	5 070 567	836 293
	2020	6 517 480	25.7	6 349 834	7 055 575	17 135 346*	1 458 804	7 258 381+	1 197 131
	2021	7 897 450	14.6	6 690 048	7 004 725	7 090 882	1 144 562	5 725 330	1 126 731
Gabon	2019	3 000	15.6	–	250	117 126	117 126	117 126	117 126
	2020	–	14.7	–	1 250	30 819$	30 819	30 819#	30 819
	2021	–	13.8	–	38 093	255 700	255 700	103 866	103 866

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AFRICAN									
Gambia	2019	1 115 780	60.6	507 872	505 895	66 899	53 386	66 899	53 385
	2020	71 469	53.9	477 032	525 505	90 603[$]	72 300	90 603[+]	72 300
	2021	262 065	47.6	423 511	773 375	151 189	72 247	151 045	72 247
Ghana	2019	2 924 717	78.9	1 986 408	12 866 700	4 208 875	6 164 160	4 208 875	6 164 160
	2020	2 957 388	59.0	2 214 552	–	7 037 451*	5 174 075	7 037 451[+]	5 174 075
	2021	17 845 229	63.8	2 128 109	10 663 060	5 948 832	5 728 505	5 948 832	5 728 505
Guinea	2019	8 964 940	69.6	–	2 857 744	2 053 442	1 646 493	2 053 442	1 646 493
	2020	837 395	76.0	–	–	2 187 117[$]	1 831 203	2 187 117[+]	1 792 653
	2021	945 879	49.9	–	3 803 960	3 497 974	2 358 447	3 497 974	2 358 447
Guinea-Bissau	2019	102 586	37.7	–	325 690	155 848	155 848	140 478	140 478
	2020	1 294 976	24.8	–	–	152 900*	152 900	137 821[#]	137 821
	2021	73 488	21.7	–	–	168 720^	168 720	152 081[+]	152 081
Kenya	2019	1 797 075	61.2	2 011 860	4 179 875	8 285 622	5 259 988	7 247 430	5 004 487
	2020	1 349 895	46.2	1 792 495	7 223 850	9 293 158*	5 899 605	8 543 728[+]	5 899 605
	2021	17 912 956	57.4	2 083 177	5 930 410	4 428 207	3 618 614	4 169 317	3 618 614
Liberia	2019	197 736	60.5	–	536 915	2 108 721	1 004 895	2 108 721	732 322
	2020	–	26.1	–	–	1 790 171[$]	621 695	1 790 171[+]	621 695
	2021	2 943 429	59.1	–	2 158 290	785 485	835 087	785 485	785 485
Madagascar	2019	1 078 541	66.8	1 640 183	2 899 007	975 587	1 008 480	975 587	1 008 480
	2020	1 720 923	49.8	981 936	1 950 471	1 613 457[$]	1 667 856	1 613 457	1 667 856
	2021	13 669 688	57.3	885 814	4 345 213	1 918 587	1 947 787	1 918 587	1 921 755
Malawi	2019	1 064 495	71.1	1 456 138	–	6 638 406	5 089 716	6 638 406	5 089 716
	2020	926 690	43.2	2 379 659	16 258 123	7 957 086[$]	7 095 977	7 957 086[+]	7 095 977
	2021	9 134 777	54.1	2 407 351	–	8 433 158	6 723 831	8 433 158	6 723 831
Mali	2019	4 005 010	74.5	690 793	3 656 317	5 543 127	2 846 438	5 543 127	2 826 112
	2020	8 680 286	84.5	503 043	2 927 529	3 516 929	2 629 557	3 516 929	1 793 074
	2021	3 113 190	85.1	233 663	3 267 184	1 924 709	3 153 865	1 924 709	2 126 004
Mauritania	2019	22 470	10.4	–	–	–	–	–	–
	2020	1 632 858	24.6	–	–	760[$]	760	760[#]	760
	2021	10 029	43.1	–	–	439 943	342	20 760	342
Mayotte	2019	–	–	–	–	–	–	–	–
	2020	–	–	–	–	–	–	–	–
	2021	–	–	–	–	–	–	–	–
Mozambique	2019	6 614 068	52.8	6 303 792	21 365 400	16 867 851	10 742 632	16 867 851	10 742 632
	2020	24 534 223	65.3	6 880 851	21 425 892	17 808 682	11 132 323	17 808 682	11 132 323
	2021	1 606 570	59.6	6 484 733	24 986 825	18 756 461	9 979 416	18 756 461	9 979 416
Namibia	2019	–	–	149 306	247 425	3 404	3 404	3 404	3 404
	2020	–	–	1 017 366	–	13 636^	13 636	13 636[#]	13 636
	2021	–	–	191 819	–	13 738	13 738	13 738	13 738
Niger	2019	1 427 735	76.6	–	5 831 287	3 211 243	3 015 081	3 211 243	3 015 081
	2020	8 595 289	84.3	–	–	3 678 980[$]	3 350 428	3 678 980[+]	3 350 428
	2021	5 356 900	89.2	–	689 230	5 064 124	3 251 475	5 064 124	3 251 475
Nigeria	2019	32 360 674	48.0	–	26 312 300	38 240 771	21 252 650	38 240 771	21 252 650
	2020	33 619 587	44.6	–	15 593 375	17 892 696	19 902 369	17 892 696	19 902 369
	2021	16 401 333	51.0	–	40 314 426	40 314 426	34 236 521	40 314 426	34 236 521
Rwanda	2019	536 637	40.1	4 532 103	4 904 370	4 231 880	3 566 544	4 215 120	3 545 251
	2020	6 218 906	60.1	4 951 899	–	1 243 100[$]	1 048 450	1 243 100[+]	1 048 450
	2021	753 171	65.4	5 070 159	–	262 633	221 509	259 921	219 221
Sao Tome and Principe	2019	16 260	–	53 401	221 450	2 457	2 457	2 457	2 457
	2020	11 107	–	69 902	–	1 772	1 772	1 772[#]	1 772
	2021	8 143	–	27 174	156 757	2 515	2 515	2 515	2 515
Senegal	2019	9 373 577	62.7	51 652	2 552 381	1 073 464	354 708	971 497	339 598
	2020	581 648	82.4	793 026	3 324 538	1 347 665[$]	445 313	1 347 665	442 413
	2021	1 342 541	57.7	803 093	4 736 075	1 177 667	536 850	1 177 667	520 738

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AFRICAN									
Sierra Leone	2019	492 622	49.5	–	3 930 606	4 751 000	2 813 086	4 751 000	2 404 286
	2020	4 807 339	68.1	–	429 467	1 302 117*	658 948	1 302 117+	658 948
	2021	452 249	69.6	629 659	–	6 706 736*	3 394 004	6 706 736+	3 394 004
South Africa	2019	–	–	1 477 420	879 625	10 592$	13 833	10 592	13 833
	2020	–	–	1 830 342	435 600	16 028$	20 190	16 028#	16 028
	2021	–	–	1 704 233	58 750	16 853$	16 853	16 853	16 853
South Sudan[1]	2019	713 717	33.6	344 242	–	4 308 214	122 665	4 308 214	122 665
	2020	4 273 644	52.5	–	280 150	220 548	822 563	195 878	822 563
	2021	1 685 771	59.3	263 856	–	1 618 709^	1 618 709	1 618 709#	1 618 709
Togo	2019	407 911	65.7	–	2 957 298	2 889 270	2 284 746	1 499 012	2 266 412
	2020	6 265 275	83.8	–	–	2 169 770$	1 729 667	1 134 827	1 715 787
	2021	453 410	88.9	–	–	1 401 474*	1 772 292	732 995+	1 099 350
Uganda	2019	1 855 163	60.6	4 478 754	30 979 775	17 706 390	28 847 873	17 706 390	9 728 920
	2020	25 700 519	69.8	4 671 960	36 746 550	26 674 975*	30 962 280	26 674 975+	14 656 782
	2021	1 410 031	74.5	4 466 905	–	31 746 773	13 522 685	31 746 773	14 772 475
United Republic of Tanzania[2]	2019	6 968 606	53.8	2 989 048	26 058 455	8 487 473	6 385 075	8 485 301	6 385 075
	2020	19 684 506	56.1	2 510 463	41 180 225	22 636 877*	7 759 228	10 314 557+	7 759 228
	2021	8 264 964	50.7	2 869 266	27 850 825	11 665 860	5 874 588	11 665 860	5 868 238
Mainland	2019	6 745 132	–	2 507 920	25 699 255	8 479 635	6 378 890	8 479 635	6 378 890
	2020	19 386 472	–	2 285 089	40 821 350	10 314 557*	7 759 228	10 314 557+	7 759 228
	2021	7 513 065	–	2 655 998	27 850 825	11 665 860	5 868 238	11 665 860	5 868 238
Zanzibar	2019	223 474	–	481 128	359 200	7 838	6 963	5 666	6 185
	2020	298 034	–	225 374	358 875	4 900	–	–	–
	2021	751 899	–	213 268	–	–	6 350	–	–
Zambia	2019	1 024 635	48.2	11 767 404	17 737 525	19 134 471	19 134 471	19 134 471	19 134 471
	2020	6 179 374	45.3	11 157 421	28 988 900	7 473 255	7 473 255	7 473 255#	7 473 255
	2021	12 147 773	57.0	9 480 413	37 006 526	21 379 380	21 379 380	21 379 380	21 379 380
Zimbabwe	2019	2 160 175	37.8	3 164 344	1 445 007	2 446 203	304 309	2 446 203	304 309
	2020	727 377	40.3	3 528 051	2 932 248	443 164$	443 164	443 164#	443 164
	2021	1 227 112	36.4	3 113 471	2 289 531	133 926	133 926	133 926	133 926
AMERICAS									
Belize	2019	0	–	43 497	–	2	2	0	0
	2020	0	–	45 100	0	0	0	0	0
	2021	5 753	–	42 901	–	0	0	0	0
Bolivia (Plurinational State of)	2019	27 000	–	29 228	36 800	9 357	9 357	9 357	9 357
	2020	91 700	–	29 228	–	12 093$	12 093	12 093#	12 093
	2021	23 500	–	–	–	9 959	9 959	9 959	9 959
Brazil	2019	–	–	84 126	102 275	491 126	491 126	74 360	74 360
	2020	173 850	–	148 897	148 200	172 047	172 047	23 691#	23 691
	2021	144 250	–	202 715	154 050	148 240	137 289	34 952#	34 952
Colombia	2019	336 432	–	141 000	25 000	80 418	39 891	39 891	39 891
	2020	336 432	–	242 748	153 867	81 368	39 879	39 879	39 879
	2021	208 296	–	245 984	95 867	73 974	36 531	36 531	36 531
Costa Rica	2019	–	–	–	–	–	–	–	–
	2020	–	–	6 895	5 175	141^	141	–	–
	2021	3 300	–	27 756	–	504^	504	12#	12
Dominican Republic	2019	–	–	35 220	55 000	1 314	1 314	7	7
	2020	11 500	–	37 211	–	829^	829	–	–
	2021	28 500	–	107 375	–	291^	291	–	–
Ecuador	2019	31 271	–	698 292	73 425	5 030	1 909	2 650	265
	2020	4 983	–	17 276	41 968	5 272*	2 001	2430+	243
	2021	43 159	–	1 435 556	54 450	5 380	2 450	1 493	499

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AMERICAS									
French Guiana	2019	–	–	–	–	–	–	–	–
	2020	–	–	–	–	–	–	–	–
	2021	–	–	–	–	–	–	–	–
Guatemala	2019	128 982	–	4 091	61 275	2^	2	2#	2
	2020	197 944	–	13 386	–	1 233*	1 058	–	–
	2021	381 291	–	12 401	161 675	1 265	1 265	0	0
Guyana	2019	1 759	–	–	37 800	20 313	20 313	7 052	7 052
	2020	1 816	–	–	22 175	32 958	32 958	13 980	13 980
	2021	95 058	–	–	26 622	36 844	36 844	14 010	14 010
Haiti	2019	19 063	–	–	293 200	10 418	10 418	–	–
	2020	971 530	–	–	–	21 856	21 856	–	–
	2021	19 858	–	–	–	9 513	9 513	–	–
Honduras	2019	32 091	–	335 928	18 754	383	–	45#	45
	2020	20 760	–	181 715	10 350	913	–	12#	12
	2021	18 863	–	124 554	14 605	1 657	–	12#	12
Mexico	2019	19 001	–	83 581	–	631	641	12	12
	2020	13 301	–	72 759	–	369	369	0	0
	2021	17 673	–	142 618	4 500	275	275	0	0
Nicaragua	2019	228 589	–	139 795	63 500	35 649	13 226	57	–
	2020	61 520	–	226 731	–	68 813*	25 530	702	–
	2021	61 766	–	47 948	–	23 323	8 653	1 521	–
Panama	2019	4 337	–	12 806	30 725	–	–	3	3
	2020	–	–	12 492	2 500	1 538	1 582	5	5
	2021	–	–	20 719	40 000	3 539	3 539	0	0
Peru	2019	–	–	59 438	204 000	51 289	51 289	4 724	4 724
	2020	93 067	–	–	–	34 721*	34 721	3 198#	3 198
	2021	20 267	–	–	–	18 140	18 140	3 595+	3 595
Suriname	2019	6 847	–	–	20 625	202	202	202	202
	2020	6 864	–	–	17 250	236^	236	127#	127
	2021	10 059	–	–	14 625	76	76	8	8
Venezuela (Bolivarian Republic of)	2019	249 411	–	–	250 000	398 285	398 285	90 153	90 153
	2020	73 605	–	–	115 417	231 384^	231 384	48 292#	48 292
	2021	36 362	–	–	257 626	194 057	194 057	32 582	32 582
EASTERN MEDITERRANEAN									
Afghanistan	2019	1 336 070	–	–	714 700	180 992\$	169 504	180 992	118 145
	2020	3 140 845	–	–	337 840	153 403\$	103 466	153 403+	100 136
	2021	195 273	–	–	468 330	11 681\$	84 873	11 681	84 817
Djibouti	2019	218 650	21.0	37 663	335 625	148 890	47 691	148 890	47 691
	2020	145 392	12.2	28 496	268 147	215 507*	69 029	215 507+	69 029
	2021	19 984	10.4	116 961	100 000	76 380	56 081	76 380	56 081
Iran (Islamic Republic of)	2019	–	–	59 869	7 737		1 192	8 139	158
	2020	10 543	–	73 846	–		1 051	6 491+	126
	2021	6 044	–	47 762	25 025	2 856	999	2 856	151
Pakistan	2019	2 413 275	–	1 657 670	3 895 000	290 170	413 533	57 781	90 178
	2020	1 515 426	–	120 610	3 616 500	428 738	347 500	99 425	347 500
	2021	147 880	–	307 272	3 721 655	422 798	365 626	123 617	87 825
Saudi Arabia	2019	–	–	225 510	135 000	25 000	2 152	15 000	1 515
	2020	–	–	129 105	165 000	37 930*	3 265	31 990+	3 231
	2021	–	–	95 754	165 000	30 390*	2 616	20 030+	2 023
Somalia	2019	388 766	18.0	82 720	974 700	174 030	38 112	174 030	38 112
	2020	1 565 552	20.6	283 665	554 500	109 490\$	23 978	109 490	27 333
	2021	79 895	21.0	80 622	647 500	180 840	–	180 840	–

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EASTERN MEDITERRANEAN									
Sudan	2019	9 288 816	59.8	3 886 652	7 246 975	4 297 167	4 297 167	4 297 167	4 297 167
	2020	5 003 295	59.8	3 901 092	4 849 600	69 300 703	4 863 826	69 300 703	4 863 826
	2021	791 079	58.5	3 870 477	2 590 000	7 343 701	3 708 843	7 373 701	3 700 843
Yemen	2019	612 884	–	1 982 284	907 425	458 103	–	42 698	–
	2020	855 693	–	762 755	–	–	–	–	–
	2021	1 769 759	–	1 499 738	–	–	–	–	–
SOUTH-EAST ASIA									
Bangladesh	2019	727 253	–	98 786	756 573	17 225	17 225	15 099	15 099
	2020	1 316 909	–	–	805 166	6 130	6 130	4 885[#]	4 885
	2021	961 156	–	–	823 336	7 294	7 294	5 340	5 340
Bhutan	2019	13 906	–	118 730	29 100	235	42	235	11
	2020	122 670	–	122 406	42 675	–	54	31[+]	8
	2021	13 294	–	120 166	28 345	656	23	0	5
Democratic People's Republic of Korea	2019	30 928	–	–	458 743	4 000	1 869	–	–
	2020	–	–	402 861	354 097	3 893*	1 819	–	–
	2021	–	–	–	–	2 357	1 101	–	–
India	2019	22 410 000	–	30 363 425	–	12 641 952	338 494	12 641 952	338 494
	2020	25 221 045	–	23 950 862	20 000 000	4 447 618[$]	186 532	4 447 618[+]	119 087
	2021	16 197 740	–	16 159 858	–	335 062	161 753	335 062	101 566
Indonesia	2019	200 990	–	164 192	1 980 775	1 174 186	234 381	1 174 186	234 381
	2020	3 448 169	–	38 332	613 300	1 208 253[$]	241 181	1 208 253[+]	241 181
	2021	50 350	–	131 818	2 894 125	3 583 329	299 148	3 583 329	299 148
Myanmar	2019	11 046 312	–	4 361	2 652 010	51 779	53 003	51 779	23 623
	2020	569 016	–	17 381	2 944 555	34 132[$]	15 572	34 132[+]	15 572
	2021	160 688	–	–	–	33 157*	15 127	33 157[+]	15 127
Nepal	2019	162 409	–	263 000	205 636	13 621	710	3 522	63
	2020	72 561	–	41 235	202 300	8 249*	430	2 180[+]	39
	2021	134 085	–	43 500	325 075	15 647	391	9 539	92
Thailand	2019	80 000	–	489 105	303 613	31 276	3 904	11 976	536
	2020	102 150	–	219 162	69 912	26 766*	3 341	3 910[+]	175
	2021	130 873	–	159 097	144 925	361 459	3 254	4 505	86
Timor-Leste	2019	97 586	–	175 654	249 750	1 070	9	1 070	9
	2020	176 785	–	116 949	137 668	1 664*	14	1 664[+]	14
	2021	52 886	–	76 574	122 955	0	0	0	0

ANNEX 4 – D. COMMODITIES DISTRIBUTION AND COVERAGE, 2019–2021

WHO region Country/area	Year	No. of LLINs delivered	Modelled percentage of population with access to an ITN	No. of people protected by IRS	No. of RDTs distributed	Any first-line treatment courses delivered (including ACT)	No. of malaria cases treated with any first-line treatment courses (including ACT)	ACT treatment courses delivered	No. of malaria cases treated with ACT
WESTERN PACIFIC									
Cambodia	2019	555 962	–	–	923 375	98 965	31 883	98 965	31 883
	2020	1 205 286	–	–	1 069 200	37 143	9 176	37 143	9 176
	2021	603 528	–	–	851 240	100 483	4 270	100 483	4 270
Lao People's Democratic Republic	2019	1 085 527	–	3 333	1 371 367	21 071	6 551	21 071	6 550
	2020	100 518	–	2 333	1 667 795	11 251*	3 498	11 185[+]	3 477
	2021	46 353	–	5 606	749 710	16 252	3 852	16 252	3 870
Malaysia	2019	112 054	–	323 208	–	3 933	3 933	3 933	3 923
	2020	123 115	–	305 688	–	2 830	2 830	2 829[#]	2 829
	2021	119 584	–	324 018	–	3 676	3 676	3 663	3 663
Papua New Guinea	2019	1 476 976	–	–	2 454 525	1 323 042	788 796	1 323 042	788 796
	2020	1 579 301	–	200	3 139 420	1 258 396[$]	750 439	1 258 396	750 254
	2021	1 626 031	–	–	3 398 965	1 368 984	1 324 753	2 222 000	1 324 753
Philippines	2019	695 691	–	731 696	370 700	49 359	5 435	16 857	4 845
	2020	329 412	–	476 804	77 645	54 372*	5 987	20 830[+]	4 890
	2021	205 704	–	497 569	262 895	36 318	3 999	15 910	3 735
Republic of Korea	2019	–	–	–	20 000	196	196	–	–
	2020	–	–	–	–	386^	385	–	–
	2021	–	–	–	–	294	294	–	–
Solomon Islands	2019	297 010	–	–	484 750	230 880	83 733	230 880	83 364
	2020	7 530	–	–	275 000	239 064[$]	87 477	239 064[+]	86 319
	2021	182 926	–	–	–	328587[$]	118 643	328 587	118 643
Vanuatu	2019	80 623	–	–	4 490	7 235	571	579	571
	2020	–	–	–	59 825	6 285*	496	503[+]	496
	2021	37 090	–	–	2 164	42 501	304	42 501	304
Viet Nam	2019	31 740	–	696 751	472 173	31 348	5 892	27 704	3 134
	2020	53 155	–	433 405	531 795	9 220*	1 733	7 231[+]	818
	2021	1 486 700	–	262 297	389 745	9 569	1 799	193	–

Data as of 1 November 2022

ACT: artemisinin-based combination therapy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; LLIN: long-lasting insecticidal net; RDT: rapid diagnostic test; WHO: World Health Organization.

"–" refers to data not available.

[1] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

[2] Where national data for the United Republic of Tanzania are unavailable, refer to Mainland and Zanzibar.

* Any first-line courses delivered (including ACT) are calculated.

^ The number of malaria cases treated with any first-line treatment courses (including ACT) has been used as a proxy for any first-line treatment courses delivered (including ACT), or the country reports the number of patients treated rather than the number of treatment courses delivered.

[$] ACT treatment courses delivered are used to replace missing data for any first-line treatment courses delivered (including ACT).

[+] ACT treatment courses delivered are calculated.

[#] The number of malaria cases treated with ACT has been used as a proxy for ACT treatment courses delivered, or the country reports the number of patients treated rather than the number of treatment courses delivered.

Note: Similar adjustments were made for 2019 where deliveries of first-line treatment courses and ACT were missing.

ANNEX 4 – Ea. HOUSEHOLD SURVEY RESULTS, 2017–2021, COMPILED BY STATCOMPILER

WHO region Country/area	Source	% of households					% of population	
		with at least one ITN	with at least one ITN for every two persons who stayed in the household the previous night	with IRS in the past 12 months	with at least one ITN and/or IRS in the past 12 months	with at least one ITN for every two persons and/or IRS in the past 12 months	with access to an ITN	who slept under an ITN last night
AFRICAN								
Benin	2017–18 DHS	91.5	60.5	8.7	92.0	63.8	77.2	71.1
Burkina Faso	2017–18 MIS	75.3	32.8	–	–	–	54.5	44.1
Cameroon	2018 DHS	73.4	40.7	–	–	–	58.5	53.9
Gambia	2019–20 DHS	77.3	36.3	–	–	–	60.8	37.8
Ghana	2019 MIS	73.7	51.8	5.8	75.0	54.7	66.7	43.2
Guinea	2018 DHS	43.9	16.7	–	–	–	30.7	22.7
Guinea	2021 MIS	63.3	22.0	–	–	–	41.9	33.4
Kenya	2020 MIS	49.0	28.7	–	–	–	39.6	34.9
Liberia	2019–20 DHS	54.7	25.2	–	–	–	39.7	39.0
Madagascar	2021 DHS	69.1	30.1	–	–	–	48.4	48.8
Malawi	2017 MIS	82.1	41.7	–	–	–	63.1	55.4
Mali	2018 DHS	89.8	54.8	–	–	–	75.2	72.9
Mauritania	2019–21 DHS	32.2	8.0	–	–	–	19.5	10.9
Mozambique	2018 MIS	82.2	51.2	–	–	–	68.5	68.4
Nigeria	2018 DHS	60.6	29.8	–	–	–	47.5	43.2
Rwanda	2017 MIS	84.1	55.1	19.6	89.2	66.9	71.9	63.9
Rwanda	2019–20 DHS	66.4	34.3	–	–	–	50.8	47.7
Senegal	2017 DHS	84.2	50.4	4.2	84.5	52.3	72.8	56.9
Senegal	2018 DHS	76.6	39.0	2.1	76.8	40.1	62.2	51.6
Senegal	2019 DHS	81.0	56.8	2.4	81.5	57.7	74.2	62.5
Senegal	2020–21 MIS	75.3	33.8	3.3	76.3	36.1	57.8	46.4
Sierra Leone	2019 DHS	67.9	25.0	–	–	–	46.8	50.6
United Republic of Tanzania	2017 MIS	77.9	45.4	–	–	–	62.5	52.2
Togo	2017 MIS	85.2	71.4	–	–	–	82.3	62.5
Uganda	2018–19 MIS	83.0	53.9	10.1	84.2	58.7	71.5	59.2
Zambia	2018 DHS	78.3	40.9	35.3	83.3	60.4	59.9	46.4

% of ITNs	% of pregnant women		% of children <5 years				% of children <5 years with fever in the past 2 weeks			
that were used last night	who slept under an ITN	who took 3+ doses of IPTp	who slept under an ITN	with moderate or severe anaemia	with a positive RDT	with a positive microscopy blood smear	for whom advice or treatment was sought	who had blood taken from a finger or heel for testing	who took antimalarial drugs	who took an ACT among those who received any antimalarial
73.4	79.3	13.7	76.3	43.8	36.3	39.1	53.1	17.7	17.5	37.0
76.0	58.2	57.7	54.4	50.1	20.2	16.9	73.5	48.8	51.1	79.4
76.2	61.0	31.9	59.8	31.0	24.0	–	61.0	21.4	32.7	21.2
55.0	44.2	52.2	44.0	20.7	0.4	–	64.2	27.3	3.5	46.7
50.1	48.7	61.0	54.1	27.9	23.0	14.1	69.0	34.1	45.9	84.5
64.0	28.1	35.7	26.6	43.8	–	–	62.3	20.5	24.8	18.2
72.0	39.4	50.3	38.2	45.5	33.7	17.4	61.1	28.0	31.4	38.0
80.2	39.8	22.0	42.0	21.3	4.4	3.0	63.6	35.5	20.2	91.0
74.7	46.5	40.3	44.3	41.6	–	–	80.9	49.0	52.1	41.2
77.3	54.9	31.0	55.6	20.2	7.5	–	44.6	19.9	15.3	54.7
76.8	62.5	41.1	67.5	37.1	36.0	24.3	54.4	37.6	29.4	96.4
88.7	83.7	28.3	79.1	56.7	18.9	–	52.8	16.4	18.7	31.0
42.0	11.7	10.2	11.9	54.9	1.1	–	31.4	5.8	15.3	19.0
85.4	76.4	40.6	72.7	55.2	38.9	–	68.6	47.9	32.7	98.6
80.6	58.0	16.6	52.2	41.1	36.2	22.6	72.8	13.8	43.5	52.0
71.0	68.5	–	68.0	–	11.8	7.2	55.6	38.1	19.6	98.7
78.0	56.1	–	55.6	15.2	2.7	0.9	62.3	40.7	8.1	92.4
68.6	61.8	22.0	60.7	41.8	0.9	0.4	51.4	16.1	4.7	65.5
74.5	55.7	22.4	56.4	–	–	–	52.8	13.8	5.1	24.0
68.2	68.1	19.6	65.4	–	–	–	50.0	15.7	1.4	–
81.4	52.5	37.7	46.5	67.3	–	–	63.0	21.7	2.7	1.7
89.5	63.8	35.7	59.1	37.9	–	–	75.4	61.3	55.9	31.9
66.7	51.4	25.8	54.6	30.5	7.3	–	75.4	43.1	36.2	89.4
52.3	69.0	41.7	69.7	47.8	43.9	28.3	55.9	29.3	31.1	76.3
74.3	65.4	41.0	60.3	25.0	18.2	9.8	87.0	50.7	62.5	87.7
64.2	48.9	58.7	51.6	29.5	–	–	77.2	63.0	34.9	96.9

ANNEX 4 – Ea. HOUSEHOLD SURVEY RESULTS, 2017–2021, COMPILED BY STATCOMPILER

WHO region Country/area	Source	% of households					% of population	
		with at least one ITN	with at least one ITN for every two persons who stayed in the household the previous night	with IRS in the past 12 months	with at least one ITN and/or IRS in the past 12 months	with at least one ITN for every two persons and/or IRS in the past 12 months	with access to an ITN	who slept under an ITN last night
EASTERN MEDITERRANEAN								
Jordan	2017–18 DHS	–	–	–	–	–	–	–
Pakistan	2017–18 DHS	3.6	0.6	5.1	8.4	5.7	2.0	0.2
SOUTH-EAST ASIA								
India	2019–21 DHS	7.9	4.0	–	–	–	5.8	3.8
WESTERN PACIFIC								
Papua New Guinea	2016–18 DHS	68.5	45.2	–	–	–	57.9	46.0
Philippines	2017 DHS	–	–	–	–	–	–	–

ACT: artemisinin-based combination therapy; DHS: demographic and health survey; IPTp: intermittent preventive treatment of malaria in pregnancy; IRS: indoor residual spraying; ITN: insecticide-treated mosquito net; MIS: malaria indicator survey; RDT: rapid diagnostic test; WHO: World Health Organization.

"–" refers to not applicable or data not available.

Sources: Nationally representative household survey data from DHS and MIS, compiled through STATcompiler – https://www.statcompiler.com/.

% of ITNs	% of pregnant women		% of children <5 years				% of children <5 years with fever in the past 2 weeks			
that were used last night	who slept under an ITN	who took 3+ doses of IPTp	who slept under an ITN	with moderate or severe anaemia	with a positive RDT	with a positive microscopy blood smear	for whom advice or treatment was sought	who had blood taken from a finger or heel for testing	who took antimalarial drugs	who took an ACT among those who received any antimalarial
–	–	–	–	10.6	–	–	68.4	–	–	–
11.6	0.4	–	0.4	–	–	–	81.4	–	9.2	3.3
58.5	4.2	–	4.4	38.8	–	–	79.9	13.6	25.2	6.0
67.9	49.0	23.5	51.5	–	–	–	49.5	24.6	21.3	3.3
–	–	–	–	–	–	–	54.5	–	–	–

Data as of 24 October 2022

ANNEX 4 - Eb. HOUSEHOLD SURVEY RESULTS, 2017–2021, COMPILED THROUGH WHO CALCULATIONS

WHO region Country	Survey	Fever prevalence	Health sector where treatment was sought							Diagnostic testing coverage in each health sector	
		Overall	Public excluding community health workers	Community health workers	Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Informal private	No treatment seeking	Trained provider	Public excluding community health workers	Community health workers
AFRICAN											
Benin	2017 DHS	20 (18, 21)	22 (20, 24)	0 (0, 0)	9 (8, 11)	9 (8, 11)	14 (12, 16)	46 (43, 49)	40 (37, 43)	52 (47, 57)	–
Burkina Faso	2017 MIS	20 (19, 22)	71 (67, 75)	1 (0, 1)	1 (1, 4)	0 (0, 1)	2 (1, 3)	26 (22, 30)	73 (69, 76)	66 (61, 70)	–
Cameroon	2018 DHS	16 (14, 17)	20 (17, 23)	1 (0, 1)	12 (9, 15)	12 (9, 14)	21 (18, 24)	37 (33, 41)	43 (39, 47)	52 (44, 61)	–
Gambia	2019 DHS	15 (14, 17)	45 (41, 49)	0 (0, 1)	7 (5, 10)	13 (10, 16)	1 (0, 2)	35 (31, 39)	64 (60, 68)	42 (37, 48)	–
Ghana	2019 MIS	30 (27, 33)	34 (30, 38)	0 (0, 1)	20 (17, 24)	14 (10, 18)	3 (1, 5)	30 (26, 35)	67 (63, 71)	78 (72, 83)	–
Guinea	2021 MIS	23 (21, 25)	43 (37, 48)	4 (3, 6)	6 (4, 10)	5 (3, 7)	7 (5, 10)	38 (33, 43)	56 (51, 61)	54 (48, 60)	42 (26, 61)
Kenya	2020 MIS	17 (16, 19)	43 (36, 51)	0 (0, 1)	9 (6, 14)	11 (9, 15)	1 (0, 3)	36 (30, 42)	63 (57, 69)	60 (49, 70)	–
Liberia	2019 DHS	26 (23, 28)	39 (35, 44)	0 (0, 0)	14 (11, 17)	26 (22, 31)	7 (5, 9)	19 (16, 22)	76 (72, 79)	82 (77, 87)	–
Madagascar	2021 DHS	12 (11, 13)	35 (32, 38)	0 (0, 0)	8 (6, 10)	1 (0, 1)	2 (2, 3)	55 (51, 58)	43 (40, 47)	46 (41, 51)	–
Malawi	2017 MIS	40 (38, 43)	38 (34, 43)	3 (2, 5)	6 (4, 8)	2 (1, 4)	7 (5, 10)	46 (41, 51)	48 (43, 52)	76 (70, 82)	–
Mali	2018 DHS	16 (15, 17)	24 (21, 27)	3 (2, 5)	2 (1, 3)	7 (5, 9)	23 (19, 27)	42 (38, 46)	36 (33, 39)	46 (39, 53)	37 (22, 56)
Mauritania	2020 DHS	17 (16, 18)	25 (22, 28)	0 (0, 1)	2 (1, 3)	4 (3, 5)	2 (1, 2)	68 (65, 71)	31 (28, 34)	11 (8, 15)	–
Mozambique	2018 MIS	31 (28, 35)	64 (57, 70)	4 (2, 7)	0 (0, 1)	0 (0, 1)	1 (1, 3)	31 (26, 37)	68 (62, 73)	72 (67, 76)	41 (13, 76)
Nigeria	2018 DHS	24 (23, 25)	27 (25, 29)	1 (1, 1)	38 (36, 40)	5 (4, 6)	4 (3, 5)	26 (25, 28)	70 (68, 72)	35 (32, 38)	9 (4, 18)
Rwanda	2019 DHS	19 (18, 20)	44 (41, 46)	11 (9, 13)	5 (3, 6)	5 (4, 6)	1 (1, 2)	37 (34, 40)	62 (59, 65)	64 (59, 68)	68 (61, 75)
Senegal	2019 DHS	16 (14, 17)	42 (37, 47)	0 (0, 1)	3 (2, 4)	4 (2, 6)	2 (1, 4)	50 (44, 55)	48 (43, 53)	32 (26, 38)	–
Sierra Leone	2019 DHS	17 (16, 18)	66 (62, 69)	1 (1, 3)	2 (1, 3)	6 (5, 8)	1 (1, 2)	25 (22, 27)	74 (71, 77)	78 (74, 82)	31 (13, 58)
Togo	2017 MIS	24 (22, 27)	26 (22, 31)	5 (4, 8)	7 (5, 9)	3 (2, 5)	16 (12, 21)	43 (37, 49)	42 (37, 47)	78 (71, 84)	76 (60, 87)
Uganda	2018 MIS	27 (24, 30)	33 (29, 37)	7 (5, 9)	38 (34, 41)	12 (10, 15)	1 (1, 1)	13 (11, 15)	86 (84, 88)	84 (79, 88)	77 (68, 83)
United Republic of Tanzania	2017 MIS	21 (19, 22)	46 (43, 50)	0 (0, 1)	13 (11, 16)	17 (15, 20)	1 (1, 2)	25 (22, 28)	75 (71, 78)	66 (60, 71)	–
Zambia	2018 DHS	16 (15, 17)	69 (66, 72)	3 (2, 5)	4 (3, 6)	0 (0, 1)	1 (0, 2)	23 (20, 26)	76 (73, 79)	78 (73, 82)	83 (64, 93)

Notes:
The analysis is presented as: point estimate (95% confidence interval).
Figures with fewer than 30 children in the denominator were removed.
"–" refers to not applicable or data not available.

Diagnostic testing coverage in each health sector				Antimalarial treatment coverage in each health sector							ACT use among antimalarial treatment in each health sector		
Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Informal private	Trained provider	Public excluding community health workers	Community health workers	Formal medical private excluding pharmacies	Pharmacies or accredited drug stores	Self-treatment	No treatment seeking	Trained provider	Public	Private	Informal private
30 (23, 38)	9 (6, 14)	8 (5, 12)	37 (33, 40)	38 (34, 44)	–	34 (27, 41)	23 (17, 30)	12 (9, 17)	7 (5, 9)	34 (30, 37)	44 (36, 52)	31 (24, 39)	40 (26, 55)
–	–	25 (13, 42)	66 (61, 70)	69 (64, 73)	–	–	–	62 (37, 82)	10 (7, 14)	68 (64, 72)	80 (76, 83)	82 (54, 95)	–
54 (43, 65)	11 (7, 19)	8 (5, 15)	42 (36, 48)	58 (49, 66)	–	48 (38, 58)	33 (24, 43)	46 (38, 54)	12 (9, 16)	48 (43, 54)	25 (17, 35)	21 (15, 27)	15 (8, 27)
54 (33, 73)	27 (19, 36)	–	40 (35, 45)	5 (3, 8)	–	5 (1, 18)	6 (3, 14)	–	1 (0, 4)	5 (3, 7)	71 (51, 85)	–	–
30 (22, 39)	8 (4, 16)	3 (0, 28)	50 (45, 55)	63 (56, 70)	–	55 (46, 63)	57 (44, 69)	50 (24, 76)	18 (14, 24)	59 (54, 65)	88 (80, 93)	86 (77, 92)	–
35 (21, 52)	7 (2, 19)	7 (3, 18)	47 (42, 53)	55 (48, 61)	70 (49, 85)	26 (15, 42)	23 (12, 40)	24 (14, 38)	9 (6, 13)	50 (44, 56)	53 (46, 60)	53 (36, 70)	–
54 (33, 74)	5 (2, 13)	–	49 (41, 57)	4 (2, 9)	–	8 (3, 19)	4 (1, 15)	–	1 (0, 2)	5 (3, 8)	–	–	–
66 (54, 77)	25 (19, 32)	38 (25, 53)	60 (55, 65)	72 (67, 76)	–	62 (51, 72)	42 (31, 53)	76 (67, 83)	22 (17, 29)	59 (54, 64)	40 (33, 46)	47 (38, 56)	34 (19, 52)
26 (17, 37)	–	4 (1, 11)	42 (38, 46)	32 (27, 37)	–	13 (7, 22)	–	10 (7, 14)	6 (4, 9)	28 (24, 32)	55 (46, 63)	–	–
76 (61, 86)	10 (2, 38)	4 (1, 14)	73 (67, 78)	55 (48, 62)	–	55 (39, 69)	22 (4, 64)	21 (9, 41)	7 (5, 11)	54 (48, 61)	98 (94, 99)	97 (81, 99)	–
16 (5, 38)	8 (3, 17)	5 (3, 9)	36 (30, 42)	61 (54, 68)	56 (38, 72)	29 (11, 57)	17 (9, 30)	5 (2, 10)	4 (3, 6)	50 (44, 57)	35 (27, 43)	20 (9, 38)	–
25 (11, 49)	16 (7, 34)	2 (0, 14)	13 (10, 17)	48 (42, 54)	–	60 (22, 89)	51 (35, 66)	–	2 (2, 4)	49 (43, 55)	21 (15, 29)	15 (6, 35)	–
–	–	–	70 (65, 74)	47 (40, 53)	57 (44, 70)	–	–	–	10 (6, 17)	47 (41, 53)	98 (97, 99)	–	–
8 (6, 9)	11 (7, 16)	3 (1, 5)	18 (17, 20)	64 (61, 66)	57 (39, 73)	51 (48, 53)	37 (32, 43)	23 (17, 31)	19 (17, 21)	55 (53, 56)	54 (50, 57)	50 (46, 53)	35 (22, 50)
67 (54, 78)	31 (21, 42)	–	62 (58, 66)	9 (6, 12)	40 (32, 49)	10 (5, 20)	7 (3, 16)	–	1 (0, 2)	13 (11, 17)	92 (84, 97)	–	–
13 (4, 37)	10 (2, 37)	0 (0, 0)	29 (24, 35)	3 (2, 6)	–	0 (0, 0)	2 (0, 14)	–	0 (0, 0)	3 (2, 5)	–	–	–
78 (50, 93)	23 (13, 36)	18 (6, 44)	73 (69, 76)	73 (68, 77)	71 (39, 91)	81 (59, 92)	57 (44, 69)	46 (17, 77)	23 (18, 30)	72 (67, 76)	31 (27, 36)	33 (23, 45)	–
45 (31, 60)	5 (1, 25)	4 (2, 11)	66 (60, 72)	70 (60, 79)	83 (69, 91)	54 (37, 70)	32 (14, 57)	10 (5, 17)	7 (4, 10)	66 (59, 73)	82 (74, 88)	56 (38, 73)	–
48 (43, 53)	20 (15, 28)	34 (15, 60)	58 (54, 62)	72 (66, 76)	90 (84, 93)	72 (67, 77)	54 (42, 66)	–	30 (23, 37)	70 (66, 74)	89 (84, 93)	87 (82, 91)	–
76 (68, 83)	13 (8, 21)	–	55 (51, 60)	34 (28, 40)	–	49 (41, 57)	57 (48, 66)	–	24 (19, 30)	42 (36, 47)	96 (92, 98)	83 (73, 90)	–
79 (65, 89)	–	–	78 (73, 82)	42 (37, 47)	86 (72, 93)	54 (41, 67)	–	–	10 (7, 13)	44 (40, 49)	97 (95, 98)	94 (76, 99)	–

Data as of 24 October 2022

ACT: artemisinin-based combination therapy; DHS: demographic and health survey; MIS: malaria indicator survey; WHO: World Health Organization.

Sources: Nationally representative household survey data from DHS and MIS, compiled through WHO calculations.

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Algeria[1,2,3]	2000	1 807 701	–	34	–	–	2	–
	2001	1 832 745	–	6	–	–	1	–
	2002	1 857 634	–	10	–	–	0	–
	2003	1 882 962	–	5	–	–	0	–
	2004	1 909 648	–	2	–	–	0	–
	2005	1 935 875	–	1	–	–	0	–
	2006	1 963 976	–	1	–	–	0	–
	2007	1 996 210	–	26	–	–	0	–
	2008	2 030 617	–	3	–	–	0	–
	2009	2 067 415	–	0	–	–	0	–
	2010	2 106 201	–	1	–	–	1	–
	2011	2 146 567	–	1	–	–	0	–
	2012	2 188 685	–	55	–	–	0	–
	2013	2 232 156	–	8	–	–	0	–
	2014	2 276 772	–	0	–	–	0	–
	2015	2 322 764	–	0	–	–	0	–
	2016	2 369 532	–	0	–	–	0	–
	2017	2 416 360	–	0	–	–	0	–
	2018	2 462 792	–	0	–	–	0	–
	2019	2 508 513	–	0	–	–	0	–
	2020	2 552 350	–	0	–	–	0	–
	2021	2 595 013	–	0	–	–	0	–
Angola	2000	16 394 062	3 236 000	5 339 605	8 305 000	21 100	23 478	26 200
	2001	16 941 588	3 373 000	5 533 981	8 504 000	21 300	23 856	26 700
	2002	17 516 140	3 325 000	5 414 605	8 296 000	19 600	21 992	24 700
	2003	18 124 342	3 647 000	5 686 167	8 424 000	19 700	22 162	25 000
	2004	18 771 124	4 083 000	5 889 113	8 234 000	19 500	22 190	25 200
	2005	19 450 960	4 635 000	6 146 933	7 996 000	18 800	21 628	24 900
	2006	20 162 340	4 693 000	6 076 182	7 752 000	17 400	20 340	23 900
	2007	20 909 684	4 435 000	5 736 210	7 278 000	15 200	18 172	21 700
	2008	21 691 522	3 863 000	5 063 972	6 515 000	12 600	15 179	18 400
	2009	22 507 674	3 343 000	4 429 795	5 763 000	10 700	13 168	16 200
	2010	23 364 184	3 010 000	4 035 439	5 309 000	9 870	12 352	15 500
	2011	24 259 112	2 845 000	3 812 871	5 003 000	9 210	11 773	15 100
	2012	25 188 292	2 902 000	3 884 445	5 100 000	8 800	11 463	15 000
	2013	26 147 002	3 119 000	4 201 780	5 552 000	8 650	11 470	15 400
	2014	27 128 336	3 416 000	4 524 454	5 923 000	8 610	11 659	16 000
	2015	28 127 720	3 800 000	4 969 705	6 372 000	9 100	12 675	18 000
	2016	29 154 746	4 280 000	5 523 430	6 989 000	9 510	13 553	19 800
	2017	30 208 628	4 902 000	6 312 055	8 010 000	9 740	14 080	21 000
	2018	31 273 532	5 140 000	6 700 267	8 519 000	9 520	13 624	20 500
	2019	32 353 588	5 514 000	7 352 473	9 561 000	9 630	13 897	21 300
	2020	33 428 486	5 591 000	8 410 016	12 200 000	9 990	14 853	23 700
	2021	34 503 776	5 818 000	8 794 084	12 740 000	11 400	17 836	29 800
Benin	2000	6 998 023	2 153 000	2 886 309	3 813 000	7 030	7 420	7 840
	2001	7 212 041	2 389 000	3 107 278	3 960 000	7 250	7 662	8 100
	2002	7 431 783	2 620 000	3 371 811	4 264 000	8 220	8 693	9 200
	2003	7 659 208	2 826 000	3 601 326	4 523 000	9 200	9 748	10 300
	2004	7 894 554	3 088 000	3 859 662	4 763 000	10 500	11 134	11 800
	2005	8 149 419	3 266 000	4 026 128	4 910 000	11 500	12 180	12 900
	2006	8 402 631	3 366 000	4 140 781	5 049 000	12 300	13 078	13 900
	2007	8 647 761	3 456 000	4 220 168	5 116 000	11 600	12 342	13 100
	2008	8 906 469	3 413 000	4 183 971	5 108 000	10 100	10 790	11 500
	2009	9 172 514	3 225 000	4 032 019	5 026 000	8 870	9 491	10 100
	2010	9 445 710	3 027 000	3 862 955	4 873 000	8 110	8 694	9 320
	2011	9 726 380	2 862 000	3 703 932	4 723 000	7 840	8 429	9 060
	2012	10 014 078	2 831 000	3 650 774	4 614 000	8 290	8 942	9 640
	2013	10 308 730	2 912 000	3 753 591	4 731 000	9 210	9 973	10 800
	2014	10 614 844	3 056 000	3 917 119	4 932 000	9 680	10 522	11 400
	2015	10 932 783	3 398 000	4 260 585	5 273 000	10 500	11 546	12 600
	2016	11 260 085	3 833 000	4 721 694	5 784 000	10 700	11 849	13 000
	2017	11 596 779	3 919 000	4 876 484	5 953 000	9 790	10 854	12 000
	2018	11 940 683	3 843 000	4 872 597	6 058 000	9 320	10 428	11 700
	2019	12 290 444	3 806 000	4 937 253	6 291 000	9 160	10 454	11 900
	2020	12 643 123	3 327 000	4 781 051	6 563 000	8 870	10 585	12 700
	2021	12 996 895	3 541 000	4 983 668	6 875 000	8 590	11 154	14 400

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Botswana	2000	1 144 956	13 000	19 146	33 000	20	49	100
	2001	1 168 124	4 700	7 698	15 000	7	19	44
	2002	1 190 135	2 100	3 663	7 100	3	9	21
	2003	1 211 173	750	1 862	4 500	1	4	13
	2004	1 232 536	250	1 217	3 700	0	3	10
	2005	1 254 893	850	1 466	2 800	1	3	8
	2006	1 278 692	3 200	4 801	7 800	5	12	24
	2007	1 304 066	500	1 292	3 200	0	3	9
	2008	1 330 813	1 200	2 457	4 900	2	6	15
	2009	1 358 444	1 300	2 719	5 100	2	6	15
	2010	1 386 731	1 300	2 229	3 900	2	5	12
	2011	1 414 823	520	682	950	0	1	3
	2012	1 442 263	230	304	410	0	0	1
	2013	1 470 010	570	725	1 000	0	1	3
	2014	1 498 584	1 600	2 076	2 800	2	5	9
	2015	1 528 282	350	455	620	0	1	2
	2016	1 559 604	760	985	1 300	1	2	4
	2017	1 592 371	2 300	2 933	4 000	3	7	13
	2018	1 625 235	620	808	1 100	0	2	3
	2019	1 657 252	200	259	360	0	0	1
	2020	1 688 213	1 200	1 776	2 700	1	4	8
	2021	1 716 072	820	1 067	1 500	1	2	4
Burkina Faso	2000	11 882 888	5 672 000	7 121 621	8 835 000	35 600	37 845	40 300
	2001	12 249 764	5 865 000	7 346 774	9 048 000	38 200	40 660	43 400
	2002	12 632 269	6 023 000	7 513 033	9 196 000	36 500	38 905	41 600
	2003	13 030 591	6 110 000	7 615 906	9 373 000	35 200	37 642	40 300
	2004	13 445 977	6 050 000	7 546 925	9 280 000	32 900	35 229	37 800
	2005	13 876 127	5 819 000	7 363 398	9 204 000	30 300	32 505	34 900
	2006	14 316 242	5 772 000	7 347 269	9 212 000	29 300	31 512	33 900
	2007	14 757 074	6 064 000	7 693 631	9 614 000	30 100	32 545	35 100
	2008	15 197 915	6 759 000	8 386 574	10 290 000	32 800	35 534	38 500
	2009	15 650 022	7 147 000	8 932 652	10 950 000	28 800	31 446	34 300
	2010	16 116 845	7 399 000	9 194 223	11 260 000	32 800	36 142	39 700
	2011	16 602 651	7 455 000	9 242 057	11 290 000	31 400	34 912	38 700
	2012	17 113 732	7 380 000	9 159 529	11 230 000	25 200	28 346	31 900
	2013	17 636 408	6 941 000	8 620 220	10 590 000	23 800	27 175	31 100
	2014	18 169 842	6 535 000	8 132 937	10 000 000	20 200	23 619	27 600
	2015	18 718 020	6 210 000	7 848 131	9 775 000	18 400	21 940	26 200
	2016	19 275 498	5 351 000	7 215 226	9 555 000	16 900	20 625	25 200
	2017	19 835 858	4 906 000	7 093 584	10 000 000	16 200	20 228	25 500
	2018	20 392 724	4 892 000	7 280 725	10 380 000	14 500	18 482	24 100
	2019	20 951 640	5 064 000	7 472 680	10 750 000	14 700	19 228	25 900
	2020	21 522 626	5 375 000	8 122 685	11 720 000	14 300	21 402	33 100
	2021	22 100 684	5 527 000	8 326 915	12 050 000	13 400	18 976	28 000
Burundi	2000	6 307 659	2 059 000	2 828 604	3 815 000	10 500	11 340	12 300
	2001	6 465 729	2 118 000	2 817 680	3 708 000	9 690	10 469	11 400
	2002	6 648 938	2 053 000	2 777 742	3 656 000	8 500	9 186	9 970
	2003	6 860 846	1 984 000	2 699 483	3 594 000	7 660	8 268	8 970
	2004	7 120 496	1 809 000	2 453 417	3 258 000	6 550	7 064	7 650
	2005	7 388 874	1 711 000	2 307 035	3 045 000	5 700	6 117	6 600
	2006	7 658 190	1 554 000	2 161 939	2 903 000	5 320	5 699	6 130
	2007	7 944 609	1 316 000	1 891 093	2 611 000	5 150	5 512	5 920
	2008	8 278 109	1 164 000	1 694 813	2 379 000	5 160	5 529	5 960
	2009	8 709 366	1 046 000	1 532 448	2 181 000	5 140	5 530	5 970
	2010	9 126 605	1 050 000	1 544 609	2 198 000	5 080	5 470	5 930
	2011	9 455 733	1 089 000	1 560 776	2 191 000	4 810	5 187	5 630
	2012	9 795 479	1 163 000	1 628 919	2 219 000	4 660	5 048	5 510
	2013	10 149 577	1 275 000	1 778 478	2 420 000	4 500	4 899	5 390
	2014	10 494 913	1 368 000	1 916 653	2 607 000	4 530	4 990	5 560
	2015	10 727 148	1 543 000	2 144 520	2 908 000	4 650	5 198	5 910
	2016	10 903 327	1 856 000	2 526 223	3 358 000	5 090	5 851	6 890
	2017	11 155 593	2 050 000	2 794 830	3 720 000	5 230	6 125	7 390
	2018	11 493 472	2 477 000	3 315 862	4 379 000	4 600	5 299	6 320
	2019	11 874 838	2 531 000	3 549 058	4 887 000	4 600	5 315	6 420
	2020	12 220 227	2 352 000	3 708 079	5 573 000	4 640	5 792	7 810
	2021	12 551 213	2 280 000	3 657 985	5 557 000	4 700	5 957	8 240

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Cabo Verde[1,2]	2000	119 145	–	144	–	–	0	–
	2001	121 149	–	107	–	–	0	–
	2002	123 040	–	76	–	–	2	–
	2003	124 823	–	68	–	–	4	–
	2004	126 511	–	45	–	–	4	–
	2005	128 135	–	68	–	–	2	–
	2006	129 709	–	80	–	–	8	–
	2007	131 230	–	18	–	–	2	–
	2008	132 687	–	35	–	–	2	–
	2009	134 065	–	65	–	–	2	–
	2010	135 515	–	47	–	–	1	–
	2011	137 155	–	7	–	–	1	–
	2012	138 804	–	1	–	–	0	–
	2013	140 384	–	22	–	–	0	–
	2014	141 979	–	26	–	–	1	–
	2015	143 563	–	7	–	–	0	–
	2016	145 182	–	49	–	–	1	–
	2017	146 888	–	423	–	–	2	–
	2018	148 512	–	2	–	–	0	–
	2019	150 027	–	0	–	–	0	–
	2020	151 486	–	0	–	–	0	–
	2021	152 860	–	0	–	–	0	–
Cameroon	2000	15 091 594	4 858 000	6 133 781	7 672 000	15 100	16 029	17 000
	2001	15 493 253	5 102 000	6 421 751	7 948 000	15 000	15 962	17 000
	2002	15 914 033	5 212 000	6 530 590	8 124 000	16 200	17 289	18 400
	2003	16 354 326	5 515 000	6 910 604	8 574 000	16 800	17 958	19 200
	2004	16 809 408	5 789 000	7 231 963	8 913 000	17 800	19 026	20 400
	2005	17 275 172	5 792 000	7 297 108	9 106 000	18 400	19 704	21 100
	2006	17 751 332	5 557 000	7 222 479	9 224 000	18 200	19 474	20 900
	2007	18 251 866	5 298 000	7 031 151	9 201 000	16 600	17 798	19 100
	2008	18 777 080	4 832 000	6 574 374	8 732 000	14 600	15 635	16 700
	2009	19 319 274	4 370 000	5 936 562	7 877 000	13 300	14 198	15 200
	2010	19 878 036	4 249 000	5 688 134	7 415 000	12 200	13 110	14 000
	2011	20 448 872	4 124 000	5 451 139	7 021 000	11 300	12 048	12 900
	2012	21 032 684	4 070 000	5 418 988	7 102 000	11 200	12 056	12 900
	2013	21 632 850	4 161 000	5 667 877	7 535 000	11 400	12 197	13 100
	2014	22 299 584	4 234 000	5 825 479	7 800 000	11 600	12 438	13 400
	2015	23 012 646	4 386 000	5 996 035	8 053 000	12 000	12 932	14 000
	2016	23 711 630	4 604 000	6 126 789	8 036 000	12 600	13 698	15 000
	2017	24 393 180	4 720 000	6 151 314	7 931 000	12 400	13 736	15 200
	2018	25 076 748	4 711 000	6 218 960	8 007 000	11 500	12 898	14 500
	2019	25 782 340	4 526 000	6 246 049	8 397 000	11 300	12 792	14 600
	2020	26 491 088	4 187 000	6 601 170	9 884 000	11 900	14 505	17 900
	2021	27 198 628	4 301 000	6 665 957	10 060 000	11 200	13 839	17 300
Central African Republic	2000	3 759 170	1 089 000	1 661 418	2 411 000	6 780	7 525	8 340
	2001	3 844 773	1 104 000	1 668 386	2 458 000	6 920	7 709	8 580
	2002	3 930 648	1 142 000	1 707 571	2 459 000	7 040	7 862	8 820
	2003	4 026 841	1 216 000	1 767 275	2 491 000	7 470	8 391	9 480
	2004	4 115 138	1 289 000	1 837 290	2 530 000	7 750	8 777	10 000
	2005	4 208 834	1 297 000	1 872 113	2 610 000	8 170	9 367	10 800
	2006	4 294 352	1 294 000	1 889 964	2 649 000	8 630	10 017	11 800
	2007	4 375 569	1 270 000	1 891 580	2 726 000	8 410	9 890	11 800
	2008	4 467 233	1 203 000	1 888 773	2 848 000	7 710	9 181	11 200
	2009	4 564 540	1 116 000	1 869 529	2 926 000	7 220	8 749	10 900
	2010	4 660 067	1 034 000	1 843 530	3 071 000	6 540	8 125	10 300
	2011	4 732 022	987 000	1 825 670	3 070 000	5 710	7 279	9 470
	2012	4 773 306	987 000	1 802 996	3 000 000	5 590	7 343	9 840
	2013	4 802 428	995 000	1 782 614	2 992 000	5 050	6 813	9 450
	2014	4 798 734	971 000	1 740 283	2 919 000	4 800	6 684	9 590
	2015	4 819 333	901 000	1 669 623	2 837 000	4 320	6 174	9 160
	2016	4 904 177	869 000	1 638 585	2 790 000	3 940	5 763	8 860
	2017	4 996 741	868 000	1 642 425	2 845 000	3 680	5 533	8 740
	2018	5 094 780	868 000	1 654 108	2 868 000	3 520	5 397	8 770
	2019	5 209 324	862 000	1 681 948	2 945 000	3 260	5 096	8 570
	2020	5 343 020	926 000	1 795 225	3 142 000	3 180	5 130	8 970
	2021	5 457 154	920 000	1 826 551	3 217 000	3 120	5 151	9 270

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Chad	2000	8 168 699	1 321 000	2 205 617	3 486 000	7 950	8 426	8 970
	2001	8 445 304	1 337 000	2 291 665	3 704 000	8 550	9 069	9 670
	2002	8 741 588	1 131 000	2 066 768	3 529 000	8 120	8 615	9 180
	2003	9 095 665	1 125 000	2 100 279	3 539 000	8 350	8 876	9 460
	2004	9 508 235	1 169 000	2 133 329	3 524 000	8 420	8 964	9 570
	2005	9 895 457	1 225 000	2 232 423	3 745 000	8 840	9 428	10 100
	2006	10 252 110	1 297 000	2 342 105	3 881 000	9 360	9 994	10 700
	2007	10 605 317	1 449 000	2 424 988	3 836 000	9 750	10 446	11 200
	2008	10 977 133	1 729 000	2 521 828	3 547 000	10 100	10 874	11 700
	2009	11 370 245	2 064 000	2 687 611	3 451 000	10 600	11 421	12 400
	2010	11 764 479	2 160 000	2 777 637	3 520 000	10 900	11 796	12 800
	2011	12 182 850	2 022 000	2 680 861	3 489 000	10 600	11 519	12 600
	2012	12 615 239	1 721 000	2 581 469	3 722 000	10 300	11 291	12 400
	2013	13 072 042	1 454 000	2 516 380	4 078 000	10 100	11 132	12 300
	2014	13 547 142	1 402 000	2 584 781	4 354 000	9 930	11 106	12 400
	2015	13 985 437	1 495 000	2 681 805	4 506 000	9 870	11 141	12 600
	2016	14 432 796	1 618 000	2 812 456	4 572 000	9 960	11 414	13 100
	2017	14 920 693	1 702 000	2 961 677	4 822 000	10 000	11 657	13 700
	2018	15 433 343	1 851 000	3 216 108	5 303 000	9 750	11 502	13 800
	2019	15 950 276	1 854 000	3 277 966	5 393 000	9 670	11 621	14 300
	2020	16 462 441	1 904 000	3 433 441	5 752 000	9 580	12 190	16 000
	2021	16 991 621	1 938 000	3 506 428	5 833 000	9 320	11 744	15 400
Comoros[1]	2000	536 758	24 000	35 604	48 000	31	89	180
	2001	547 741	24 000	35 623	48 000	30	89	180
	2002	559 047	24 000	35 657	48 000	31	89	180
	2003	570 130	24 000	35 658	48 000	31	89	180
	2004	581 154	24 000	35 631	48 000	31	89	180
	2005	592 683	24 000	35 616	48 000	31	89	180
	2006	604 658	24 000	35 607	48 000	31	89	180
	2007	616 899	24 000	35 591	48 000	31	89	180
	2008	629 470	24 000	35 567	48 000	31	89	180
	2009	642 493	24 000	35 544	48 000	30	89	180
	2010	656 024	–	36 538	–	42	92	140
	2011	670 071	–	24 856	–	28	62	96
	2012	684 553	–	49 840	–	58	125	190
	2013	699 393	–	53 156	–	63	135	210
	2014	714 612	–	2 203	–	2	5	8
	2015	730 216	–	1 300	–	1	3	5
	2016	746 232	–	1 143	–	1	2	4
	2017	761 664	–	3 230	–	3	8	12
	2018	776 313	–	15 186	–	17	38	59
	2019	790 986	–	17 599	–	21	45	69
	2020	806 166	–	4 546	–	5	11	17
	2021	821 625	–	10 537	–	12	26	41
Congo	2000	3 134 030	794 000	1 107 615	1 502 000	2 690	2 879	3 100
	2001	3 254 101	784 000	1 141 982	1 604 000	2 610	2 790	3 000
	2002	3 331 158	699 000	1 071 547	1 599 000	2 380	2 526	2 700
	2003	3 424 653	697 000	1 093 188	1 632 000	2 370	2 513	2 680
	2004	3 543 012	727 000	1 126 012	1 671 000	2 280	2 416	2 580
	2005	3 672 839	707 000	1 100 055	1 619 000	2 250	2 386	2 540
	2006	3 813 323	699 000	1 063 802	1 559 000	2 100	2 225	2 360
	2007	3 956 329	678 000	1 015 538	1 448 000	1 960	2 065	2 180
	2008	4 089 602	653 000	946 201	1 321 000	1 840	1 928	2 040
	2009	4 257 230	638 000	923 124	1 295 000	1 810	1 898	2 000
	2010	4 437 884	656 000	951 092	1 332 000	1 830	1 931	2 040
	2011	4 584 216	688 000	987 985	1 386 000	1 850	1 970	2 100
	2012	4 713 257	713 000	1 020 805	1 409 000	1 850	2 001	2 160
	2013	4 828 066	733 000	1 058 288	1 473 000	1 920	2 119	2 340
	2014	4 944 861	719 000	1 053 862	1 492 000	1 920	2 147	2 430
	2015	5 064 386	716 000	1 068 094	1 538 000	1 820	2 024	2 300
	2016	5 186 824	707 000	1 126 282	1 722 000	1 910	2 158	2 530
	2017	5 312 340	739 000	1 238 519	1 975 000	1 940	2 215	2 640
	2018	5 441 062	801 000	1 321 959	2 068 000	1 940	2 227	2 680
	2019	5 570 733	813 000	1 324 386	2 026 000	2 020	2 360	2 930
	2020	5 702 174	820 000	1 304 055	1 963 000	1 970	2 279	2 850
	2021	5 835 806	800 000	1 280 047	1 949 000	1 980	2 293	2 900

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Côte d'Ivoire	2000	16 799 670	6 671 000	8 349 017	10 370 000	30 000	32 078	34 400
	2001	17 245 468	7 113 000	8 818 723	10 800 000	31 600	33 888	36 300
	2002	17 683 896	7 350 000	9 068 162	11 040 000	32 100	34 372	36 900
	2003	18 116 452	7 470 000	9 270 252	11 310 000	32 000	34 284	36 900
	2004	18 544 904	7 509 000	9 314 093	11 450 000	30 400	32 711	35 200
	2005	18 970 216	7 109 000	8 692 864	10 560 000	29 400	31 615	34 100
	2006	19 394 056	6 911 000	8 496 241	10 310 000	28 900	31 237	33 700
	2007	19 817 700	7 112 000	8 685 416	10 500 000	29 400	31 806	34 500
	2008	20 244 448	7 515 000	9 176 757	11 090 000	28 400	30 883	33 500
	2009	20 677 762	7 883 000	9 645 843	11 690 000	28 000	30 583	33 300
	2010	21 120 042	8 136 000	9 969 293	12 070 000	24 900	27 301	29 900
	2011	21 562 914	8 165 000	9 963 140	11 970 000	20 700	22 772	25 100
	2012	22 010 712	6 556 000	8 330 987	10 440 000	15 000	16 621	18 400
	2013	22 469 268	4 912 000	6 533 301	8 599 000	12 000	13 315	14 800
	2014	22 995 556	4 369 000	5 955 704	7 945 000	10 900	12 233	13 700
	2015	23 596 740	3 962 000	5 658 630	7 916 000	12 300	14 009	15 900
	2016	24 213 622	3 722 000	5 867 998	8 772 000	14 600	16 874	19 400
	2017	24 848 016	3 611 000	6 229 084	9 899 000	15 400	18 079	21 100
	2018	25 493 988	3 853 000	6 730 934	10 910 000	12 600	15 035	17 800
	2019	26 147 552	4 117 000	7 184 054	11 810 000	12 300	14 918	18 100
	2020	26 811 790	4 158 000	7 398 482	12 240 000	11 800	15 110	19 300
	2021	27 478 248	4 149 000	7 443 146	12 400 000	11 400	14 906	19 500
Democratic Republic of the Congo	2000	48 616 316	18 280 000	22 826 514	28 320 000	92 100	100 495	110 000
	2001	50 106 656	18 690 000	23 541 817	29 230 000	91 700	100 200	110 000
	2002	51 662 072	19 130 000	24 298 635	30 430 000	92 900	101 615	112 000
	2003	53 205 640	19 960 000	25 246 571	31 260 000	96 100	105 477	116 000
	2004	54 815 608	21 210 000	26 379 550	32 420 000	102 000	112 038	124 000
	2005	56 550 248	22 130 000	27 239 636	33 190 000	102 000	112 726	125 000
	2006	58 381 632	22 480 000	27 667 876	33 730 000	104 000	115 483	129 000
	2007	60 289 424	22 940 000	27 977 616	33 950 000	99 100	111 540	125 000
	2008	62 249 724	22 730 000	27 698 851	33 540 000	93 400	106 675	121 000
	2009	64 270 232	21 920 000	26 605 770	32 130 000	87 500	101 411	117 000
	2010	66 391 256	21 120 000	25 886 795	31 370 000	77 700	91 816	107 000
	2011	68 654 272	20 460 000	25 108 174	30 590 000	66 400	79 872	94 300
	2012	70 997 872	19 620 000	24 531 464	30 210 000	55 200	67 514	81 000
	2013	73 460 024	19 040 000	23 984 116	29 820 000	47 600	59 282	72 500
	2014	76 035 584	18 390 000	23 381 296	29 330 000	44 600	56 824	70 900
	2015	78 656 904	18 210 000	23 263 844	29 360 000	44 700	58 166	74 400
	2016	81 430 976	18 790 000	24 224 130	30 810 000	47 900	63 972	84 500
	2017	84 283 272	20 050 000	25 976 981	33 100 000	49 500	67 810	92 300
	2018	87 087 352	21 480 000	27 944 491	35 280 000	46 800	65 576	92 200
	2019	89 906 888	22 130 000	28 830 863	36 930 000	45 400	65 353	94 500
	2020	92 853 168	23 120 000	30 103 686	38 300 000	52 200	78 709	120 000
	2021	95 894 120	23 460 000	30 518 545	38 840 000	50 600	78 847	126 000
Equatorial Guinea	2000	684 977	136 000	213 141	320 000	660	715	780
	2001	719 270	151 000	219 511	310 000	660	712	780
	2002	754 115	164 000	227 948	306 000	660	716	790
	2003	789 681	181 000	242 764	319 000	680	739	820
	2004	826 355	202 000	264 018	339 000	700	766	850
	2005	864 726	222 000	287 656	368 000	700	772	860
	2006	905 418	230 000	302 024	388 000	680	752	840
	2007	948 814	238 000	314 016	405 000	620	698	780
	2008	994 971	229 000	307 734	406 000	580	648	730
	2009	1 043 686	213 000	293 747	394 000	540	610	690
	2010	1 094 524	213 000	293 402	395 000	620	712	820
	2011	1 144 588	219 000	306 229	419 000	630	731	850
	2012	1 193 636	250 000	343 007	461 000	660	786	940
	2013	1 243 941	274 000	382 479	523 000	720	873	1 060
	2014	1 295 183	277 000	397 146	552 000	730	904	1 130
	2015	1 346 973	271 000	406 082	584 000	650	803	1 010
	2016	1 398 927	249 000	397 276	604 000	600	740	930
	2017	1 450 694	223 000	380 328	608 000	610	756	980
	2018	1 502 091	200 000	360 556	600 000	590	724	940
	2019	1 553 031	192 000	347 501	584 000	590	726	960
	2020	1 596 049	188 000	352 514	617 000	600	766	1 060
	2021	1 634 466	183 000	348 428	603 000	610	785	1 120

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Eritrea	2000	2 392 880	14 000	42 711	88 000	24	98	250
	2001	2 461 927	19 000	54 461	107 000	35	130	310
	2002	2 547 424	12 000	32 823	64 000	20	74	170
	2003	2 653 390	23 000	49 490	87 000	35	112	240
	2004	2 763 140	7 500	15 093	26 000	11	32	70
	2005	2 831 732	16 000	27 680	42 000	22	59	120
	2006	2 880 093	10 000	16 438	23 000	14	36	69
	2007	2 926 168	24 000	37 568	53 000	25	60	110
	2008	3 005 779	13 000	20 767	29 000	15	37	70
	2009	3 083 888	18 000	27 656	39 000	17	41	73
	2010	3 147 727	53 000	83 471	117 000	66	161	290
	2011	3 207 570	49 000	76 678	107 000	57	141	260
	2012	3 252 596	33 000	52 483	76 000	35	85	160
	2013	3 296 367	31 000	49 309	70 000	36	88	160
	2014	3 323 425	71 000	109 689	153 000	91	227	420
	2015	3 340 006	41 000	64 020	89 000	51	128	240
	2016	3 365 287	47 000	86 561	139 000	71	198	400
	2017	3 396 933	74 000	115 928	161 000	90	221	400
	2018	3 445 374	64 000	99 716	139 000	79	196	360
	2019	3 498 818	129 000	200 382	279 000	170	437	820
	2020	3 555 868	102 000	158 684	220 000	150	372	690
	2021	3 620 312	60 000	92 898	129 000	83	211	390
Eswatini[1]	2000	288 538	340	787	1 400	0	2	5
	2001	291 590	–	1 395	–	1	3	5
	2002	294 226	–	670	–	0	1	2
	2003	296 463	–	342	–	0	0	1
	2004	298 413	–	574	–	0	1	2
	2005	300 128	–	279	–	0	0	1
	2006	301 765	–	155	–	–	0	–
	2007	303 522	–	84	–	–	0	–
	2008	305 163	–	58	–	–	0	–
	2009	306 568	–	106	–	–	0	–
	2010	307 977	–	268	–	0	0	1
	2011	309 503	–	379	–	0	0	1
	2012	311 204	–	409	–	0	1	1
	2013	313 129	–	728	–	0	1	2
	2014	315 242	–	389	–	0	0	1
	2015	317 502	–	318	–	0	0	1
	2016	319 906	–	250	–	–	0	–
	2017	322 389	–	440	–	0	1	1
	2018	324 919	–	686	–	0	1	2
	2019	327 491	–	235	–	–	0	–
	2020	330 583	–	233	–	–	0	–
	2021	333 835	–	306	–	0	0	1
Ethiopia	2000	45 581 670	9 009 000	15 016 444	23 740 000	10 300	25 208	47 700
	2001	46 932 871	3 555 000	13 910 882	26 450 000	4 980	23 352	52 600
	2002	48 329 786	3 541 000	12 570 226	23 260 000	4 730	21 590	47 000
	2003	49 754 811	4 418 000	13 022 221	24 510 000	6 520	22 799	50 200
	2004	51 204 696	5 365 000	12 673 710	33 330 000	6 820	23 844	72 600
	2005	52 679 556	3 827 000	8 879 900	23 720 000	4 990	16 956	51 500
	2006	54 189 912	3 464 000	8 345 640	23 760 000	4 200	15 221	47 500
	2007	55 757 405	3 020 000	7 346 228	19 960 000	3 410	12 705	41 200
	2008	57 362 830	3 037 000	6 406 358	16 430 000	3 430	11 109	32 000
	2009	58 993 797	3 737 000	8 773 515	23 360 000	4 440	16 218	49 500
	2010	60 681 698	4 405 000	10 362 488	27 230 000	5 200	19 144	57 400
	2011	62 436 191	5 956 000	10 953 634	23 750 000	6 380	17 276	43 700
	2012	64 226 870	6 611 000	13 064 346	24 140 000	8 010	20 863	45 200
	2013	66 017 370	6 857 000	15 281 540	23 400 000	9 410	27 024	51 000
	2014	67 827 802	3 726 000	14 339 644	28 070 000	4 680	23 862	58 100
	2015	69 680 889	3 473 000	12 528 267	25 030 000	4 560	22 125	54 000
	2016	71 599 397	2 833 000	8 922 403	18 580 000	3 750	16 302	40 600
	2017	73 574 607	2 511 000	6 600 689	13 700 000	3 420	12 460	30 400
	2018	75 568 019	1 541 000	2 793 314	4 176 000	2 330	6 500	12 800
	2019	77 602 002	1 472 000	2 645 193	3 979 000	2 060	5 708	11 100
	2020	79 689 820	2 351 000	4 227 742	6 366 000	3 410	9 424	18 500
	2021	81 792 456	2 094 000	3 783 896	5 673 000	2 920	8 041	15 800

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Gabon	2000	1 272 935	279 000	420 619	613 000	340	365	400
	2001	1 306 590	281 000	421 598	607 000	270	292	320
	2002	1 341 696	255 000	393 460	575 000	260	276	300
	2003	1 378 398	218 000	342 808	505 000	230	243	260
	2004	1 417 110	173 000	266 172	388 000	210	218	230
	2005	1 458 353	141 000	214 915	315 000	210	218	230
	2006	1 502 534	130 000	202 209	302 000	200	214	220
	2007	1 549 774	123 000	200 278	310 000	200	213	220
	2008	1 599 978	143 000	245 099	392 000	220	226	240
	2009	1 653 542	182 000	325 788	544 000	230	243	260
	2010	1 711 105	228 000	400 246	663 000	250	269	290
	2011	1 772 500	259 000	452 439	738 000	280	300	330
	2012	1 836 705	265 000	473 866	774 000	300	332	370
	2013	1 902 226	251 000	475 337	824 000	340	378	430
	2014	1 966 855	242 000	473 210	837 000	350	403	470
	2015	2 028 517	243 000	473 905	838 000	350	407	480
	2016	2 086 206	250 000	476 346	825 000	340	387	460
	2017	2 140 215	245 000	488 279	879 000	330	383	460
	2018	2 192 012	248 000	499 577	913 000	330	387	470
	2019	2 242 785	269 000	512 184	897 000	330	384	470
	2020	2 292 573	283 000	527 769	907 000	320	385	490
	2021	2 341 179	287 000	535 939	916 000	320	384	500
Gambia	2000	1 437 539	334 000	449 173	582 000	600	632	660
	2001	1 479 449	331 000	449 211	582 000	560	584	610
	2002	1 522 223	333 000	449 003	581 000	520	542	570
	2003	1 566 257	331 000	448 547	582 000	500	517	540
	2004	1 612 225	332 000	447 989	581 000	480	498	520
	2005	1 660 368	333 000	447 415	581 000	470	488	510
	2006	1 711 294	331 000	447 057	580 000	470	487	510
	2007	1 764 883	331 000	446 954	576 000	470	488	510
	2008	1 820 542	331 000	446 959	579 000	480	492	510
	2009	1 878 119	331 000	447 032	576 000	480	496	510
	2010	1 937 275	332 000	447 124	577 000	500	518	540
	2011	1 998 212	384 000	473 874	574 000	510	528	550
	2012	2 061 014	420 000	523 991	638 000	520	536	560
	2013	2 124 869	338 000	429 429	529 000	520	541	560
	2014	2 189 019	237 000	303 721	376 000	530	551	570
	2015	2 253 133	346 000	450 479	564 000	540	557	580
	2016	2 317 206	225 000	297 058	375 000	540	562	590
	2017	2 381 182	110 000	148 057	189 000	550	577	600
	2018	2 444 916	143 000	196 160	253 000	570	596	630
	2019	2 508 883	85 000	109 975	137 000	570	601	640
	2020	2 573 995	148 000	210 897	304 000	580	608	650
	2021	2 639 916	150 000	213 311	307 000	580	615	660
Ghana	2000	19 665 502	6 322 000	8 477 878	11 070 000	17 900	18 647	19 400
	2001	20 195 576	6 553 000	8 428 599	10 670 000	17 600	18 294	19 000
	2002	20 758 326	6 429 000	8 148 113	10 170 000	16 400	16 996	17 700
	2003	21 329 514	6 182 000	7 895 135	9 933 000	16 100	16 714	17 400
	2004	21 906 444	5 878 000	7 590 600	9 596 000	15 300	15 838	16 400
	2005	22 496 952	5 673 000	7 350 612	9 341 000	14 900	15 430	16 000
	2006	23 098 586	5 690 000	7 330 580	9 305 000	15 100	15 682	16 300
	2007	23 708 320	5 889 000	7 556 676	9 540 000	14 600	15 139	15 700
	2008	24 326 088	6 533 000	8 170 400	10 210 000	14 900	15 430	16 000
	2009	24 950 762	7 235 000	8 947 844	10 960 000	15 800	16 413	17 100
	2010	25 574 720	7 798 000	9 571 242	11 620 000	15 800	16 496	17 200
	2011	26 205 940	8 137 000	9 973 490	11 990 000	16 900	17 663	18 500
	2012	26 858 762	8 187 000	9 977 648	12 050 000	16 300	17 076	17 900
	2013	27 525 596	7 783 000	9 540 098	11 660 000	15 600	16 352	17 100
	2014	28 196 358	7 104 000	8 867 522	10 960 000	14 200	14 869	15 600
	2015	28 870 940	6 263 000	7 999 986	10 090 000	12 900	13 459	14 100
	2016	29 554 304	5 286 000	6 953 304	8 934 000	11 700	12 174	12 800
	2017	30 222 262	4 475 000	5 991 625	7 808 000	11 300	11 839	12 500
	2018	30 870 640	3 976 000	5 314 525	7 054 000	11 600	12 227	13 000
	2019	31 522 290	3 917 000	5 242 734	6 942 000	11 600	12 324	13 200
	2020	32 180 400	3 799 000	5 313 608	7 289 000	11 600	12 516	13 800
	2021	32 833 032	3 833 000	5 396 652	7 371 000	11 600	12 557	14 000

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Guinea	2000	8 336 967	2 705 000	3 616 058	4 733 000	15 500	16 416	17 400
	2001	8 445 717	2 728 000	3 641 386	4 852 000	15 000	15 929	16 900
	2002	8 577 790	2 536 000	3 556 986	4 850 000	13 600	14 464	15 400
	2003	8 772 254	2 406 000	3 457 916	4 817 000	12 100	12 852	13 700
	2004	8 961 039	2 228 000	3 277 416	4 643 000	10 300	10 996	11 700
	2005	9 140 114	2 101 000	3 143 778	4 511 000	9 290	9 906	10 600
	2006	9 330 625	2 129 000	3 153 121	4 483 000	9 070	9 681	10 300
	2007	9 547 082	2 302 000	3 297 950	4 599 000	9 300	9 941	10 600
	2008	9 779 785	2 692 000	3 612 353	4 728 000	10 100	10 773	11 500
	2009	10 021 323	3 144 000	4 003 420	5 045 000	11 500	12 366	13 300
	2010	10 270 728	3 468 000	4 320 306	5 328 000	12 400	13 305	14 400
	2011	10 527 712	3 715 000	4 565 610	5 530 000	12 900	13 865	15 000
	2012	10 788 692	3 884 000	4 696 591	5 631 000	12 700	13 731	14 900
	2013	11 055 430	3 638 000	4 568 741	5 658 000	11 500	12 537	13 700
	2014	11 333 365	3 402 000	4 460 552	5 743 000	10 600	11 602	12 800
	2015	11 625 998	3 251 000	4 402 690	5 878 000	9 580	10 530	11 700
	2016	11 930 985	3 073 000	4 297 908	5 822 000	8 810	9 742	10 800
	2017	12 240 789	3 058 000	4 377 224	6 041 000	8 330	9 277	10 400
	2018	12 554 864	3 126 000	4 508 348	6 301 000	7 590	8 500	9 630
	2019	12 877 539	2 977 000	4 425 904	6 386 000	7 610	8 611	9 870
	2020	13 205 153	2 698 000	4 416 575	6 876 000	8 210	9 954	12 300
	2021	13 531 906	2 740 000	4 477 687	6 958 000	8 010	9 439	11 300
Guinea-Bissau	2000	1 230 849	294 000	496 631	781 000	2 120	2 296	2 510
	2001	1 257 380	228 000	410 118	673 000	1 680	1 814	1 980
	2002	1 285 678	168 000	323 277	570 000	1 230	1 324	1 440
	2003	1 315 653	122 000	240 938	430 000	800	855	910
	2004	1 347 009	88 000	166 563	286 000	720	766	820
	2005	1 379 713	72 000	131 429	221 000	730	775	830
	2006	1 414 091	63 000	111 165	181 000	710	756	810
	2007	1 450 572	73 000	112 956	169 000	710	756	810
	2008	1 488 431	99 000	134 274	178 000	720	774	840
	2009	1 527 196	115 000	166 267	234 000	750	811	880
	2010	1 567 220	122 000	198 836	304 000	770	839	920
	2011	1 609 017	120 000	212 103	348 000	760	844	940
	2012	1 652 717	108 000	213 019	379 000	740	827	930
	2013	1 697 753	89 000	208 894	418 000	730	815	920
	2014	1 743 309	70 000	186 564	413 000	710	800	910
	2015	1 788 919	58 000	161 401	379 000	690	772	880
	2016	1 834 552	47 000	139 154	326 000	720	817	950
	2017	1 879 826	41 000	122 291	294 000	720	829	980
	2018	1 924 955	42 000	125 653	301 000	760	880	1 060
	2019	1 970 457	49 000	146 986	342 000	750	875	1 060
	2020	2 015 828	61 000	189 707	453 000	770	969	1 310
	2021	2 060 721	72 000	216 542	499 000	820	1 029	1 400
Kenya	2000	30 851 606	5 328 000	6 837 558	8 588 000	11 000	11 376	11 900
	2001	31 800 344	6 270 000	7 808 825	9 619 000	12 600	13 118	13 700
	2002	32 779 824	5 883 000	7 444 032	9 248 000	12 500	12 989	13 600
	2003	33 767 120	5 627 000	7 177 403	8 995 000	12 100	12 595	13 200
	2004	34 791 836	4 830 000	6 304 649	8 064 000	10 900	11 285	11 700
	2005	35 843 008	3 700 000	5 018 999	6 681 000	9 750	10 098	10 500
	2006	36 925 252	2 817 000	3 900 370	5 279 000	9 250	9 562	9 880
	2007	38 036 792	2 216 000	3 076 957	4 175 000	9 240	9 541	9 850
	2008	39 186 896	1 918 000	2 652 387	3 558 000	9 200	9 479	9 770
	2009	40 364 444	1 910 000	2 593 628	3 452 000	9 340	9 618	9 920
	2010	41 517 896	1 993 000	2 696 154	3 583 000	9 500	9 788	10 100
	2011	42 635 144	2 105 000	2 844 501	3 761 000	9 760	10 074	10 400
	2012	43 725 808	2 252 000	3 052 340	4 052 000	9 720	10 037	10 400
	2013	44 792 368	2 372 000	3 232 499	4 327 000	9 720	10 058	10 400
	2014	45 831 864	2 428 000	3 312 249	4 390 000	9 810	10 182	10 600
	2015	46 851 488	2 421 000	3 319 230	4 397 000	9 930	10 351	10 900
	2016	47 894 672	2 301 000	3 191 546	4 302 000	10 200	10 733	11 400
	2017	48 948 136	2 217 000	3 155 636	4 375 000	10 600	11 223	12 100
	2018	49 953 304	2 148 000	3 068 062	4 260 000	10 500	11 218	12 200
	2019	50 951 448	2 168 000	3 037 541	4 130 000	10 600	11 298	12 400
	2020	51 985 780	2 385 000	3 302 189	4 466 000	10 600	11 768	13 600
	2021	53 005 616	2 478 000	3 419 698	4 641 000	10 800	12 011	14 000

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Liberia	2000	2 895 224	784 000	1 248 403	1 870 000	6 020	6 426	6 860
	2001	2 981 648	830 000	1 311 933	1 965 000	5 970	6 369	6 800
	2002	3 060 599	838 000	1 343 961	2 049 000	5 950	6 352	6 780
	2003	3 085 173	843 000	1 339 076	2 021 000	5 240	5 596	5 970
	2004	3 122 447	831 000	1 270 287	1 886 000	4 400	4 688	5 000
	2005	3 266 318	886 000	1 269 211	1 765 000	3 810	4 062	4 330
	2006	3 455 397	956 000	1 300 190	1 722 000	3 440	3 675	3 920
	2007	3 632 740	1 020 000	1 347 464	1 742 000	3 300	3 522	3 760
	2008	3 783 887	1 090 000	1 403 261	1 770 000	3 300	3 525	3 770
	2009	3 905 066	1 073 000	1 384 603	1 769 000	3 090	3 305	3 540
	2010	4 019 956	1 037 000	1 354 819	1 748 000	2 680	2 871	3 080
	2011	4 181 150	1 031 000	1 354 061	1 745 000	2 630	2 813	3 020
	2012	4 331 740	981 000	1 328 628	1 758 000	2 570	2 760	2 980
	2013	4 427 313	995 000	1 381 944	1 876 000	2 700	2 916	3 170
	2014	4 519 398	1 106 000	1 506 350	2 024 000	3 040	3 315	3 640
	2015	4 612 329	1 223 000	1 591 767	2 054 000	2 790	3 070	3 400
	2016	4 706 097	1 436 000	1 773 971	2 171 000	3 380	3 789	4 300
	2017	4 796 631	1 555 000	1 939 400	2 403 000	3 540	4 046	4 690
	2018	4 889 391	1 496 000	1 966 210	2 550 000	2 960	3 419	4 030
	2019	4 985 289	1 383 000	1 954 336	2 690 000	2 880	3 390	4 100
	2020	5 087 584	1 172 000	1 914 081	2 944 000	2 820	3 931	5 620
	2021	5 193 416	1 124 000	1 852 429	2 958 000	2 690	3 578	4 960
Madagascar	2000	16 216 431	84 000	905 987	1 995 000	190	2 239	5 830
	2001	16 709 665	173 000	1 111 496	2 374 000	290	2 747	6 900
	2002	17 211 934	24 000	898 515	2 020 000	69	2 221	5 890
	2003	17 724 310	26 000	1 180 072	2 700 000	76	2 917	7 880
	2004	18 250 774	30 000	834 134	1 860 000	93	2 062	5 350
	2005	18 792 172	24 000	662 852	1 477 000	64	1 638	4 310
	2006	19 350 300	24 000	666 523	1 455 000	71	1 647	4 300
	2007	19 924 958	135 000	442 208	875 000	260	1 092	2 560
	2008	20 513 600	260 000	469 371	798 000	430	1 160	2 410
	2009	21 117 092	529 000	882 824	1 397 000	840	2 182	4 350
	2010	21 731 052	524 000	893 540	1 440 000	820	2 208	4 460
	2011	22 348 158	500 000	823 538	1 197 000	770	2 035	3 850
	2012	22 966 240	972 000	1 594 592	2 509 000	1 520	3 941	7 730
	2013	23 588 072	961 000	1 497 292	2 300 000	1 470	3 701	7 170
	2014	24 215 976	767 000	1 078 280	1 441 000	1 130	2 665	4 720
	2015	24 850 912	1 696 000	2 345 948	3 074 000	2 480	5 800	10 200
	2016	25 501 940	1 034 000	1 408 501	1 840 000	1 480	3 482	6 050
	2017	26 169 542	1 431 000	1 971 342	2 576 000	2 060	4 873	8 610
	2018	26 846 540	1 356 000	1 921 403	2 541 000	1 960	4 750	8 550
	2019	27 533 134	1 390 000	2 032 961	2 723 000	2 050	5 026	9 120
	2020	28 225 176	2 660 000	4 010 537	5 479 000	4 050	10 265	18 800
	2021	28 915 652	3 126 000	4 911 293	6 833 000	4 890	12 571	23 400
Malawi	2000	11 229 387	3 985 000	5 068 222	6 336 000	17 300	18 170	19 100
	2001	11 498 818	4 274 000	5 289 453	6 504 000	16 100	16 919	17 800
	2002	11 784 498	4 086 000	5 157 186	6 371 000	13 700	14 390	15 100
	2003	12 087 965	3 777 000	4 851 733	6 108 000	11 500	12 078	12 600
	2004	12 411 342	3 631 000	4 633 730	5 816 000	10 100	10 600	11 100
	2005	12 755 648	3 728 000	4 716 725	5 875 000	9 620	10 078	10 600
	2006	13 118 307	3 709 000	4 638 347	5 718 000	9 970	10 424	10 900
	2007	13 495 463	3 765 000	4 731 580	5 843 000	10 700	11 175	11 700
	2008	13 889 423	4 113 000	5 115 871	6 313 000	11 000	11 588	12 200
	2009	14 298 932	4 398 000	5 457 399	6 648 000	10 900	11 492	12 200
	2010	14 718 422	4 539 000	5 615 374	6 873 000	10 200	10 817	11 500
	2011	15 146 094	4 460 000	5 570 026	6 906 000	9 400	9 906	10 500
	2012	15 581 251	3 896 000	5 053 353	6 421 000	8 580	9 015	9 520
	2013	16 024 775	3 566 000	4 685 666	6 075 000	7 530	7 925	8 390
	2014	16 477 966	3 306 000	4 353 265	5 658 000	6 930	7 365	7 870
	2015	16 938 942	3 115 000	4 106 623	5 354 000	6 520	7 023	7 600
	2016	17 405 624	2 975 000	3 949 459	5 105 000	6 370	6 954	7 630
	2017	17 881 168	2 961 000	3 911 675	5 053 000	6 350	7 024	7 850
	2018	18 367 884	2 893 000	3 859 499	5 054 000	6 280	7 021	7 990
	2019	18 867 336	2 661 000	3 867 128	5 358 000	6 260	7 061	8 160
	2020	19 377 060	2 503 000	4 252 631	6 787 000	6 300	7 400	9 200
	2021	19 889 742	2 557 000	4 359 158	6 888 000	6 310	7 392	9 230

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Mali	2000	11 239 101	3 100 000	4 565 653	6 579 000	23 400	24 739	26 200
	2001	11 583 824	3 192 000	4 719 788	6 804 000	21 000	22 250	23 600
	2002	11 952 660	3 328 000	4 977 784	7 234 000	21 100	22 339	23 700
	2003	12 342 165	3 492 000	5 230 718	7 473 000	20 700	21 913	23 200
	2004	12 751 995	3 741 000	5 475 357	7 761 000	21 300	22 551	23 900
	2005	13 180 551	3 946 000	5 683 984	8 192 000	22 400	23 776	25 300
	2006	13 623 541	3 844 000	5 527 211	7 850 000	22 000	23 397	24 900
	2007	14 080 912	3 825 000	5 474 736	7 702 000	20 400	21 774	23 200
	2008	14 551 117	3 813 000	5 515 727	7 710 000	18 000	19 237	20 600
	2009	15 032 635	3 905 000	5 630 658	7 774 000	16 000	17 172	18 400
	2010	15 529 181	4 268 000	5 957 047	8 204 000	16 100	17 356	18 700
	2011	16 039 734	4 634 000	6 491 808	8 858 000	18 700	20 247	22 000
	2012	16 514 687	5 122 000	7 194 633	9 768 000	21 900	23 944	26 200
	2013	17 004 032	5 513 000	7 699 696	10 580 000	23 200	25 545	28 100
	2014	17 551 814	5 562 000	7 740 479	10 730 000	20 500	22 863	25 400
	2015	18 112 908	5 034 000	7 097 168	10 060 000	15 800	17 783	20 000
	2016	18 700 106	5 063 000	7 184 988	10 200 000	12 900	14 736	16 800
	2017	19 311 356	5 279 000	7 469 199	10 620 000	13 300	15 442	17 900
	2018	19 934 298	5 441 000	7 710 138	10 950 000	15 500	18 423	21 800
	2019	20 567 424	4 844 000	6 863 255	9 742 000	15 300	18 630	22 600
	2020	21 224 040	5 354 000	7 586 538	10 780 000	15 100	20 662	28 000
	2021	21 904 984	5 463 000	7 744 735	11 010 000	14 600	19 933	27 400
Mauritania	2000	2 695 003	147 000	304 757	559 000	890	937	990
	2001	2 761 823	153 000	307 700	552 000	850	900	950
	2002	2 821 703	130 000	308 961	579 000	830	880	940
	2003	2 883 326	136 000	319 661	628 000	820	877	940
	2004	2 946 575	90 000	286 610	557 000	790	845	910
	2005	3 012 360	77 000	281 841	563 000	820	880	960
	2006	3 081 229	61 000	258 559	552 000	800	874	960
	2007	3 153 508	64 000	246 899	519 000	790	863	960
	2008	3 233 336	50 000	209 089	423 000	790	867	970
	2009	3 322 616	3 600	108 111	256 000	790	874	990
	2010	3 419 461	6 900	123 348	275 000	790	869	990
	2011	3 524 249	35 000	162 490	343 000	810	902	1 040
	2012	3 636 113	5 600	88 074	212 000	840	939	1 100
	2013	3 742 959	5 800	101 247	237 000	840	953	1 130
	2014	3 843 174	75 000	216 687	431 000	870	996	1 210
	2015	3 946 220	107 000	291 679	578 000	890	1 032	1 280
	2016	4 051 890	162 000	386 314	723 000	910	1 049	1 310
	2017	4 160 015	112 000	306 475	614 000	920	1 069	1 340
	2018	4 270 712	98 000	236 485	436 000	930	1 085	1 380
	2019	4 383 849	65 000	184 057	356 000	950	1 114	1 440
	2020	4 498 604	69 000	201 771	395 000	970	1 129	1 460
	2021	4 614 974	40 000	85 030	145 000	980	1 144	1 500
Mozambique	2000	17 768 504	6 834 000	8 416 877	10 240 000	41 500	44 699	48 100
	2001	18 220 716	7 454 000	8 997 785	10 840 000	41 000	44 168	47 600
	2002	18 694 946	7 613 000	9 283 388	11 120 000	38 000	40 972	44 200
	2003	19 186 754	7 634 000	9 278 676	11 180 000	34 200	36 977	39 900
	2004	19 694 412	7 385 000	8 967 650	10 870 000	29 500	31 912	34 500
	2005	20 211 114	6 982 000	8 517 561	10 330 000	25 100	27 220	29 400
	2006	20 735 982	6 796 000	8 325 146	10 090 000	25 200	27 304	29 500
	2007	21 280 512	6 739 000	8 256 754	10 030 000	24 000	26 006	28 100
	2008	21 845 572	6 821 000	8 345 403	10 100 000	23 600	25 587	27 700
	2009	22 436 660	6 916 000	8 469 429	10 330 000	24 000	25 990	28 200
	2010	23 073 724	7 027 000	8 660 053	10 530 000	24 000	26 140	28 600
	2011	23 760 420	7 196 000	8 783 904	10 700 000	23 300	25 686	28 500
	2012	24 487 612	7 374 000	9 032 885	11 010 000	22 400	25 176	28 500
	2013	25 251 732	7 595 000	9 291 989	11 360 000	22 100	25 425	29 500
	2014	26 038 704	7 549 000	9 315 947	11 400 000	21 000	24 756	29 700
	2015	26 843 246	7 652 000	9 403 454	11 440 000	19 600	23 519	29 000
	2016	27 696 492	7 668 000	9 501 504	11 610 000	18 600	22 857	29 200
	2017	28 569 440	7 590 000	9 422 965	11 580 000	17 000	21 403	28 100
	2018	29 423 878	7 453 000	9 406 462	11 690 000	14 900	19 200	25 900
	2019	30 285 596	7 228 000	9 421 431	12 000 000	14 500	19 156	26 700
	2020	31 178 240	7 028 000	9 990 474	13 770 000	14 700	23 693	40 300
	2021	32 077 072	7 172 000	10 283 922	14 230 000	13 900	22 291	37 800

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Namibia	2000	1 443 943	31 000	77 408	155 000	56	198	470
	2001	1 473 519	56 000	102 902	185 000	93	263	580
	2002	1 499 016	33 000	70 395	139 000	56	180	420
	2003	1 520 368	28 000	67 564	140 000	48	172	430
	2004	1 539 403	51 000	105 493	202 000	89	270	630
	2005	1 558 024	34 000	65 303	118 000	57	167	370
	2006	1 576 830	41 000	68 176	113 000	66	174	350
	2007	1 596 621	6 300	20 663	47 000	11	52	150
	2008	1 618 100	1 600	12 094	33 000	2	30	97
	2009	1 641 410	790	6 068	18 000	1	15	53
	2010	1 666 296	800	2 590	6 200	1	6	19
	2011	1 692 544	2 100	3 092	4 800	3	7	15
	2012	1 720 429	2 200	5 465	9 400	3	13	32
	2013	1 749 829	6 200	7 844	9 600	8	20	33
	2014	1 780 382	20 000	25 780	32 000	28	65	110
	2015	1 811 896	12 000	15 052	18 000	17	38	65
	2016	1 844 160	25 000	32 052	39 000	36	82	140
	2017	1 876 848	71 000	89 155	109 000	100	228	380
	2018	1 909 508	40 000	50 217	61 000	56	128	220
	2019	1 942 023	4 100	5 705	8 100	6	14	26
	2020	1 975 721	16 000	20 258	25 000	22	51	87
	2021	2 008 307	17 000	21 322	26 000	23	54	92
Niger	2000	11 622 665	2 317 000	4 134 706	6 854 000	24 400	26 182	28 100
	2001	12 031 430	2 346 000	4 180 737	6 946 000	21 600	23 238	25 000
	2002	12 456 517	2 278 000	4 048 859	6 616 000	19 900	21 344	23 000
	2003	12 900 790	2 266 000	3 825 282	6 086 000	17 800	19 133	20 600
	2004	13 366 885	2 525 000	4 016 648	6 010 000	16 600	17 876	19 300
	2005	13 855 221	2 688 000	4 271 200	6 443 000	18 500	20 011	21 600
	2006	14 365 168	2 712 000	4 386 050	6 753 000	17 800	19 349	21 000
	2007	14 897 873	2 984 000	4 668 666	6 934 000	18 400	20 076	21 900
	2008	15 455 175	3 756 000	5 403 729	7 532 000	19 200	21 260	23 500
	2009	16 037 915	4 323 000	6 017 879	8 204 000	21 300	23 951	26 900
	2010	16 647 543	4 821 000	6 785 885	9 379 000	23 100	26 471	30 300
	2011	17 283 112	5 094 000	7 283 090	10 040 000	24 000	28 225	33 000
	2012	17 954 408	5 207 000	7 633 594	10 810 000	24 000	28 977	34 700
	2013	18 653 200	5 056 000	7 717 689	11 360 000	23 200	28 864	35 800
	2014	19 372 014	5 052 000	7 880 779	11 660 000	21 900	27 969	35 700
	2015	20 128 124	5 143 000	8 073 585	12 100 000	19 900	26 184	34 500
	2016	20 921 744	5 142 000	8 053 568	12 120 000	19 300	26 110	35 500
	2017	21 737 922	5 016 000	7 883 346	11 850 000	17 100	23 815	33 400
	2018	22 577 058	4 896 000	7 760 340	11 740 000	15 400	22 047	32 200
	2019	23 443 392	4 731 000	7 631 511	11 760 000	15 300	22 568	34 200
	2020	24 333 640	4 583 000	7 845 383	12 750 000	15 400	24 068	39 200
	2021	25 252 722	4 723 000	8 166 369	13 300 000	15 300	24 997	42 700
Nigeria	2000	122 851 984	39 480 000	50 779 020	64 300 000	236 000	249 259	263 000
	2001	126 152 680	39 830 000	51 229 713	65 120 000	229 000	242 479	256 000
	2002	129 583 024	39 530 000	50 952 482	64 780 000	218 000	230 464	244 000
	2003	133 119 800	40 940 000	52 423 482	66 420 000	213 000	226 442	240 000
	2004	136 756 848	43 690 000	55 028 747	68 160 000	213 000	226 548	240 000
	2005	140 490 720	46 230 000	57 411 916	70 620 000	217 000	230 350	244 000
	2006	144 329 760	47 900 000	59 418 382	72 790 000	218 000	232 391	247 000
	2007	148 294 032	49 660 000	61 400 329	75 070 000	215 000	229 178	244 000
	2008	152 382 512	51 780 000	63 355 538	76 750 000	207 000	221 435	237 000
	2009	156 595 760	51 800 000	63 192 869	76 430 000	196 000	210 275	226 000
	2010	160 952 848	49 030 000	60 551 056	73 900 000	183 000	197 612	214 000
	2011	165 463 744	46 920 000	58 184 509	71 320 000	169 000	184 121	200 000
	2012	170 075 936	44 970 000	55 718 235	68 540 000	158 000	173 344	191 000
	2013	174 726 128	43 380 000	53 921 321	66 320 000	152 000	168 943	188 000
	2014	179 379 008	42 810 000	53 483 458	65 930 000	147 000	165 188	186 000
	2015	183 995 792	43 300 000	54 115 123	67 110 000	143 000	163 088	188 000
	2016	188 666 928	44 060 000	55 667 334	69 130 000	143 000	165 672	195 000
	2017	193 495 904	45 870 000	57 869 533	72 050 000	150 000	176 539	212 000
	2018	198 387 616	46 930 000	59 652 248	75 230 000	156 000	186 940	231 000
	2019	203 304 496	47 440 000	61 379 283	78 810 000	152 000	187 428	239 000
	2020	208 327 408	46 800 000	65 133 759	88 650 000	151 000	195 720	263 000
	2021	213 401 328	47 520 000	65 399 501	89 000 000	146 000	193 512	268 000

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Rwanda	2000	8 109 989	745 000	1 536 115	2 793 000	6 480	6 769	7 080
	2001	8 223 941	756 000	1 478 868	2 630 000	6 180	6 459	6 760
	2002	8 372 306	708 000	1 375 805	2 495 000	5 100	5 320	5 560
	2003	8 567 992	610 000	1 231 753	1 987 000	4 230	4 393	4 570
	2004	8 791 853	455 000	1 101 660	1 815 000	3 600	3 718	3 850
	2005	9 026 299	385 000	1 385 594	2 311 000	3 230	3 334	3 450
	2006	9 270 066	360 000	1 396 437	2 213 000	3 040	3 129	3 230
	2007	9 523 168	501 000	840 559	1 264 000	2 950	3 031	3 120
	2008	9 781 996	425 000	683 661	1 003 000	2 900	2 984	3 070
	2009	10 043 737	1 007 000	1 546 660	2 169 000	2 880	2 956	3 040
	2010	10 309 031	747 000	1 079 765	1 422 000	2 900	2 982	3 080
	2011	10 576 932	291 000	390 611	494 000	2 850	2 936	3 030
	2012	10 840 334	511 000	646 386	788 000	2 820	2 903	3 000
	2013	11 101 350	1 014 000	1 214 623	1 429 000	2 810	2 894	3 000
	2014	11 368 451	1 727 000	2 299 121	2 895 000	2 820	2 904	3 010
	2015	11 642 959	2 667 000	3 585 563	4 538 000	2 850	2 948	3 070
	2016	11 930 899	3 602 000	4 887 836	6 231 000	2 910	3 027	3 180
	2017	12 230 339	6 334 000	8 681 013	11 160 000	2 950	3 086	3 270
	2018	12 531 808	4 523 000	6 184 131	7 923 000	2 940	3 093	3 310
	2019	12 835 028	3 862 000	5 279 485	6 772 000	2 970	3 143	3 400
	2020	13 146 362	2 177 000	2 986 047	3 831 000	3 010	3 205	3 530
	2021	13 461 888	1 242 000	1 700 493	2 184 000	3 050	3 258	3 630
Sao Tome and Principe[1,2]	2000	143 714	–	31 975	–	–	254	–
	2001	146 258	–	42 086	–	–	248	–
	2002	149 841	–	50 586	–	–	321	–
	2003	153 762	–	42 656	–	–	193	–
	2004	157 697	–	46 486	–	–	169	–
	2005	161 680	–	18 139	–	–	85	–
	2006	165 725	–	5 146	–	–	26	–
	2007	169 845	–	2 421	–	–	3	–
	2008	174 004	–	6 258	–	–	16	–
	2009	178 128	–	6 182	–	–	23	–
	2010	182 138	–	3 146	–	–	14	–
	2011	186 044	–	8 442	–	–	19	–
	2012	189 924	–	12 550	–	–	7	–
	2013	193 757	–	9 243	–	–	11	–
	2014	197 497	–	1 754	–	–	0	–
	2015	201 124	–	2 056	–	–	0	–
	2016	204 632	–	2 238	–	–	1	–
	2017	208 036	–	2 239	–	–	1	–
	2018	211 344	–	2 937	–	–	0	–
	2019	214 599	–	2 732	–	–	0	–
	2020	218 641	–	1 933	–	–	0	–
	2021	223 107	–	2 719	–	–	1	–
Senegal	2000	9 704 287	1 762 000	2 676 527	3 648 000	5 890	6 114	6 350
	2001	9 938 027	669 000	2 470 115	3 713 000	5 590	5 796	6 010
	2002	10 180 950	505 000	2 248 602	3 810 000	4 610	4 753	4 900
	2003	10 434 504	726 000	2 063 074	3 342 000	4 720	4 867	5 020
	2004	10 698 691	308 000	1 393 434	2 581 000	4 310	4 435	4 560
	2005	10 974 057	441 000	1 362 379	2 275 000	3 950	4 056	4 160
	2006	11 263 387	442 000	1 376 263	2 459 000	3 830	3 926	4 020
	2007	11 563 869	361 000	1 160 145	2 134 000	3 760	3 850	3 940
	2008	11 872 929	396 000	628 766	914 000	3 770	3 862	3 950
	2009	12 195 029	276 000	405 713	550 000	3 760	3 847	3 940
	2010	12 530 121	536 000	763 134	1 012 000	3 750	3 833	3 920
	2011	12 875 880	437 000	626 038	831 000	3 720	3 799	3 880
	2012	13 231 833	489 000	706 020	954 000	3 640	3 712	3 790
	2013	13 595 566	567 000	793 415	1 058 000	3 670	3 741	3 820
	2014	13 970 308	390 000	532 782	694 000	3 780	3 857	3 940
	2015	14 356 181	684 000	1 010 929	1 370 000	3 820	3 910	4 010
	2016	14 751 356	467 000	684 129	924 000	3 810	3 904	4 020
	2017	15 157 793	559 000	805 691	1 073 000	3 870	3 987	4 130
	2018	15 574 909	731 000	1 047 659	1 405 000	4 040	4 192	4 390
	2019	16 000 781	455 000	672 221	913 000	4 070	4 251	4 490
	2020	16 436 120	565 000	835 455	1 131 000	4 110	4 311	4 580
	2021	16 876 720	674 000	995 763	1 347 000	4 160	4 375	4 680

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Sierra Leone	2000	4 584 067	1 336 000	2 081 568	3 098 000	11 900	12 666	13 500
	2001	4 857 096	1 414 000	2 201 474	3 271 000	13 000	13 847	14 700
	2002	5 140 113	1 427 000	2 269 445	3 436 000	13 000	13 834	14 700
	2003	5 350 907	1 406 000	2 246 838	3 467 000	12 300	13 061	13 900
	2004	5 533 329	1 411 000	2 267 452	3 451 000	11 800	12 513	13 300
	2005	5 683 334	1 388 000	2 270 241	3 575 000	10 700	11 356	12 100
	2006	5 809 774	1 356 000	2 277 054	3 631 000	10 200	10 844	11 600
	2007	5 939 163	1 490 000	2 396 659	3 650 000	10 500	11 216	12 000
	2008	6 090 860	1 876 000	2 654 929	3 670 000	11 900	12 713	13 600
	2009	6 259 842	2 161 000	2 881 379	3 778 000	13 300	14 159	15 100
	2010	6 436 698	2 222 000	2 977 797	3 884 000	14 400	15 377	16 500
	2011	6 612 385	2 266 000	3 009 591	3 916 000	14 000	15 008	16 100
	2012	6 788 587	2 324 000	2 986 182	3 751 000	13 000	14 021	15 100
	2013	6 964 859	2 344 000	2 921 184	3 620 000	12 000	13 009	14 100
	2014	7 140 688	2 265 000	2 868 023	3 563 000	10 400	11 317	12 400
	2015	7 314 773	2 252 000	2 857 523	3 601 000	9 940	10 884	12 000
	2016	7 493 913	2 304 000	2 914 796	3 616 000	8 720	9 659	10 700
	2017	7 677 565	2 239 000	2 883 985	3 668 000	7 830	8 760	9 790
	2018	7 861 281	2 165 000	2 901 372	3 819 000	6 550	7 408	8 370
	2019	8 046 828	1 953 000	2 857 585	4 016 000	6 330	7 236	8 300
	2020	8 233 970	1 646 000	2 795 827	4 477 000	6 260	9 020	12 600
	2021	8 420 641	1 596 000	2 777 394	4 538 000	5 940	8 314	11 400
South Africa[1,2]	2000	4 681 326	13 000	18 206	26 000	–	424	–
	2001	4 722 971	–	26 506	–	–	81	–
	2002	4 766 151	–	15 649	–	–	96	–
	2003	4 810 404	–	13 459	–	–	142	–
	2004	4 855 607	–	13 399	–	–	88	–
	2005	4 901 714	–	7 755	–	–	63	–
	2006	4 949 175	–	12 098	–	–	87	–
	2007	4 999 609	–	6 327	–	–	37	–
	2008	5 056 581	–	7 796	–	–	43	–
	2009	5 117 078	–	6 072	–	–	45	–
	2010	5 178 492	–	8 060	–	–	83	–
	2011	5 244 332	–	9 866	–	–	54	–
	2012	5 314 503	–	6 621	–	–	72	–
	2013	5 387 361	–	8 645	–	–	105	–
	2014	5 472 955	–	11 705	–	–	174	–
	2015	5 587 650	–	4 959	–	–	110	–
	2016	5 642 227	–	4 323	–	–	34	–
	2017	5 664 120	–	23 381	–	–	301	–
	2018	5 733 963	–	9 562	–	–	69	–
	2019	5 808 705	–	4 821	–	–	79	–
	2020	5 880 192	–	4 463	–	–	38	–
	2021	5 939 225	–	2 958	–	–	56	–
South Sudan[4]	2000	6 114 440	1 533 000	2 245 004	3 162 000	9 630	10 974	12 500
	2001	6 394 431	1 488 000	2 283 971	3 398 000	9 240	10 504	11 900
	2002	6 686 100	1 410 000	2 250 591	3 418 000	8 320	9 420	10 700
	2003	6 992 367	1 421 000	2 229 084	3 353 000	7 760	8 771	9 920
	2004	7 317 118	1 514 000	2 243 889	3 253 000	7 150	8 090	9 180
	2005	7 662 654	1 618 000	2 342 844	3 292 000	6 640	7 547	8 600
	2006	8 029 517	1 710 000	2 450 862	3 393 000	6 290	7 226	8 290
	2007	8 417 823	1 819 000	2 520 885	3 395 000	5 920	6 861	7 950
	2008	8 823 888	2 000 000	2 586 745	3 267 000	5 670	6 687	7 860
	2009	9 229 227	2 099 000	2 640 300	3 268 000	5 320	6 387	7 630
	2010	9 714 419	2 183 000	2 775 374	3 450 000	5 010	6 108	7 390
	2011	10 243 050	2 308 000	2 979 272	3 782 000	4 760	5 900	7 270
	2012	10 701 604	2 358 000	3 079 924	3 971 000	4 640	5 840	7 330
	2013	11 106 031	2 399 000	3 173 418	4 121 000	4 590	5 925	7 640
	2014	11 213 284	2 282 000	3 098 291	4 115 000	4 660	6 232	8 330
	2015	11 194 299	2 108 000	3 033 662	4 190 000	4 720	6 542	9 090
	2016	11 066 105	1 901 000	2 949 646	4 401 000	4 760	6 890	10 000
	2017	10 658 226	1 791 000	2 960 681	4 578 000	4 690	7 134	10 900
	2018	10 395 329	1 695 000	2 898 120	4 628 000	4 400	6 869	11 000
	2019	10 447 666	1 652 000	2 938 499	4 811 000	4 380	7 095	11 900
	2020	10 606 227	1 664 000	3 042 784	5 116 000	4 340	7 290	12 800
	2021	10 748 272	1 643 000	2 953 582	4 972 000	4 200	7 344	13 600

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Togo	2000	5 008 035	1 614 000	2 221 914	2 995 000	4 900	5 177	5 490
	2001	5 145 426	1 700 000	2 289 405	3 019 000	4 980	5 270	5 590
	2002	5 281 538	1 806 000	2 382 832	3 104 000	5 400	5 723	6 080
	2003	5 421 001	1 957 000	2 518 511	3 171 000	5 630	5 978	6 360
	2004	5 565 218	2 123 000	2 657 728	3 295 000	6 100	6 497	6 920
	2005	5 711 597	2 152 000	2 693 615	3 327 000	6 420	6 843	7 300
	2006	5 874 240	2 115 000	2 660 724	3 317 000	6 210	6 626	7 080
	2007	6 047 537	2 020 000	2 566 605	3 203 000	5 660	6 042	6 470
	2008	6 222 482	1 780 000	2 307 220	2 934 000	4 670	4 984	5 330
	2009	6 398 624	1 588 000	2 050 314	2 609 000	3 990	4 253	4 540
	2010	6 571 855	1 551 000	1 984 921	2 513 000	3 780	4 046	4 330
	2011	6 748 672	1 581 000	2 034 724	2 574 000	3 800	4 076	4 380
	2012	6 926 635	1 801 000	2 295 985	2 867 000	4 190	4 526	4 890
	2013	7 106 229	2 106 000	2 609 672	3 177 000	4 720	5 138	5 600
	2014	7 288 383	2 179 000	2 688 180	3 267 000	4 870	5 356	5 880
	2015	7 473 229	2 163 000	2 669 469	3 274 000	4 670	5 177	5 730
	2016	7 661 354	1 986 000	2 488 548	3 091 000	3 960	4 414	4 920
	2017	7 852 795	1 692 000	2 179 253	2 774 000	3 390	3 793	4 260
	2018	8 046 679	1 497 000	2 014 395	2 660 000	3 240	3 667	4 180
	2019	8 243 094	1 351 000	1 966 638	2 775 000	3 220	3 703	4 310
	2020	8 442 580	1 236 000	2 049 459	3 196 000	3 160	3 745	4 570
	2021	8 644 829	1 246 000	2 053 345	3 216 000	3 090	3 715	4 650
Uganda	2000	24 020 696	9 001 000	11 703 496	14 900 000	42 500	44 688	47 000
	2001	24 763 324	9 580 000	12 579 134	16 060 000	48 500	51 069	53 800
	2002	25 545 090	9 848 000	12 776 442	16 360 000	46 100	48 487	51 000
	2003	26 354 736	9 768 000	12 758 978	16 370 000	41 600	43 827	46 100
	2004	27 146 084	9 362 000	12 210 978	15 630 000	35 800	37 670	39 600
	2005	27 946 588	9 381 000	12 118 906	15 490 000	27 800	29 135	30 600
	2006	28 773 228	9 271 000	12 122 459	15 580 000	24 200	25 409	26 700
	2007	29 629 804	9 526 000	12 308 621	15 730 000	23 400	24 542	25 800
	2008	30 509 862	10 080 000	12 751 923	15 880 000	25 600	26 929	28 400
	2009	31 412 520	10 610 000	13 289 108	16 390 000	27 300	28 832	30 400
	2010	32 341 728	10 580 000	13 241 888	16 340 000	25 500	26 913	28 400
	2011	33 295 738	10 370 000	13 141 152	16 350 000	22 400	23 606	24 900
	2012	34 273 296	10 170 000	12 905 814	16 150 000	18 600	19 568	20 700
	2013	35 273 568	8 926 000	11 722 973	15 070 000	15 200	15 938	16 800
	2014	36 336 540	7 964 000	10 693 203	14 110 000	14 400	15 148	16 000
	2015	37 477 356	6 650 000	9 501 063	12 970 000	14 800	15 704	16 800
	2016	38 748 300	7 796 000	10 971 082	14 470 000	17 000	18 494	20 300
	2017	40 127 084	7 821 000	11 833 607	16 340 000	18 500	20 560	23 200
	2018	41 515 396	7 261 000	10 905 744	17 280 000	15 500	17 114	19 300
	2019	42 949 080	7 420 000	11 282 360	17 810 000	15 500	17 282	19 800
	2020	44 404 612	8 333 000	12 602 807	19 840 000	15 700	20 279	27 800
	2021	45 853 776	8 637 000	13 023 397	20 610 000	15 700	19 663	26 400
United Republic of Tanzania	2000	34 463 704	9 392 000	12 072 965	15 090 000	40 700	42 579	44 700
	2001	35 414 468	9 448 000	12 064 438	15 210 000	38 200	40 009	41 900
	2002	36 353 532	8 826 000	11 478 532	14 640 000	33 400	34 901	36 500
	2003	37 333 920	8 430 000	11 088 120	14 240 000	30 200	31 635	33 100
	2004	38 360 880	8 086 000	10 574 049	13 660 000	27 000	28 232	29 500
	2005	39 439 504	7 651 000	9 949 128	12 810 000	24 800	25 833	27 000
	2006	40 562 052	6 980 000	9 232 996	11 950 000	23 100	24 055	25 100
	2007	41 716 496	6 160 000	8 298 126	10 990 000	21 900	22 751	23 700
	2008	42 870 884	5 486 000	7 417 960	9 901 000	21 500	22 293	23 200
	2009	43 957 932	4 999 000	6 797 118	9 043 000	21 200	21 981	22 900
	2010	45 110 528	4 659 000	6 350 485	8 422 000	20 900	21 764	22 700
	2011	46 416 032	4 415 000	5 992 159	8 018 000	20 500	21 356	22 300
	2012	47 786 136	4 348 000	5 841 953	7 779 000	20 000	20 879	21 800
	2013	49 253 644	4 775 000	6 440 590	8 504 000	20 700	21 744	22 900
	2014	50 814 552	5 387 000	7 267 262	9 511 000	21 200	22 378	23 700
	2015	52 542 824	5 516 000	7 382 963	9 735 000	21 600	22 917	24 500
	2016	54 401 800	5 324 000	7 151 258	9 366 000	22 100	23 689	25 600
	2017	56 267 032	5 188 000	7 003 374	9 204 000	22 100	23 852	26 100
	2018	58 090 444	5 082 000	6 852 548	9 022 000	22 400	24 278	26 900
	2019	59 872 580	5 051 000	7 040 493	9 508 000	22 600	24 699	27 700
	2020	61 704 520	4 974 000	7 604 750	10 990 000	22 800	25 464	29 500
	2021	63 588 336	5 300 000	7 997 711	11 620 000	23 000	25 787	30 300

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AFRICAN								
Zambia	2000	9 891 136	2 989 000	3 927 883	5 045 000	11 900	12 485	13 200
	2001	10 191 964	3 233 000	4 119 122	5 158 000	11 900	12 569	13 200
	2002	10 508 294	3 021 000	3 903 346	4 956 000	10 500	10 981	11 500
	2003	10 837 973	2 894 000	3 777 289	4 879 000	9 600	10 055	10 500
	2004	11 188 040	2 576 000	3 376 477	4 342 000	8 360	8 759	9 170
	2005	11 564 870	2 316 000	2 988 921	3 805 000	7 360	7 702	8 050
	2006	11 971 567	2 061 000	2 663 591	3 403 000	6 840	7 118	7 420
	2007	12 402 073	1 842 000	2 399 017	3 054 000	6 520	6 767	7 030
	2008	12 852 966	1 714 000	2 217 906	2 805 000	6 450	6 688	6 940
	2009	13 318 087	1 712 000	2 200 401	2 773 000	6 480	6 720	6 980
	2010	13 792 086	1 811 000	2 323 628	2 922 000	6 440	6 675	6 930
	2011	14 265 814	2 024 000	2 575 149	3 259 000	6 790	7 047	7 330
	2012	14 744 658	2 318 000	2 954 071	3 705 000	7 160	7 458	7 780
	2013	15 234 976	2 727 000	3 467 685	4 340 000	7 630	7 974	8 360
	2014	15 737 793	2 864 000	3 656 181	4 594 000	7 980	8 385	8 840
	2015	16 248 230	2 796 000	3 563 606	4 453 000	7 820	8 231	8 700
	2016	16 767 761	2 607 000	3 453 634	4 480 000	7 660	8 104	8 620
	2017	17 298 054	2 257 000	3 204 416	4 410 000	7 510	8 011	8 610
	2018	17 835 892	2 156 000	3 189 765	4 575 000	7 520	8 107	8 870
	2019	18 380 476	2 122 000	3 205 531	4 623 000	7 560	8 244	9 190
	2020	18 927 716	2 217 000	3 537 563	5 289 000	7 590	8 846	10 800
	2021	19 473 124	2 316 000	3 655 518	5 482 000	7 580	8 806	10 800
Zimbabwe	2000	9 318 943	240 000	987 103	2 453 000	440	2 526	7 240
	2001	9 379 025	226 000	993 468	2 460 000	470	2 543	7 270
	2002	9 437 032	226 000	999 612	2 445 000	490	2 559	7 160
	2003	9 508 833	232 000	1 007 217	2 517 000	480	2 578	7 440
	2004	9 575 806	217 000	1 014 311	2 486 000	480	2 596	7 340
	2005	9 626 100	228 000	1 019 639	2 515 000	460	2 610	7 480
	2006	9 709 360	236 000	1 028 458	2 582 000	490	2 632	7 750
	2007	9 803 913	718 000	1 690 025	2 968 000	1 340	4 326	9 310
	2008	9 882 482	119 000	688 884	1 367 000	270	1 763	4 240
	2009	9 984 424	298 000	763 956	1 343 000	560	1 955	4 240
	2010	10 110 382	608 000	1 097 776	1 733 000	1 000	2 810	5 630
	2011	10 256 854	472 000	722 030	993 000	730	1 848	3 430
	2012	10 445 479	405 000	592 559	794 000	620	1 516	2 760
	2013	10 673 905	618 000	863 692	1 126 000	910	2 211	3 960
	2014	10 910 394	808 000	1 093 059	1 399 000	1 180	2 798	4 870
	2015	11 145 979	726 000	1 067 121	1 450 000	1 090	2 731	4 970
	2016	11 380 449	501 000	760 626	1 052 000	780	1 947	3 600
	2017	11 615 415	833 000	1 337 886	1 931 000	1 300	3 424	6 530
	2018	11 852 496	392 000	634 718	896 000	630	1 624	3 100
	2019	12 090 632	471 000	782 740	1 125 000	750	2 003	3 860
	2020	12 338 718	693 000	1 152 901	1 662 000	1 080	2 951	5 680
	2021	12 593 732	205 000	342 543	492 000	320	876	1 680
AMERICAS								
Argentina[1,2,3]	2000	185 353	–	440	–	–	0	–
	2001	187 402	–	215	–	–	0	–
	2002	189 425	–	125	–	–	0	–
	2003	191 390	–	124	–	–	1	–
	2004	193 343	–	116	–	–	0	–
	2005	195 352	–	231	–	–	0	–
	2006	197 384	–	172	–	–	0	–
	2007	199 380	–	328	–	–	0	–
	2008	201 368	–	105	–	–	0	–
	2009	203 421	–	92	–	–	0	–
	2010	205 500	–	54	–	–	0	–
	2011	207 603	–	0	–	–	0	–
	2012	209 761	–	0	–	–	0	–
	2013	211 941	–	0	–	–	0	–
	2014	214 120	–	0	–	–	0	–
	2015	216 285	–	0	–	–	0	–
	2016	218 341	–	0	–	–	0	–
	2017	220 273	–	0	–	–	0	–
	2018	222 067	–	0	–	–	0	–
	2019	223 727	–	0	–	–	0	–
	2020	225 180	–	0	–	–	0	–
	2021	226 383	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Belize[1,2]	2000	165 880	–	1 486	–	–	0	–
	2001	171 189	–	1 162	–	–	0	–
	2002	176 631	–	1 134	–	–	0	–
	2003	182 158	–	1 324	–	–	0	–
	2004	187 768	–	1 066	–	–	1	–
	2005	193 458	–	1 549	–	–	0	–
	2006	199 223	–	844	–	–	1	–
	2007	205 049	–	845	–	–	0	–
	2008	210 912	–	540	–	–	0	–
	2009	216 777	–	256	–	–	0	–
	2010	222 253	–	150	–	–	0	–
	2011	227 381	–	72	–	–	0	–
	2012	232 570	–	33	–	–	0	–
	2013	237 834	–	20	–	–	0	–
	2014	243 111	–	19	–	–	0	–
	2015	248 310	–	9	–	–	0	–
	2016	253 445	–	4	–	–	0	–
	2017	258 538	–	7	–	–	0	–
	2018	263 625	–	3	–	–	0	–
	2019	268 475	–	0	–	–	0	–
	2020	272 495	–	0	–	–	0	–
	2021	276 021	–	0	–	–	0	–
Bolivia (Plurinational State of)[5]	2000	3 898 230	34 000	45 647	58 000	11	24	41
	2001	3 967 835	17 000	22 330	28 000	4	9	18
	2002	4 037 927	15 000	19 768	25 000	3	9	15
	2003	4 109 060	22 000	27 568	34 000	5	12	21
	2004	4 181 149	16 000	20 206	25 000	3	9	15
	2005	4 254 239	21 000	27 296	33 000	5	12	21
	2006	4 329 219	20 000	25 742	32 000	6	14	23
	2007	4 405 658	15 000	19 799	24 000	5	11	19
	2008	4 482 528	10 000	13 210	16 000	3	6	11
	2009	4 559 980	10 000	13 344	16 000	2	6	10
	2010	4 637 990	15 000	18 659	23 000	4	10	16
	2011	4 716 464	7 600	9 680	12 000	1	4	7
	2012	4 795 154	7 900	10 048	12 000	1	4	7
	2013	4 873 935	8 300	10 906	14 000	3	6	11
	2014	4 952 709	8 400	10 994	14 000	1	4	8
	2015	5 031 238	7 300	9 315	11 000	1	3	6
	2016	5 109 692	5 900	7 510	9 200	0	2	5
	2017	5 187 958	4 800	6 195	7 600	0	2	4
	2018	5 265 704	5 700	7 239	8 900	0	2	4
	2019	5 343 014	9 900	12 654	16 000	1	4	8
	2020	5 415 078	13 000	16 506	20 000	2	6	11
	2021	5 480 094	12 000	14 930	18 000	1	5	10
Brazil[2]	2000	35 702 366	644 000	760 760	887 000	–	245	–
	2001	36 177 013	406 000	467 114	535 000	–	142	–
	2002	36 636 767	363 000	407 200	458 000	–	95	–
	2003	37 073 743	425 000	465 651	513 000	–	104	–
	2004	37 498 575	481 000	516 739	561 000	–	102	–
	2005	37 919 857	624 000	658 276	709 000	–	123	–
	2006	38 330 599	561 000	584 183	624 000	–	110	–
	2007	38 728 229	478 000	534 516	578 000	–	93	–
	2008	39 112 480	322 000	335 694	359 000	–	68	–
	2009	39 487 063	316 000	328 858	351 000	–	85	–
	2010	39 859 758	349 000	390 024	422 000	–	76	–
	2011	40 231 615	273 000	284 024	303 000	–	70	–
	2012	40 595 475	248 000	258 095	276 000	–	60	–
	2013	40 949 517	177 000	197 679	214 000	–	40	–
	2014	41 302 308	141 000	146 599	156 000	–	36	–
	2015	41 653 206	147 000	164 589	178 000	–	35	–
	2016	41 992 495	127 000	132 022	141 000	–	35	–
	2017	42 326 506	198 000	220 913	239 000	–	34	–
	2018	42 663 818	196 000	218 813	237 000	–	56	–
	2019	42 991 924	160 000	178 650	193 000	–	37	–
	2020	43 278 849	150 000	167 113	181 000	–	51	–
	2021	43 508 223	145 000	162 016	175 000	–	58	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Colombia[2]	2000	8 681 838	154 000	210 720	269 000	–	124	–
	2001	8 819 707	246 000	333 024	423 000	–	168	–
	2002	8 956 121	218 000	291 432	367 000	–	162	–
	2003	9 089 761	193 000	254 224	319 000	–	118	–
	2004	9 220 510	151 000	197 464	246 000	–	126	–
	2005	9 347 293	129 000	166 899	207 000	–	87	–
	2006	9 469 494	127 000	165 418	205 000	–	77	–
	2007	9 587 644	133 000	173 191	215 000	–	68	–
	2008	9 700 271	84 000	109 966	137 000	–	54	–
	2009	9 810 657	84 000	110 555	138 000	–	28	–
	2010	9 921 838	125 000	164 564	206 000	–	42	–
	2011	10 030 937	68 000	90 130	113 000	–	23	–
	2012	10 135 769	64 000	84 176	105 000	–	24	–
	2013	10 236 614	55 000	72 346	91 000	–	10	–
	2014	10 334 030	43 000	57 024	71 000	–	17	–
	2015	10 431 836	63 000	84 841	109 000	–	18	–
	2016	10 543 910	87 000	115 550	145 000	–	36	–
	2017	10 704 576	60 000	80 963	104 000	–	19	–
	2018	10 909 426	69 000	93 827	121 000	–	9	–
	2019	11 110 990	89 000	119 761	154 000	–	3	–
	2020	11 275 539	81 000	105 996	132 000	–	5	–
	2021	11 405 251	78 000	102 418	128 000	–	11	–
Costa Rica[1,2]	2000	1 392 717	–	1 879	–	–	0	–
	2001	1 418 627	–	1 363	–	–	0	–
	2002	1 442 918	–	1 021	–	–	0	–
	2003	1 466 013	–	718	–	–	0	–
	2004	1 488 480	–	1 289	–	–	0	–
	2005	1 510 560	–	3 541	–	–	0	–
	2006	1 532 360	–	2 903	–	–	0	–
	2007	1 554 006	–	1 223	–	–	0	–
	2008	1 575 672	–	966	–	–	0	–
	2009	1 597 094	–	262	–	–	1	–
	2010	1 617 788	–	110	–	–	0	–
	2011	1 637 974	–	10	–	–	0	–
	2012	1 657 807	–	6	–	–	0	–
	2013	1 677 037	–	0	–	–	0	–
	2014	1 695 500	–	0	–	–	0	–
	2015	1 713 334	–	0	–	–	0	–
	2016	1 730 821	–	4	–	–	0	–
	2017	1 747 844	–	12	–	–	0	–
	2018	1 764 256	–	70	–	–	0	–
	2019	1 779 586	–	95	–	–	0	–
	2020	1 793 086	–	90	–	–	0	–
	2021	1 803 884	–	189	–	–	0	–
Dominican Republic[2]	2000	4 704 438	1 300	1 524	1 800	–	6	–
	2001	4 775 080	1 100	1 315	1 600	–	17	–
	2002	4 844 517	1 400	1 685	2 000	–	11	–
	2003	4 913 232	1 600	1 983	2 400	–	12	–
	2004	4 981 135	2 500	3 046	3 600	–	16	–
	2005	5 048 137	4 000	4 950	5 900	–	16	–
	2006	5 113 905	3 700	4 535	5 400	–	10	–
	2007	5 178 923	2 900	3 478	4 100	–	17	–
	2008	5 245 430	1 900	2 365	2 800	–	11	–
	2009	5 314 344	1 700	2 115	2 500	–	14	–
	2010	5 384 681	2 600	3 202	3 800	–	15	–
	2011	5 455 176	1 700	2 088	2 500	–	10	–
	2012	5 525 210	1 000	1 232	1 500	–	8	–
	2013	5 594 706	500	613	730	–	5	–
	2014	5 663 594	480	566	660	–	4	–
	2015	5 731 740	660	778	900	–	3	–
	2016	5 798 808	720	851	990	–	1	–
	2017	5 864 714	360	420	490	–	1	–
	2018	5 929 869	450	534	620	–	1	–
	2019	5 993 958	1 400	1 592	1 800	–	4	–
	2020	6 058 834	870	1 019	1 200	–	2	–
	2021	6 123 946	320	378	440	–	1	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Ecuador[1,2]	2000	367 936	–	104 528	–	–	66	–
	2001	374 318	–	108 903	–	–	84	–
	2002	380 877	–	86 757	–	–	64	–
	2003	387 596	–	52 065	–	–	46	–
	2004	394 398	–	28 730	–	–	37	–
	2005	401 258	–	17 050	–	–	22	–
	2006	408 224	–	9 863	–	–	9	–
	2007	415 298	–	8 194	–	–	8	–
	2008	422 436	–	4 891	–	–	5	–
	2009	429 604	–	4 126	–	–	6	–
	2010	436 796	–	1 888	–	–	0	–
	2011	444 027	–	1 219	–	–	0	–
	2012	451 200	–	544	–	–	0	–
	2013	458 167	–	368	–	–	0	–
	2014	465 015	–	242	–	–	0	–
	2015	471 948	–	618	–	–	0	–
	2016	479 049	–	1 191	–	–	0	–
	2017	486 548	–	1 275	–	–	0	–
	2018	495 836	–	1 653	–	–	0	–
	2019	505 396	–	1 803	–	–	0	–
	2020	512 531	–	1 934	–	–	3	–
	2021	518 626	–	2 175	–	–	0	–
El Salvador[1,2,3]	2000	1 209 571	–	753	–	–	0	–
	2001	1 215 583	–	362	–	–	0	–
	2002	1 220 288	–	117	–	–	0	–
	2003	1 223 450	–	85	–	–	0	–
	2004	1 225 237	–	112	–	–	0	–
	2005	1 225 676	–	67	–	–	0	–
	2006	1 224 990	–	49	–	–	0	–
	2007	1 226 958	–	40	–	–	0	–
	2008	1 231 824	–	33	–	–	0	–
	2009	1 236 511	–	21	–	–	0	–
	2010	1 241 148	–	17	–	–	0	–
	2011	1 245 881	–	7	–	–	0	–
	2012	1 250 741	–	13	–	–	0	–
	2013	1 255 685	–	6	–	–	0	–
	2014	1 260 533	–	6	–	–	0	–
	2015	1 264 906	–	5	–	–	0	–
	2016	1 268 853	–	12	–	–	0	–
	2017	1 272 130	–	0	–	–	0	–
	2018	1 274 097	–	0	–	–	0	–
	2019	1 274 884	–	0	–	–	0	–
	2020	1 277 424	–	0	–	–	0	–
	2021	1 281 775	–	0	–	–	0	–
French Guiana	2000	90 932	3 900	4 428	5 300	4	9	15
	2001	94 831	4 000	4 554	5 400	4	9	15
	2002	98 887	3 800	4 348	5 200	3	8	13
	2003	103 024	4 000	4 540	5 300	4	9	15
	2004	107 167	3 200	3 580	4 200	3	7	11
	2005	111 352	3 600	4 015	4 700	2	5	9
	2006	115 009	4 300	4 796	5 600	2	5	9
	2007	118 016	5 000	5 647	6 600	2	5	8
	2008	120 901	3 500	3 884	4 500	1	4	5
	2009	123 671	3 600	4 051	4 700	1	3	6
	2010	126 398	1 700	2 092	2 700	1	4	6
	2011	129 263	1 300	1 413	1 600	1	2	4
	2012	132 368	940	1 054	1 200	0	2	3
	2013	135 758	910	1 025	1 200	0	1	3
	2014	139 078	480	541	620	0	0	1
	2015	142 207	410	462	530	–	0	–
	2016	145 409	240	268	310	–	0	–
	2017	149 027	610	685	790	–	0	–
	2018	153 063	570	640	740	–	0	–
	2019	157 171	220	248	290	–	0	–
	2020	160 987	150	164	190	–	0	–
	2021	164 572	77	86	100	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Guatemala	2000	8 859 661	56 000	63 676	76 000	11	27	45
	2001	9 065 980	37 000	42 680	51 000	7	18	30
	2002	9 277 858	37 000	42 213	50 000	9	20	32
	2003	9 489 724	32 000	36 810	43 000	7	16	26
	2004	9 702 560	30 000	34 124	40 000	6	14	23
	2005	9 914 223	42 000	46 748	55 000	8	20	32
	2006	10 125 293	32 000	36 610	43 000	6	15	25
	2007	10 339 841	16 000	17 992	21 000	2	6	11
	2008	10 553 367	7 500	8 421	9 800	1	3	5
	2009	10 764 714	7 400	8 285	9 600	1	3	5
	2010	10 978 892	7 800	9 468	12 000	1	3	6
	2011	11 198 070	7 100	7 968	9 200	1	2	5
	2012	11 420 660	5 600	6 262	7 300	0	2	3
	2013	11 642 875	6 500	7 282	8 400	0	2	4
	2014	11 862 616	5 100	5 764	6 600	0	2	3
	2015	12 079 555	5 800	6 482	7 500	0	2	4
	2016	12 298 404	5 200	5 857	6 700	0	2	3
	2017	12 515 609	4 300	4 832	5 600	0	1	3
	2018	12 720 534	3 200	3 541	4 100	0	1	2
	2019	12 913 916	2 200	2 428	2 800	0	0	1
	2020	13 107 463	1 100	1 241	1 400	–	0	–
	2021	13 292 996	1 300	1 493	1 700	–	0	–
Guyana	2000	759 051	28 000	33 628	40 000	23	50	80
	2001	759 809	31 000	37 974	46 000	25	52	85
	2002	760 323	25 000	30 656	37 000	21	42	69
	2003	760 562	32 000	38 681	46 000	26	53	86
	2004	760 424	33 000	40 416	48 000	25	51	83
	2005	759 709	45 000	54 583	65 000	34	69	110
	2006	758 367	24 000	27 629	32 000	19	40	62
	2007	756 521	13 000	15 697	18 000	9	20	31
	2008	754 150	14 000	16 365	19 000	11	23	37
	2009	751 258	14 000	17 877	22 000	13	28	45
	2010	747 932	24 000	29 631	35 000	24	52	83
	2011	744 230	32 000	38 863	46 000	33	72	120
	2012	743 966	36 000	43 572	52 000	36	76	120
	2013	747 420	43 000	57 459	79 000	41	90	160
	2014	751 115	17 000	22 310	30 000	13	27	48
	2015	755 031	14 000	18 030	25 000	10	22	38
	2016	759 087	14 000	19 317	26 000	11	25	43
	2017	763 252	19 000	25 167	34 000	16	34	58
	2018	785 514	23 000	30 769	42 000	18	39	67
	2019	798 753	22 000	26 307	31 000	15	30	47
	2020	797 202	19 000	22 159	26 000	14	28	44
	2021	804 567	22 000	25 792	30 000	14	27	43
Haiti	2000	7 469 192	42 000	72 190	116 000	68	184	370
	2001	7 604 548	42 000	73 498	120 000	69	188	380
	2002	7 738 398	43 000	74 792	121 000	69	191	380
	2003	7 873 035	44 000	76 093	123 000	72	194	400
	2004	8 006 373	44 000	77 382	125 000	74	198	400
	2005	8 140 753	45 000	78 681	127 000	74	201	400
	2006	8 278 687	48 000	81 199	129 000	78	207	410
	2007	8 416 754	43 000	73 292	115 000	70	187	380
	2008	8 554 717	54 000	89 554	141 000	87	229	460
	2009	8 693 546	48 000	84 023	137 000	80	215	440
	2010	8 793 825	48 000	84 993	138 000	81	217	440
	2011	8 893 381	49 000	81 483	126 000	79	208	410
	2012	9 031 170	40 000	65 545	101 000	65	167	330
	2013	9 167 566	38 000	62 551	97 000	62	160	310
	2014	9 302 950	22 000	33 119	45 000	33	84	160
	2015	9 437 871	21 000	32 185	44 000	32	82	150
	2016	9 571 966	24 000	36 279	49 000	36	92	170
	2017	9 705 706	22 000	33 122	45 000	34	84	160
	2018	9 838 717	11 000	16 000	22 000	16	40	75
	2019	9 970 958	12 000	17 703	24 000	18	45	82
	2020	10 101 722	27 000	40 876	57 000	40	104	190
	2021	10 227 487	14 000	22 546	35 000	22	57	110

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Honduras	2000	6 029 661	38 000	51 498	66 000	9	23	41
	2001	6 193 734	26 000	35 405	45 000	6	15	27
	2002	6 358 632	18 000	25 251	32 000	4	11	19
	2003	6 523 463	15 000	20 706	27 000	3	9	16
	2004	6 687 890	18 000	25 353	33 000	4	12	20
	2005	6 852 026	17 000	23 468	30 000	4	11	20
	2006	7 015 602	13 000	17 218	22 000	3	8	14
	2007	7 177 977	11 000	14 962	19 000	3	7	13
	2008	7 338 589	8 900	11 741	15 000	2	6	9
	2009	7 497 580	9 900	12 900	16 000	3	8	14
	2010	7 654 855	10 000	13 308	16 000	3	7	12
	2011	7 810 264	8 100	10 269	13 000	2	5	8
	2012	7 964 126	6 800	8 680	11 000	1	4	7
	2013	8 116 563	5 700	7 231	8 900	2	5	9
	2014	8 268 002	3 600	4 553	5 600	1	3	5
	2015	8 418 962	3 800	4 792	5 900	1	4	6
	2016	8 569 590	4 300	5 519	6 800	2	5	8
	2017	8 719 993	1 300	1 716	2 100	0	0	1
	2018	8 870 363	710	933	1 200	–	0	–
	2019	9 020 707	350	444	540	–	0	–
	2020	9 168 292	860	1 098	1 300	0	0	1
	2021	9 310 124	1 800	2 290	2 900	1	2	4
Mexico[1,2]	2000	2 074 916	–	7 390	–	–	0	–
	2001	2 107 158	–	4 996	–	–	0	–
	2002	2 139 442	–	4 624	–	–	0	–
	2003	2 171 502	–	3 819	–	–	0	–
	2004	2 203 651	–	3 406	–	–	0	–
	2005	2 235 378	–	2 967	–	–	0	–
	2006	2 265 999	–	2 514	–	–	0	–
	2007	2 296 023	–	2 361	–	–	0	–
	2008	2 325 311	–	2 357	–	–	0	–
	2009	2 354 247	–	2 703	–	–	0	–
	2010	2 385 686	–	1 226	–	–	0	–
	2011	2 419 990	–	1 124	–	–	0	–
	2012	2 454 025	–	833	–	–	0	–
	2013	2 486 562	–	495	–	–	0	–
	2014	2 517 624	–	656	–	–	0	–
	2015	2 547 177	–	517	–	–	0	–
	2016	2 576 207	–	551	–	–	0	–
	2017	2 604 192	–	736	–	–	0	–
	2018	2 629 093	–	803	–	–	0	–
	2019	2 651 808	–	618	–	–	0	–
	2020	2 671 164	–	356	–	–	0	–
	2021	2 686 148	–	242	–	–	0	–
Nicaragua[2]	2000	2 236 286	25 000	29 953	35 000	–	4	–
	2001	2 266 641	11 000	13 275	16 000	–	2	–
	2002	2 295 556	8 100	9 745	11 000	–	8	–
	2003	2 323 516	7 100	8 507	10 000	–	7	–
	2004	2 351 086	7 300	8 735	10 000	–	1	–
	2005	2 380 966	7 000	8 412	9 900	–	6	–
	2006	2 413 762	3 300	3 943	4 600	–	1	–
	2007	2 447 653	1 400	1 717	2 000	–	0	–
	2008	2 482 700	800	965	1 100	–	0	–
	2009	2 518 883	640	772	910	–	0	–
	2010	2 556 027	730	876	1 000	–	1	–
	2011	2 593 924	970	1 171	1 400	–	1	–
	2012	2 632 359	1 300	1 564	1 800	–	2	–
	2013	2 671 108	1 200	1 471	1 700	–	0	–
	2014	2 710 087	1 200	1 446	1 700	–	0	–
	2015	2 749 338	2 400	2 886	3 400	–	1	–
	2016	2 788 901	6 600	7 943	9 400	–	2	–
	2017	2 828 752	11 000	13 866	16 000	–	1	–
	2018	2 868 779	17 000	20 158	24 000	–	3	–
	2019	2 908 802	14 000	16 717	20 000	–	1	–
	2020	2 948 948	27 000	32 469	38 000	–	0	–
	2021	2 990 260	24 000	29 457	35 000	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Panama[2]	2000	2 903 964	1 000	1 091	1 200	–	1	–
	2001	2 961 326	940	977	1 000	–	1	–
	2002	3 019 339	2 300	2 363	2 500	–	2	–
	2003	3 077 983	4 600	4 739	5 100	–	4	–
	2004	3 137 676	5 200	5 365	5 700	–	2	–
	2005	3 198 195	3 700	3 861	4 100	–	1	–
	2006	3 258 858	1 700	1 751	1 900	–	1	–
	2007	3 319 846	1 300	1 349	1 400	–	1	–
	2008	3 381 434	750	783	840	–	1	–
	2009	3 443 415	790	819	870	–	0	–
	2010	3 505 595	420	440	470	–	1	–
	2011	3 568 533	360	372	400	–	0	–
	2012	3 632 566	860	888	950	–	1	–
	2013	3 697 087	710	740	790	–	0	–
	2014	3 762 135	960	1 005	1 100	–	0	–
	2015	3 828 216	550	575	610	–	0	–
	2016	3 895 198	780	809	860	–	0	–
	2017	3 962 654	760	801	860	–	0	–
	2018	4 029 592	710	789	850	–	0	–
	2019	4 094 678	1 800	1 849	2 000	–	0	–
	2020	4 154 527	2 000	2 049	2 200	–	0	–
	2021	4 209 546	4 400	4 585	4 900	–	0	–
Paraguay[1,2,3]	2000	184 457	–	6 853	–	–	0	–
	2001	187 615	–	2 706	–	–	0	–
	2002	190 314	–	2 775	–	–	0	–
	2003	192 717	–	1 388	–	–	0	–
	2004	194 987	–	692	–	–	0	–
	2005	197 167	–	373	–	–	0	–
	2006	199 248	–	820	–	–	0	–
	2007	201 245	–	1 337	–	–	0	–
	2008	203 225	–	331	–	–	0	–
	2009	205 292	–	80	–	–	0	–
	2010	207 670	–	20	–	–	0	–
	2011	210 381	–	1	–	–	0	–
	2012	213 239	–	0	–	–	0	–
	2013	216 203	–	0	–	–	0	–
	2014	219 265	–	0	–	–	0	–
	2015	222 406	–	0	–	–	0	–
	2016	225 598	–	0	–	–	0	–
	2017	228 794	–	0	–	–	0	–
	2018	231 959	–	0	–	–	0	–
	2019	235 080	–	0	–	–	0	–
	2020	238 273	–	0	–	–	0	–
	2021	241 336	–	0	–	–	0	–
Peru	2000	10 468 797	78 000	103 335	132 000	51	106	170
	2001	10 610 375	83 000	105 067	128 000	45	89	140
	2002	10 735 899	105 000	128 960	155 000	55	108	170
	2003	10 849 343	93 000	111 816	132 000	49	95	150
	2004	10 955 612	98 000	115 387	134 000	51	98	150
	2005	11 055 120	92 000	108 134	125 000	41	80	120
	2006	11 146 952	68 000	80 054	93 000	25	52	80
	2007	11 233 088	53 000	62 633	73 000	21	43	68
	2008	11 313 916	47 000	54 608	63 000	17	34	53
	2009	11 393 702	45 000	52 035	60 000	15	31	48
	2010	11 480 206	33 000	37 847	43 000	9	20	31
	2011	11 577 669	26 000	30 924	36 000	9	19	30
	2012	11 684 448	33 000	40 437	48 000	11	24	38
	2013	11 798 042	51 000	62 669	75 000	23	45	71
	2014	11 921 818	69 000	83 936	100 000	30	60	94
	2015	12 062 391	71 000	86 896	104 000	36	70	110
	2016	12 227 710	60 000	72 836	87 000	35	69	110
	2017	12 413 370	60 000	72 752	87 000	32	64	100
	2018	12 648 421	48 000	58 455	70 000	24	48	75
	2019	12 892 292	33 000	45 729	64 000	17	35	61
	2020	13 080 775	22 000	29 745	41 000	11	23	41
	2021	13 242 088	19 000	23 250	28 000	9	17	28

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
AMERICAS								
Suriname[1,2]	2000	70 748	–	11 361	–	–	24	–
	2001	71 988	–	16 003	–	–	23	–
	2002	73 209	–	12 837	–	–	15	–
	2003	74 408	–	10 982	–	–	18	–
	2004	75 411	–	8 378	–	–	7	–
	2005	76 245	–	9 131	–	–	1	–
	2006	77 102	–	3 289	–	–	1	–
	2007	77 977	–	1 104	–	–	1	–
	2008	78 862	–	2 086	–	–	0	–
	2009	79 756	–	2 499	–	–	0	–
	2010	80 656	–	1 771	–	–	1	–
	2011	81 551	–	795	–	–	1	–
	2012	82 432	–	569	–	–	0	–
	2013	83 294	–	525	–	–	1	–
	2014	84 142	–	401	–	–	1	–
	2015	84 997	–	81	–	–	0	–
	2016	85 880	–	78	–	–	0	–
	2017	86 782	–	137	–	–	1	–
	2018	87 691	–	30	–	–	0	–
	2019	88 664	–	104	–	–	0	–
	2020	89 663	–	156	–	–	0	–
	2021	90 537	–	22	–	–	0	–
Venezuela (Bolivarian Republic of)	2000	12 213 864	31 000	35 517	42 000	13	26	41
	2001	12 440 102	21 000	23 834	28 000	7	15	24
	2002	12 665 464	31 000	35 029	42 000	9	19	30
	2003	12 891 014	33 000	37 510	44 000	14	27	42
	2004	13 113 464	49 000	54 984	65 000	15	31	48
	2005	13 334 392	47 000	52 979	62 000	17	34	52
	2006	13 551 040	39 000	43 638	51 000	16	33	50
	2007	13 762 548	44 000	48 834	57 000	19	37	57
	2008	13 966 916	33 000	37 482	43 000	13	26	41
	2009	14 163 946	37 000	41 927	48 000	18	36	54
	2010	14 357 511	48 000	57 905	73 000	27	53	84
	2011	14 548 080	48 000	53 565	62 000	24	47	71
	2012	14 735 213	55 000	61 850	71 000	29	56	86
	2013	14 919 010	82 000	92 159	106 000	54	105	160
	2014	15 096 629	95 000	106 079	123 000	57	110	170
	2015	15 264 858	142 000	159 661	184 000	77	150	230
	2016	15 370 732	251 000	281 897	325 000	140	261	400
	2017	15 281 716	429 000	482 617	555 000	220	424	640
	2018	14 912 826	423 000	475 212	548 000	190	373	570
	2019	14 485 842	415 000	467 421	538 000	180	351	530
	2020	14 245 226	198 000	223 349	258 000	100	196	300
	2021	14 099 934	182 000	204 683	237 000	80	156	240
EASTERN MEDITERRANEAN								
Afghanistan	2000	15 063 925	843 000	1 312 939	2 022 000	410	965	1 880
	2001	15 176 194	849 000	1 312 939	2 007 000	400	965	1 880
	2002	16 187 207	916 000	1 382 972	2 106 000	530	1 133	2 040
	2003	17 455 092	810 000	1 242 906	1 916 000	370	798	1 440
	2004	18 155 313	480 000	716 954	1 072 000	150	350	660
	2005	18 816 390	315 000	535 477	860 000	100	259	510
	2006	19 611 675	221 000	418 216	717 000	84	222	450
	2007	19 966 522	238 000	452 626	776 000	88	236	490
	2008	20 370 350	211 000	402 909	709 000	72	198	410
	2009	21 108 869	149 000	274 981	455 000	53	139	280
	2010	21 728 881	166 000	292 015	459 000	67	165	320
	2011	22 545 541	200 000	362 319	571 000	74	192	360
	2012	23 483 867	122 000	220 653	356 000	31	92	190
	2013	24 312 278	143 000	279 634	446 000	46	129	250
	2014	25 217 981	221 000	319 142	443 000	66	152	270
	2015	26 017 535	253 000	368 235	514 000	74	174	320
	2016	26 697 935	532 000	733 205	985 000	150	351	610
	2017	27 474 301	608 000	798 871	1 022 000	160	378	640
	2018	28 278 539	485 000	633 500	810 000	130	292	490
	2019	29 113 108	319 000	413 480	525 000	67	170	300
	2020	30 040 186	195 000	253 150	321 000	45	110	190
	2021	30 909 067	149 000	193 232	245 000	41	91	150

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Djibouti[1]	2000	556 465	1 300	1 731	2 100	1	4	8
	2001	574 055	1 400	1 786	2 200	1	4	8
	2002	591 783	1 400	1 841	2 300	1	4	8
	2003	604 743	1 400	1 881	2 300	1	4	8
	2004	613 714	1 500	1 909	2 300	1	4	9
	2005	623 078	1 500	1 938	2 400	1	4	9
	2006	635 142	1 500	1 976	2 400	1	5	9
	2007	648 827	1 600	2 018	2 500	1	5	9
	2008	662 093	1 600	2 060	2 500	2	5	9
	2009	675 754	–	2 686	–	3	6	10
	2010	689 325	–	1 010	–	1	2	3
	2011	702 532	1 700	2 185	2 700	2	5	10
	2012	715 646	1 700	2 226	2 700	2	5	10
	2013	728 736	–	1 684	–	2	4	6
	2014	741 735	–	9 439	–	11	24	37
	2015	754 613	–	9 473	–	11	24	37
	2016	767 363	–	13 822	–	14	30	46
	2017	780 091	–	14 671	–	12	25	38
	2018	792 813	–	24 845	–	21	43	65
	2019	805 409	–	49 402	–	47	97	140
	2020	817 529	–	72 332	–	63	126	190
	2021	829 078	–	58 445	–	57	117	180
Egypt[1,2]	2000	71 371 368	–	0	–	–	0	–
	2001	72 854 264	–	0	–	–	0	–
	2002	74 393 760	–	0	–	–	0	–
	2003	75 963 320	–	0	–	–	0	–
	2004	77 522 424	–	0	–	–	0	–
	2005	79 075 312	–	0	–	–	0	–
	2006	80 629 672	–	0	–	–	0	–
	2007	82 218 752	–	0	–	–	0	–
	2008	83 844 784	–	0	–	–	0	–
	2009	85 501 064	–	0	–	–	0	–
	2010	87 252 416	–	0	–	–	0	–
	2011	89 200 056	–	0	–	–	0	–
	2012	91 240 376	–	0	–	–	0	–
	2013	93 377 888	–	0	–	–	0	–
	2014	95 592 320	–	0	–	–	0	–
	2015	97 723 800	–	0	–	–	0	–
	2016	99 784 032	–	0	–	–	0	–
	2017	101 789 384	–	0	–	–	0	–
	2018	103 740 768	–	0	–	–	0	–
	2019	105 618 672	–	0	–	–	0	–
	2020	107 465 136	–	0	–	–	0	–
	2021	109 262 176	–	0	–	–	0	–
Iran (Islamic Republic of)[1,2]	2000	669 208	–	19 716	–	–	4	–
	2001	680 750	–	19 303	–	–	2	–
	2002	687 409	–	15 558	–	–	2	–
	2003	693 817	–	23 562	–	–	5	–
	2004	705 119	–	13 821	–	–	1	–
	2005	716 564	–	18 966	–	–	1	–
	2006	727 725	–	15 909	–	–	1	–
	2007	738 381	–	15 712	–	–	3	–
	2008	748 580	–	8 349	–	–	3	–
	2009	758 834	–	4 345	–	–	0	–
	2010	769 567	–	1 847	–	–	0	–
	2011	779 461	–	1 632	–	–	0	–
	2012	789 482	–	756	–	–	0	–
	2013	801 065	–	480	–	–	0	–
	2014	816 408	–	358	–	–	0	–
	2015	835 084	–	167	–	–	0	–
	2016	850 556	–	81	–	–	0	–
	2017	862 796	–	57	–	–	0	–
	2018	874 155	–	0	–	–	0	–
	2019	883 820	–	0	–	–	0	–
	2020	891 232	–	0	–	–	0	–
	2021	897 698	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Iraq[1,2]	2000	3 201 751	–	1 860	–	–	0	–
	2001	3 305 336	–	1 265	–	–	0	–
	2002	3 413 194	–	952	–	–	0	–
	2003	3 518 947	–	347	–	–	0	–
	2004	3 621 663	–	155	–	–	0	–
	2005	3 730 828	–	47	–	–	0	–
	2006	3 757 729	–	24	–	–	0	–
	2007	3 725 915	–	2	–	–	0	–
	2008	3 798 389	–	2	–	–	0	–
	2009	3 937 575	–	0	–	–	0	–
	2010	4 064 433	–	0	–	–	0	–
	2011	4 209 147	–	0	–	–	0	–
	2012	4 402 378	–	0	–	–	0	–
	2013	4 612 634	–	0	–	–	0	–
	2014	4 777 043	–	0	–	–	0	–
	2015	4 908 515	–	0	–	–	0	–
	2016	5 030 732	–	5	–	–	0	–
	2017	5 150 750	–	0	–	–	0	–
	2018	5 276 791	–	0	–	–	0	–
	2019	5 403 257	–	0	–	–	0	–
	2020	5 532 407	–	0	–	–	0	–
	2021	5 659 366	–	0	–	–	0	–
Morocco[1,2,3]	2000	28 554 416	–	3	–	–	0	–
	2001	28 930 096	–	0	–	–	0	–
	2002	29 301 816	–	19	–	–	0	–
	2003	29 661 270	–	4	–	–	0	–
	2004	30 033 124	–	1	–	–	0	–
	2005	30 431 902	–	0	–	–	0	–
	2006	30 833 022	–	0	–	–	0	–
	2007	31 232 632	–	0	–	–	0	–
	2008	31 634 992	–	0	–	–	0	–
	2009	32 042 876	–	0	–	–	0	–
	2010	32 464 864	–	0	–	–	0	–
	2011	32 903 700	–	0	–	–	0	–
	2012	33 352 168	–	0	–	–	0	–
	2013	33 803 528	–	0	–	–	0	–
	2014	34 248 604	–	0	–	–	0	–
	2015	34 680 456	–	0	–	–	0	–
	2016	35 107 264	–	0	–	–	0	–
	2017	35 528 116	–	0	–	–	0	–
	2018	35 927 512	–	0	–	–	0	–
	2019	36 304 408	–	0	–	–	0	–
	2020	36 688 772	–	0	–	–	0	–
	2021	37 076 584	–	0	–	–	0	–
Oman[1,2]	2000	2 344 253	–	6	–	–	0	–
	2001	2 374 653	–	2	–	–	0	–
	2002	2 403 659	–	6	–	–	0	–
	2003	2 431 600	–	6	–	–	0	–
	2004	2 468 855	–	0	–	–	0	–
	2005	2 515 192	–	0	–	–	0	–
	2006	2 560 649	–	0	–	–	0	–
	2007	2 605 700	–	4	–	–	0	–
	2008	2 651 028	–	0	–	–	0	–
	2009	2 697 537	–	0	–	–	0	–
	2010	2 881 914	–	0	–	–	0	–
	2011	3 206 870	–	0	–	–	0	–
	2012	3 535 579	–	0	–	–	0	–
	2013	3 816 680	–	0	–	–	0	–
	2014	4 009 267	–	0	–	–	0	–
	2015	4 191 776	–	0	–	–	0	–
	2016	4 398 070	–	0	–	–	0	–
	2017	4 541 854	–	0	–	–	0	–
	2018	4 601 157	–	0	–	–	0	–
	2019	4 602 768	–	0	–	–	0	–
	2020	4 543 399	–	0	–	–	0	–
	2021	4 520 471	–	0	–	–	0	–

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WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Pakistan	2000	151 762 612	361 000	923 913	2 207 000	290	989	2 630
	2001	156 528 540	436 000	1 037 774	2 359 000	370	1 144	2 990
	2002	160 505 291	359 000	966 325	2 406 000	280	1 001	2 770
	2003	164 058 125	395 000	924 733	2 204 000	320	991	2 670
	2004	167 766 368	381 000	683 580	1 342 000	270	643	1 440
	2005	171 426 951	376 000	845 170	2 011 000	310	923	2 500
	2006	175 062 381	359 000	851 104	2 033 000	290	882	2 320
	2007	178 851 822	354 000	835 398	2 025 000	280	879	2 420
	2008	182 791 561	278 000	763 800	1 945 000	190	679	1 880
	2009	186 912 034	441 000	1 015 691	2 286 000	340	1 000	2 500
	2010	191 170 159	646 000	1 445 704	3 058 000	570	1 616	3 880
	2011	195 248 335	915 000	1 905 938	3 748 000	680	1 814	4 070
	2012	198 790 599	782 000	1 652 576	3 326 000	620	1 703	3 940
	2013	201 869 416	723 000	1 381 009	2 670 000	460	1 165	2 560
	2014	204 734 261	555 000	994 600	1 834 000	290	725	1 530
	2015	207 406 024	529 000	1 000 339	2 078 000	310	765	1 790
	2016	209 918 397	658 000	1 017 237	1 741 000	400	844	1 670
	2017	212 724 995	582 000	819 944	1 270 000	320	641	1 180
	2018	216 020 207	548 000	705 529	983 000	250	511	860
	2019	219 521 856	507 000	640 380	868 000	280	544	890
	2020	223 359 383	428 000	542 779	724 000	230	454	740
	2021	227 493 730	401 000	505 620	678 000	230	460	760
Saudi Arabia[1,2]	2000	1 726 161	–	6 608	–	–	0	–
	2001	1 769 303	–	3 074	–	–	0	–
	2002	1 812 361	–	2 612	–	–	0	–
	2003	1 854 614	–	1 724	–	–	0	–
	2004	1 895 547	–	1 232	–	–	0	–
	2005	1 954 495	–	1 059	–	–	0	–
	2006	2 033 421	–	1 278	–	–	0	–
	2007	2 114 909	–	467	–	–	0	–
	2008	2 198 006	–	61	–	–	0	–
	2009	2 281 836	–	58	–	–	0	–
	2010	2 356 189	–	29	–	–	0	–
	2011	2 415 392	–	69	–	–	0	–
	2012	2 469 113	–	82	–	–	0	–
	2013	2 522 062	–	34	–	–	0	–
	2014	2 573 578	–	30	–	–	0	–
	2015	2 623 590	–	83	–	–	0	–
	2016	2 676 977	–	272	–	–	0	–
	2017	2 739 210	–	177	–	–	0	–
	2018	2 805 302	–	61	–	–	0	–
	2019	2 870 129	–	38	–	–	0	–
	2020	2 883 728	–	83	–	–	0	–
	2021	2 879 986	–	0	–	–	0	–
Somalia	2000	8 721 465	677 000	1 177 314	1 906 000	1 130	3 013	5 970
	2001	9 070 747	833 000	1 283 399	1 902 000	1 330	3 285	6 200
	2002	9 411 103	818 000	1 236 218	1 768 000	1 280	3 164	5 800
	2003	9 758 281	857 000	1 268 524	1 814 000	1 340	3 247	5 870
	2004	10 117 354	874 000	1 245 035	1 743 000	1 330	3 187	5 670
	2005	10 467 292	996 000	1 392 857	1 881 000	1 530	3 565	6 280
	2006	10 784 973	940 000	1 274 766	1 689 000	1 400	3 263	5 700
	2007	11 118 092	825 000	1 128 218	1 510 000	1 190	2 796	4 850
	2008	11 444 870	525 000	719 911	965 000	770	1 811	3 140
	2009	11 730 037	325 000	454 522	618 000	490	1 143	2 000
	2010	12 026 649	359 000	500 313	679 000	550	1 280	2 240
	2011	12 216 837	300 000	419 303	571 000	460	1 073	1 890
	2012	12 440 326	313 000	433 472	589 000	480	1 109	1 940
	2013	12 852 485	381 000	534 460	729 000	570	1 352	2 380
	2014	13 309 235	476 000	668 820	917 000	690	1 628	2 870
	2015	13 763 906	572 000	811 764	1 112 000	840	1 989	3 530
	2016	14 292 847	560 000	837 484	1 192 000	850	2 051	3 700
	2017	14 864 221	513 000	820 464	1 237 000	830	2 100	3 900
	2018	15 411 094	579 000	913 696	1 366 000	880	2 198	4 100
	2019	15 981 300	624 000	957 015	1 400 000	940	2 311	4 260
	2020	16 537 016	570 000	926 877	1 451 000	900	2 372	4 570
	2021	17 065 580	688 000	1 131 892	1 767 000	1 000	2 506	4 870

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WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Sudan	2000	26 298 772	1 624 000	2 439 775	3 493 000	2 480	5 978	10 900
	2001	26 947 252	1 516 000	2 326 967	3 408 000	2 300	5 702	10 600
	2002	27 570 318	1 156 000	1 837 673	2 863 000	1 790	4 503	8 580
	2003	28 188 976	1 061 000	1 722 030	2 663 000	1 640	4 219	8 020
	2004	28 831 550	988 000	1 596 519	2 429 000	1 560	3 911	7 430
	2005	29 540 576	994 000	1 614 440	2 428 000	1 600	3 956	7 510
	2006	30 332 968	1 009 000	1 597 895	2 435 000	1 560	3 915	7 430
	2007	31 191 164	961 000	1 450 820	2 105 000	1 460	3 555	6 560
	2008	32 065 240	887 000	1 238 850	1 678 000	1 290	3 035	5 340
	2009	32 948 156	850 000	1 140 986	1 493 000	1 210	2 795	4 780
	2010	33 739 932	820 000	1 104 287	1 457 000	1 180	2 705	4 680
	2011	34 419 624	836 000	1 120 801	1 478 000	1 190	2 746	4 700
	2012	35 159 792	868 000	1 162 568	1 530 000	1 240	2 848	4 830
	2013	35 990 704	924 000	1 257 489	1 683 000	1 330	3 081	5 320
	2014	37 003 244	1 008 000	1 427 317	1 956 000	1 510	3 497	6 230
	2015	38 171 176	1 053 000	1 611 298	2 378 000	1 620	3 948	7 300
	2016	39 377 168	1 185 000	2 097 220	3 462 000	1 700	4 527	9 060
	2017	40 679 828	1 075 000	2 187 618	3 956 000	1 810	5 213	11 300
	2018	41 999 060	1 154 000	2 485 883	4 696 000	1 930	5 882	12 800
	2019	43 232 092	1 360 000	2 835 630	5 217 000	2 240	6 673	14 400
	2020	44 440 488	1 614 000	3 261 859	5 853 000	2 690	7 635	16 400
	2021	45 657 200	1 643 000	3 325 874	5 906 000	2 680	7 784	16 800
Syrian Arab Republic[1,2]	2000	16 307 654	–	6	–	–	0	–
	2001	16 727 948	–	63	–	–	0	–
	2002	17 164 020	–	15	–	–	0	–
	2003	17 611 356	–	2	–	–	0	–
	2004	18 084 008	–	1	–	–	0	–
	2005	18 583 556	–	0	–	–	0	–
	2006	19 432 008	–	0	–	–	0	–
	2007	20 703 004	–	0	–	–	0	–
	2008	21 474 060	–	0	–	–	0	–
	2009	21 827 220	–	0	–	–	0	–
	2010	22 337 564	–	0	–	–	0	–
	2011	22 730 732	–	0	–	–	0	–
	2012	22 605 576	–	0	–	–	0	–
	2013	21 495 820	–	0	–	–	0	–
	2014	20 072 232	–	0	–	–	0	–
	2015	19 205 178	–	0	–	–	0	–
	2016	18 964 252	–	0	–	–	0	–
	2017	18 983 372	–	0	–	–	0	–
	2018	19 333 464	–	0	–	–	0	–
	2019	20 098 252	–	0	–	–	0	–
	2020	20 772 596	–	0	–	–	0	–
	2021	21 324 368	–	0	–	–	0	–
United Arab Emirates[1,2,3]	2000	3 275 333	–	0	–	–	0	–
	2001	3 454 198	–	0	–	–	0	–
	2002	3 633 655	–	0	–	–	0	–
	2003	3 813 443	–	0	–	–	0	–
	2004	3 993 339	–	0	–	–	0	–
	2005	4 280 993	–	0	–	–	0	–
	2006	4 898 954	–	0	–	–	0	–
	2007	5 872 624	–	0	–	–	0	–
	2008	6 988 685	–	0	–	–	0	–
	2009	7 992 644	–	0	–	–	0	–
	2010	8 481 771	–	0	–	–	0	–
	2011	8 575 205	–	0	–	–	0	–
	2012	8 664 969	–	0	–	–	0	–
	2013	8 751 847	–	0	–	–	0	–
	2014	8 835 951	–	0	–	–	0	–
	2015	8 916 899	–	0	–	–	0	–
	2016	8 994 263	–	0	–	–	0	–
	2017	9 068 296	–	0	–	–	0	–
	2018	9 140 169	–	0	–	–	0	–
	2019	9 211 657	–	0	–	–	0	–
	2020	9 287 289	–	0	–	–	0	–
	2021	9 365 145	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EASTERN MEDITERRANEAN								
Yemen	2000	12 010 295	453 000	1 061 470	4 602 000	800	2 656	12 100
	2001	12 342 168	526 000	1 182 990	5 327 000	930	2 961	14 100
	2002	12 675 615	628 000	1 307 377	6 120 000	1 080	3 283	15 500
	2003	13 016 123	500 000	1 188 478	5 500 000	890	2 964	15 200
	2004	13 367 241	441 000	956 179	4 233 000	780	2 391	11 600
	2005	13 745 863	441 000	1 002 795	4 657 000	800	2 495	12 100
	2006	14 162 111	546 000	1 201 845	5 711 000	970	3 027	15 100
	2007	14 597 452	431 000	852 425	1 854 000	730	2 117	5 340
	2008	15 040 675	279 000	539 905	1 223 000	490	1 361	3 570
	2009	15 492 355	358 000	702 010	1 641 000	630	1 779	4 930
	2010	15 952 916	642 000	1 131 912	2 166 000	1 080	2 866	6 460
	2011	16 424 635	492 000	792 771	1 319 000	800	2 015	4 090
	2012	16 906 745	575 000	860 962	1 313 000	900	2 197	4 240
	2013	17 397 125	491 000	700 432	1 014 000	750	1 786	3 290
	2014	17 893 110	412 000	587 292	851 000	620	1 498	2 760
	2015	18 385 186	361 000	513 816	743 000	550	1 309	2 430
	2016	18 873 534	468 000	661 252	951 000	710	1 681	3 180
	2017	19 363 770	528 000	747 173	1 068 000	810	1 886	3 480
	2018	19 851 258	603 000	871 031	1 264 000	930	2 211	4 200
	2019	20 338 783	582 000	831 533	1 200 000	900	2 108	3 900
	2020	20 814 170	562 000	800 213	1 154 000	850	2 030	3 750
	2021	21 263 922	690 000	979 967	1 420 000	1 030	2 455	4 550
EUROPEAN								
Armenia[1,2,3]	2000	3 168 523	–	141	–	–	0	–
	2001	3 133 133	–	79	–	–	0	–
	2002	3 105 037	–	52	–	–	0	–
	2003	3 084 102	–	29	–	–	0	–
	2004	3 065 745	–	47	–	–	0	–
	2005	3 047 246	–	7	–	–	0	–
	2006	3 026 486	–	0	–	–	0	–
	2007	3 004 393	–	0	–	–	0	–
	2008	2 983 421	–	0	–	–	0	–
	2009	2 964 296	–	0	–	–	0	–
	2010	2 946 293	–	0	–	–	0	–
	2011	2 928 976	–	0	–	–	0	–
	2012	2 914 421	–	0	–	–	0	–
	2013	2 901 385	–	0	–	–	0	–
	2014	2 889 930	–	0	–	–	0	–
	2015	2 878 595	–	0	–	–	0	–
	2016	2 865 835	–	0	–	–	0	–
	2017	2 851 923	–	0	–	–	0	–
	2018	2 836 557	–	0	–	–	0	–
	2019	2 820 602	–	0	–	–	0	–
	2020	2 805 608	–	0	–	–	0	–
	2021	2 790 974	–	0	–	–	0	–
Azerbaijan[1,2]	2000	188 377	–	1 526	–	–	0	–
	2001	190 486	–	1 054	–	–	0	–
	2002	192 558	–	505	–	–	0	–
	2003	194 633	–	480	–	–	0	–
	2004	196 791	–	386	–	–	0	–
	2005	199 093	–	242	–	–	0	–
	2006	201 557	–	141	–	–	0	–
	2007	204 203	–	108	–	–	0	–
	2008	206 993	–	72	–	–	0	–
	2009	209 751	–	78	–	–	0	–
	2010	212 455	–	50	–	–	0	–
	2011	215 257	–	4	–	–	0	–
	2012	218 168	–	3	–	–	0	–
	2013	221 132	–	0	–	–	0	–
	2014	224 063	–	0	–	–	0	–
	2015	226 860	–	0	–	–	0	–
	2016	229 453	–	0	–	–	0	–
	2017	231 646	–	0	–	–	0	–
	2018	233 508	–	0	–	–	0	–
	2019	235 353	–	0	–	–	0	–
	2020	236 553	–	0	–	–	0	–
	2021	237 198	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EUROPEAN								
Georgia[1,2]	2000	42 651	–	245	–	–	0	–
	2001	41 444	–	438	–	–	0	–
	2002	40 611	–	474	–	–	0	–
	2003	40 178	–	316	–	–	0	–
	2004	39 888	–	257	–	–	0	–
	2005	39 611	–	155	–	–	0	–
	2006	39 338	–	59	–	–	0	–
	2007	39 064	–	24	–	–	0	–
	2008	38 796	–	6	–	–	0	–
	2009	38 552	–	1	–	–	0	–
	2010	38 368	–	0	–	–	0	–
	2011	38 216	–	0	–	–	0	–
	2012	38 043	–	0	–	–	0	–
	2013	37 860	–	0	–	–	0	–
	2014	37 742	–	0	–	–	0	–
	2015	37 711	–	0	–	–	0	–
	2016	37 711	–	0	–	–	0	–
	2017	37 719	–	0	–	–	0	–
	2018	37 723	–	0	–	–	0	–
	2019	37 708	–	0	–	–	0	–
	2020	37 659	–	0	–	–	0	–
	2021	37 579	–	0	–	–	0	–
Kazakhstan[1,2,3]	2000	15 236 253	–	0	–	–	0	–
	2001	15 281 285	–	0	–	–	0	–
	2002	15 338 963	–	0	–	–	0	–
	2003	15 416 712	–	0	–	–	0	–
	2004	15 521 923	–	0	–	–	0	–
	2005	15 656 248	–	0	–	–	0	–
	2006	15 822 748	–	0	–	–	0	–
	2007	16 006 136	–	0	–	–	0	–
	2008	16 196 517	–	0	–	–	0	–
	2009	16 402 369	–	0	–	–	0	–
	2010	16 627 837	–	0	–	–	0	–
	2011	16 864 916	–	0	–	–	0	–
	2012	17 102 864	–	0	–	–	0	–
	2013	17 345 732	–	0	–	–	0	–
	2014	17 592 298	–	0	–	–	0	–
	2015	17 835 908	–	0	–	–	0	–
	2016	18 078 552	–	0	–	–	0	–
	2017	18 314 814	–	0	–	–	0	–
	2018	18 538 100	–	0	–	–	0	–
	2019	18 754 258	–	0	–	–	0	–
	2020	18 979 244	–	0	–	–	0	–
	2021	19 196 464	–	0	–	–	0	–
Kyrgyzstan[1,2,3]	2000	3 849 441	–	7	–	–	0	–
	2001	3 885 526	–	15	–	–	0	–
	2002	3 920 779	–	2 725	–	–	0	–
	2003	3 961 055	–	461	–	–	0	–
	2004	4 006 891	–	91	–	–	0	–
	2005	4 050 628	–	225	–	–	0	–
	2006	4 092 492	–	318	–	–	0	–
	2007	4 129 917	–	96	–	–	0	–
	2008	4 169 423	–	18	–	–	0	–
	2009	4 222 986	–	1	–	–	0	–
	2010	4 277 343	–	3	–	–	0	–
	2011	4 330 822	–	0	–	–	0	–
	2012	4 392 921	–	0	–	–	0	–
	2013	4 461 256	–	0	–	–	0	–
	2014	4 535 245	–	0	–	–	0	–
	2015	4 613 684	–	0	–	–	0	–
	2016	4 694 273	–	0	–	–	0	–
	2017	4 774 583	–	0	–	–	0	–
	2018	4 854 325	–	0	–	–	0	–
	2019	4 932 441	–	0	–	–	0	–
	2020	5 011 401	–	0	–	–	0	–
	2021	5 091 639	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EUROPEAN								
Tajikistan[1,2]	2000	2 095 181	–	19 064	–	–	0	–
	2001	2 140 542	–	11 387	–	–	0	–
	2002	2 184 946	–	6 160	–	–	0	–
	2003	2 228 612	–	5 428	–	–	0	–
	2004	2 271 602	–	3 588	–	–	0	–
	2005	2 314 334	–	2 309	–	–	0	–
	2006	2 357 177	–	1 344	–	–	0	–
	2007	2 400 922	–	635	–	–	0	–
	2008	2 446 425	–	318	–	–	0	–
	2009	2 494 511	–	164	–	–	0	–
	2010	2 545 674	–	112	–	–	0	–
	2011	2 600 129	–	78	–	–	0	–
	2012	2 657 431	–	28	–	–	0	–
	2013	2 717 627	–	4	–	–	0	–
	2014	2 781 000	–	2	–	–	0	–
	2015	2 847 037	–	0	–	–	0	–
	2016	2 914 256	–	0	–	–	0	–
	2017	2 981 125	–	0	–	–	0	–
	2018	3 048 796	–	0	–	–	0	–
	2019	3 118 559	–	0	–	–	0	–
	2020	3 187 431	–	0	–	–	0	–
	2021	3 256 521	–	0	–	–	0	–
Türkiye[1,2]	2000	4 167 380	–	11 432	–	–	0	–
	2001	4 229 681	–	10 812	–	–	0	–
	2002	4 289 263	–	10 224	–	–	0	–
	2003	4 346 376	–	9 222	–	–	0	–
	2004	4 406 029	–	5 302	–	–	0	–
	2005	4 465 806	–	2 084	–	–	0	–
	2006	4 524 086	–	796	–	–	0	–
	2007	4 580 476	–	313	–	–	0	–
	2008	4 635 847	–	166	–	–	0	–
	2009	4 694 666	–	38	–	–	0	–
	2010	4 757 697	–	0	–	–	0	–
	2011	4 821 300	–	0	–	–	0	–
	2012	4 893 033	–	0	–	–	0	–
	2013	4 977 447	–	0	–	–	0	–
	2014	5 077 284	–	0	–	–	0	–
	2015	5 177 001	–	0	–	–	0	–
	2016	5 266 260	–	0	–	–	0	–
	2017	5 335 838	–	0	–	–	0	–
	2018	5 382 604	–	0	–	–	0	–
	2019	5 426 309	–	0	–	–	0	–
	2020	5 468 802	–	0	–	–	0	–
	2021	5 510 401	–	0	–	–	0	–
Turkmenistan[1,2,3]	2000	296 993	–	24	–	–	0	–
	2001	301 281	–	8	–	–	0	–
	2002	305 432	–	18	–	–	0	–
	2003	309 334	–	7	–	–	0	–
	2004	313 286	–	3	–	–	0	–
	2005	317 575	–	1	–	–	0	–
	2006	322 011	–	1	–	–	0	–
	2007	326 618	–	0	–	–	0	–
	2008	331 505	–	0	–	–	0	–
	2009	336 762	–	0	–	–	0	–
	2010	342 418	–	0	–	–	0	–
	2011	348 452	–	0	–	–	0	–
	2012	354 814	–	0	–	–	0	–
	2013	361 406	–	0	–	–	0	–
	2014	368 104	–	0	–	–	0	–
	2015	374 818	–	0	–	–	0	–
	2016	381 456	–	0	–	–	0	–
	2017	387 944	–	0	–	–	0	–
	2018	394 229	–	0	–	–	0	–
	2019	400 297	–	0	–	–	0	–
	2020	406 278	–	0	–	–	0	–
	2021	412 220	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
EUROPEAN								
Uzbekistan[1,2,3]	2000	24 925	–	126	–	–	0	–
	2001	25 248	–	77	–	–	0	–
	2002	25 579	–	74	–	–	0	–
	2003	25 905	–	74	–	–	0	–
	2004	26 234	–	66	–	–	0	–
	2005	26 573	–	102	–	–	0	–
	2006	26 926	–	73	–	–	0	–
	2007	27 309	–	30	–	–	0	–
	2008	27 726	–	7	–	–	0	–
	2009	28 167	–	0	–	–	0	–
	2010	28 614	–	3	–	–	0	–
	2011	29 057	–	0	–	–	0	–
	2012	29 503	–	0	–	–	0	–
	2013	29 963	–	0	–	–	0	–
	2014	30 446	–	0	–	–	0	–
	2015	30 949	–	0	–	–	0	–
	2016	31 453	–	0	–	–	0	–
	2017	31 945	–	0	–	–	0	–
	2018	32 449	–	0	–	–	0	–
	2019	32 976	–	0	–	–	0	–
	2020	33 526	–	0	–	–	0	–
	2021	34 081	–	0	–	–	0	–
SOUTH-EAST ASIA								
Bangladesh	2000	13 892 158	42 000	94 616	151 000	61	199	400
	2001	14 158 526	43 000	96 431	152 000	63	203	400
	2002	14 424 055	42 000	98 239	157 000	63	206	410
	2003	14 678 189	43 000	99 970	158 000	65	210	420
	2004	14 924 059	44 000	101 645	164 000	66	213	430
	2005	15 152 331	46 000	103 199	165 000	67	216	440
	2006	15 336 878	41 000	68 539	103 000	55	139	260
	2007	15 498 937	78 000	126 937	185 000	110	263	480
	2008	15 637 153	96 000	121 043	150 000	120	264	440
	2009	15 775 383	68 000	80 603	94 000	85	187	300
	2010	15 956 498	59 000	69 307	80 000	76	166	270
	2011	16 152 189	54 000	63 432	73 000	71	155	250
	2012	16 354 308	31 000	35 375	40 000	39	85	140
	2013	16 562 861	28 000	31 594	35 000	35	77	120
	2014	16 770 518	60 000	66 274	74 000	74	160	250
	2015	16 971 459	41 000	45 478	50 000	49	105	170
	2016	17 181 635	29 000	31 621	35 000	33	72	110
	2017	17 397 705	30 000	33 331	37 000	34	73	110
	2018	17 600 935	11 000	12 397	14 000	12	26	42
	2019	17 797 959	18 000	21 202	25 000	22	47	77
	2020	18 002 774	6 400	7 545	8 800	7	15	25
	2021	18 210 878	7 700	8 974	10 000	7	16	27
Bhutan[1,2]	2000	434 533	–	5 935	–	–	15	–
	2001	446 393	–	5 982	–	–	14	–
	2002	458 095	–	6 511	–	–	11	–
	2003	469 623	–	3 806	–	–	14	–
	2004	480 993	–	2 670	–	–	7	–
	2005	490 859	–	1 825	–	–	5	–
	2006	498 212	–	1 868	–	–	7	–
	2007	504 394	–	793	–	–	2	–
	2008	510 405	–	329	–	–	2	–
	2009	516 281	–	1 057	–	–	4	–
	2010	522 081	–	436	–	–	2	–
	2011	527 864	–	194	–	–	1	–
	2012	533 647	–	82	–	–	1	–
	2013	539 377	–	15	–	–	0	–
	2014	544 904	–	19	–	–	0	–
	2015	550 022	–	34	–	–	0	–
	2016	554 823	–	15	–	–	0	–
	2017	559 529	–	11	–	–	0	–
	2018	563 951	–	6	–	–	0	–
	2019	567 919	–	2	–	–	0	–
	2020	571 654	–	22	–	–	0	–
	2021	575 339	–	9	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
SOUTH-EAST ASIA								
Democratic People's Republic of Korea[1,2]	2000	9 124 369	–	90 582	–	–	0	–
	2001	9 181 169	–	115 615	–	–	0	–
	2002	9 230 327	–	98 852	–	–	0	–
	2003	9 286 281	–	16 538	–	–	0	–
	2004	9 351 578	–	15 827	–	–	0	–
	2005	9 410 951	–	6 728	–	–	0	–
	2006	9 463 579	–	6 913	–	–	0	–
	2007	9 510 728	–	4 795	–	–	0	–
	2008	9 554 673	–	16 611	–	–	0	–
	2009	9 598 587	–	14 632	–	–	0	–
	2010	9 639 559	–	13 520	–	–	0	–
	2011	9 677 573	–	16 760	–	–	0	–
	2012	9 718 176	–	21 850	–	–	0	–
	2013	9 762 710	–	14 407	–	–	0	–
	2014	9 811 252	–	10 535	–	–	0	–
	2015	9 862 750	–	7 022	–	–	0	–
	2016	9 914 135	–	5 033	–	–	0	–
	2017	9 963 612	–	4 603	–	–	0	–
	2018	10 011 184	–	3 698	–	–	0	–
	2019	10 056 984	–	1 869	–	–	0	–
	2020	10 100 728	–	1 819	–	–	0	–
	2021	10 141 510	–	2 357	–	–	0	–
India	2000	990 121 695	15 350 000	19 692 324	25 830 000	14 300	29 561	48 400
	2001	1 008 190 390	15 790 000	20 074 161	25 840 000	13 900	28 669	46 800
	2002	1 026 263 749	14 720 000	18 873 095	24 610 000	13 200	27 176	44 900
	2003	1 044 112 732	15 750 000	20 204 783	25 900 000	13 600	27 816	45 700
	2004	1 061 725 619	17 290 000	22 459 649	29 460 000	15 100	31 229	51 000
	2005	1 078 894 419	18 090 000	24 222 815	33 260 000	15 500	32 539	54 000
	2006	1 095 466 041	14 620 000	19 820 336	27 740 000	13 200	27 819	47 500
	2007	1 111 647 995	14 190 000	19 163 338	27 170 000	13 100	27 709	47 600
	2008	1 127 573 041	14 460 000	20 063 261	29 060 000	13 800	29 850	52 100
	2009	1 143 369 395	14 800 000	20 663 404	29 800 000	14 500	32 038	56 900
	2010	1 159 229 377	14 800 000	20 241 628	28 330 000	14 500	30 654	53 200
	2011	1 175 121 294	12 760 000	17 298 372	24 320 000	12 000	25 663	44 400
	2012	1 190 880 809	10 330 000	14 056 674	19 770 000	9 590	20 485	34 800
	2013	1 206 433 770	8 181 000	10 943 831	15 260 000	7 840	16 683	28 500
	2014	1 221 491 095	8 380 000	11 138 430	15 460 000	9 350	20 130	34 600
	2015	1 236 086 513	8 956 000	11 856 993	16 020 000	9 930	21 702	37 200
	2016	1 250 821 747	8 835 000	12 411 360	17 850 000	10 100	22 399	39 900
	2017	1 265 360 473	6 853 000	9 333 319	13 220 000	7 480	16 285	28 500
	2018	1 279 196 649	4 642 000	6 743 582	9 436 000	4 430	9 630	16 800
	2019	1 292 379 912	3 697 000	5 549 896	7 805 000	3 530	7 704	13 300
	2020	1 304 784 080	2 750 000	4 133 982	5 976 000	3 170	7 316	12 900
	2021	1 315 227 711	2 874 000	4 265 027	5 880 000	3 270	7 450	13 100
Indonesia	2000	214 072 416	945 000	1 141 362	1 401 000	750	1 550	2 610
	2001	217 112 432	954 000	1 157 570	1 424 000	760	1 572	2 650
	2002	220 115 088	970 000	1 173 580	1 440 000	760	1 593	2 700
	2003	223 080 128	983 000	1 189 388	1 461 000	770	1 615	2 720
	2004	225 938 592	985 000	1 087 185	1 212 000	710	1 367	2 060
	2005	228 805 152	1 069 000	1 187 260	1 324 000	840	1 647	2 510
	2006	231 797 424	1 250 000	1 385 963	1 548 000	1 010	1 957	2 980
	2007	234 858 288	1 034 000	1 252 185	1 546 000	810	1 701	2 870
	2008	237 936 544	1 047 000	1 268 598	1 561 000	820	1 723	2 900
	2009	240 981 296	1 061 000	1 284 831	1 581 000	840	1 744	2 920
	2010	244 016 176	1 790 000	1 991 459	2 217 000	1 630	3 209	4 900
	2011	247 099 696	1 635 000	1 811 566	2 023 000	1 450	2 875	4 410
	2012	250 222 688	1 618 000	1 797 022	1 999 000	1 440	2 837	4 360
	2013	253 275 920	1 381 000	1 529 542	1 706 000	1 230	2 446	3 750
	2014	256 229 760	1 047 000	1 163 077	1 293 000	960	1 895	2 900
	2015	259 091 968	938 000	1 039 394	1 158 000	830	1 651	2 530
	2016	261 850 176	980 000	1 087 349	1 212 000	950	1 893	2 900
	2017	264 498 848	681 000	744 237	816 000	650	1 306	1 990
	2018	267 066 848	606 000	662 497	728 000	570	1 142	1 730
	2019	269 582 880	706 000	774 340	851 000	690	1 395	2 140
	2020	271 857 984	704 000	769 298	845 000	700	1 415	2 170
	2021	273 753 184	746 000	811 636	891 000	700	1 412	2 160

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
SOUTH-EAST ASIA								
Myanmar	2000	27 103 504	943 000	1 355 454	2 000 000	1 190	2 742	5 050
	2001	27 387 102	956 000	1 369 637	2 006 000	1 210	2 771	5 100
	2002	27 664 104	965 000	1 383 490	2 034 000	1 220	2 799	5 190
	2003	27 928 400	972 000	1 396 707	2 058 000	1 210	2 826	5 240
	2004	28 174 897	984 000	1 409 035	2 087 000	1 230	2 851	5 240
	2005	28 404 651	998 000	1 420 525	2 124 000	1 280	2 874	5 320
	2006	28 621 177	653 000	1 017 913	1 574 000	870	2 041	3 870
	2007	28 833 880	943 000	1 285 206	1 871 000	1 160	2 560	4 660
	2008	29 002 816	1 159 000	1 573 810	2 287 000	1 460	3 222	5 890
	2009	29 173 245	1 098 000	1 492 378	2 143 000	1 380	3 023	5 410
	2010	29 396 528	1 102 000	1 507 212	2 134 000	1 580	3 623	6 490
	2011	29 636 702	1 019 000	1 326 603	1 775 000	1 440	3 214	5 580
	2012	29 888 858	1 259 000	1 754 334	2 551 000	1 520	3 412	6 310
	2013	30 144 876	452 000	611 838	842 000	530	1 169	2 090
	2014	30 397 292	281 000	383 705	533 000	320	729	1 310
	2015	30 642 216	219 000	271 652	328 000	230	481	790
	2016	30 885 287	131 000	162 032	195 000	130	274	440
	2017	31 120 974	98 000	120 755	145 000	99	209	340
	2018	31 345 759	88 000	108 681	131 000	79	164	270
	2019	31 568 473	63 000	78 326	94 000	48	97	160
	2020	31 796 420	66 000	82 144	98 000	39	77	120
	2021	32 019 543	177 000	292 857	1 253 000	98	231	990
Nepal	2000	7 129 131	27 000	47 986	78 000	9	25	49
	2001	7 244 248	21 000	55 778	118 000	7	28	70
	2002	7 353 424	42 000	85 217	153 000	23	62	130
	2003	7 455 234	30 000	72 856	151 000	15	46	110
	2004	7 548 430	15 000	34 773	75 000	7	24	61
	2005	7 630 041	15 000	36 030	84 000	7	26	69
	2006	7 697 927	14 000	35 567	82 000	9	32	85
	2007	7 754 440	18 000	42 145	91 000	12	39	96
	2008	7 803 174	13 000	31 003	74 000	7	25	66
	2009	7 845 380	12 000	25 643	59 000	7	21	55
	2010	7 884 459	15 000	30 196	63 000	9	27	64
	2011	7 914 890	9 800	18 512	39 000	5	16	39
	2012	7 933 553	8 500	13 662	28 000	5	13	31
	2013	7 948 318	7 000	10 164	17 000	2	6	13
	2014	7 971 700	3 000	4 912	9 900	0	3	7
	2015	8 014 724	2 400	4 370	9 200	0	2	6
	2016	8 087 545	2 300	3 353	5 800	0	2	4
	2017	8 181 084	2 200	2 690	3 400	0	0	1
	2018	8 274 928	2 000	2 736	3 900	0	1	2
	2019	8 369 496	380	464	590	–	0	–
	2020	8 519 319	200	244	300	–	0	–
	2021	8 718 556	86	106	130	–	0	–
Sri Lanka[1,2,3]	2000	4 318 565	–	210 039	–	–	77	–
	2001	4 351 663	–	66 522	–	–	52	–
	2002	4 395 462	–	41 411	–	–	30	–
	2003	4 439 731	–	10 510	–	–	4	–
	2004	4 482 799	–	3 720	–	–	1	–
	2005	4 524 989	–	1 640	–	–	0	–
	2006	4 570 262	–	591	–	–	1	–
	2007	4 618 090	–	198	–	–	1	–
	2008	4 665 698	–	649	–	–	0	–
	2009	4 710 969	–	531	–	–	0	–
	2010	4 753 767	–	684	–	–	0	–
	2011	4 797 741	–	124	–	–	0	–
	2012	4 833 944	–	23	–	–	0	–
	2013	4 860 303	–	0	–	–	0	–
	2014	4 885 074	–	0	–	–	0	–
	2015	4 907 440	–	0	–	–	0	–
	2016	4 927 863	–	0	–	–	0	–
	2017	4 946 566	–	0	–	–	0	–
	2018	4 963 563	–	0	–	–	0	–
	2019	4 979 422	–	0	–	–	0	–
	2020	4 994 468	–	0	–	–	0	–
	2021	5 007 891	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
SOUTH-EAST ASIA								
Thailand[1,2]	2000	11 967 518	–	78 561	–	–	625	–
	2001	12 078 203	–	63 528	–	–	424	–
	2002	12 186 876	–	44 555	–	–	361	–
	2003	12 292 075	–	37 355	–	–	204	–
	2004	12 393 447	–	26 690	–	–	230	–
	2005	12 490 261	–	29 782	–	–	161	–
	2006	12 584 792	–	30 294	–	–	113	–
	2007	12 681 044	–	33 178	–	–	97	–
	2008	12 776 206	–	28 569	–	–	101	–
	2009	12 868 319	–	29 462	–	–	70	–
	2010	12 955 007	–	32 480	–	–	80	–
	2011	13 038 950	–	24 897	–	–	43	–
	2012	13 123 236	–	46 895	–	–	37	–
	2013	13 203 235	–	41 602	–	–	47	–
	2014	13 275 788	–	41 218	–	–	38	–
	2015	13 339 065	–	14 265	–	–	33	–
	2016	13 398 391	–	7 727	–	–	27	–
	2017	13 453 642	–	4 393	–	–	15	–
	2018	13 497 211	–	4 454	–	–	15	–
	2019	13 531 360	–	3 644	–	–	13	–
	2020	13 563 222	–	2 988	–	–	3	–
	2021	13 587 025	–	2 219	–	–	0	–
Timor-Leste	2000	826 105	55 000	128 146	290 000	64	244	680
	2001	839 875	56 000	130 282	296 000	64	248	680
	2002	855 524	70 000	104 357	142 000	86	199	350
	2003	871 589	57 000	67 524	79 000	60	125	200
	2004	889 711	141 000	234 045	328 000	180	449	810
	2005	911 648	105 000	153 748	209 000	130	304	530
	2006	935 396	102 000	164 285	235 000	140	326	590
	2007	958 719	82 000	114 693	152 000	100	226	390
	2008	981 022	89 000	134 166	185 000	120	271	480
	2009	1 002 150	66 000	100 128	139 000	83	198	350
	2010	1 023 731	68 000	95 412	127 000	85	194	330
	2011	1 046 764	25 000	30 828	38 000	30	65	110
	2012	1 069 995	6 100	7 263	8 500	4	9	15
	2013	1 092 453	1 200	1 418	1 700	0	1	2
	2014	1 114 343	400	473	550	0	0	1
	2015	1 134 078	93	110	130	–	0	–
	2016	1 151 712	94	112	130	–	0	–
	2017	1 169 274	18	22	25	–	0	–
	2018	1 186 777	–	0	–	–	0	–
	2019	1 204 264	–	0	–	–	0	–
	2020	1 222 657	3	4	4	–	0	–
	2021	1 242 358	–	0	–	–	0	–
WESTERN PACIFIC								
Cambodia	2000	8 570 323	421 000	669 109	985 000	640	1 582	2 970
	2001	8 725 446	282 000	388 681	524 000	390	904	1 580
	2002	8 883 564	257 000	349 008	463 000	350	803	1 400
	2003	9 043 340	366 000	464 899	589 000	480	1 062	1 780
	2004	9 205 047	329 000	403 094	495 000	420	894	1 470
	2005	9 367 851	329 000	388 706	461 000	350	705	1 120
	2006	9 531 350	340 000	437 975	576 000	410	897	1 530
	2007	9 698 963	140 000	191 165	272 000	180	394	710
	2008	9 860 978	163 000	214 883	291 000	220	497	880
	2009	10 010 797	332 000	426 267	554 000	400	853	1 430
	2010	10 157 746	291 000	353 293	430 000	310	644	1 040
	2011	10 306 505	320 000	368 041	425 000	310	641	1 000
	2012	10 456 963	226 000	260 016	302 000	190	383	600
	2013	10 607 625	146 000	168 806	197 000	120	231	360
	2014	10 756 937	207 000	240 449	280 000	200	399	630
	2015	10 903 118	189 000	218 837	256 000	180	374	590
	2016	11 049 549	107 000	124 137	145 000	100	204	320
	2017	11 195 304	175 000	202 696	237 000	160	336	520
	2018	11 332 888	235 000	272 272	319 000	140	265	400
	2019	11 461 955	121 000	140 073	164 000	52	102	160
	2020	11 595 695	37 000	43 341	51 000	13	27	42
	2021	11 731 591	17 000	19 064	22 000	4	10	16

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
WESTERN PACIFIC								
China[1,2,3]	2000	528 671 513	–	8 025	–	–	39	–
	2001	532 285 148	–	21 237	–	–	30	–
	2002	535 708 905	–	25 520	–	–	42	–
	2003	539 032 609	–	28 491	–	–	52	–
	2004	542 354 708	–	27 197	–	–	31	–
	2005	545 730 071	–	21 936	–	–	48	–
	2006	549 159 074	–	35 383	–	–	38	–
	2007	552 683 257	–	29 304	–	–	18	–
	2008	556 302 513	–	16 650	–	–	23	–
	2009	560 049 121	–	9 287	–	–	12	–
	2010	563 840 590	–	4 990	–	–	19	–
	2011	567 564 448	–	1 308	–	–	33	–
	2012	571 523 044	–	244	–	–	0	–
	2013	575 512 689	–	83	–	–	0	–
	2014	579 314 007	–	53	–	–	0	–
	2015	582 879 678	–	39	–	–	0	–
	2016	586 298 295	–	1	–	–	0	–
	2017	589 805 615	–	0	–	–	0	–
	2018	592 646 781	–	0	–	–	0	–
	2019	594 651 988	–	0	–	–	0	–
	2020	595 934 137	–	0	–	–	0	–
	2021	596 337 181	–	0	–	–	0	–
Lao People's Democratic Republic	2000	2 825 890	71 000	89 755	111 000	98	221	370
	2001	2 872 124	47 000	62 084	79 000	66	152	260
	2002	2 917 078	37 000	50 404	66 000	52	124	220
	2003	2 960 248	33 000	45 710	62 000	46	110	200
	2004	3 001 408	28 000	40 333	56 000	40	100	180
	2005	3 045 534	23 000	35 002	51 000	34	86	160
	2006	3 094 250	31 000	48 965	74 000	47	123	240
	2007	3 143 555	30 000	45 688	67 000	46	115	220
	2008	3 192 733	28 000	41 446	59 000	42	104	200
	2009	3 241 681	33 000	47 466	66 000	49	120	220
	2010	3 290 327	31 000	43 766	59 000	45	109	200
	2011	3 338 671	22 000	30 366	40 000	30	73	130
	2012	3 386 790	58 000	79 939	106 000	74	174	310
	2013	3 434 630	50 000	68 570	91 000	55	125	220
	2014	3 481 831	64 000	87 770	116 000	61	134	230
	2015	3 531 765	45 000	62 489	83 000	38	80	140
	2016	3 585 851	19 000	26 862	36 000	15	32	55
	2017	3 641 296	11 000	14 609	19 000	9	21	36
	2018	3 697 018	11 000	15 654	21 000	10	23	41
	2019	3 752 719	7 600	10 541	14 000	5	11	19
	2020	3 808 576	4 100	5 674	7 500	3	7	12
	2021	3 863 554	4 600	6 403	8 500	2	6	11
Malaysia[1,2]	2000	917 806	–	12 705	–	–	35	–
	2001	941 700	–	12 780	–	–	46	–
	2002	965 697	–	11 019	–	–	38	–
	2003	989 576	–	6 338	–	–	21	–
	2004	1 013 329	–	6 154	–	–	35	–
	2005	1 036 941	–	5 569	–	–	33	–
	2006	1 060 376	–	5 294	–	–	21	–
	2007	1 083 704	–	4 048	–	–	15	–
	2008	1 106 571	–	6 071	–	–	20	–
	2009	1 128 688	–	5 955	–	–	23	–
	2010	1 148 709	–	5 194	–	–	13	–
	2011	1 167 365	–	3 954	–	–	11	–
	2012	1 186 408	–	3 662	–	–	11	–
	2013	1 205 392	–	1 028	–	–	10	–
	2014	1 224 258	–	596	–	–	4	–
	2015	1 242 753	–	242	–	–	4	–
	2016	1 261 056	–	266	–	–	2	–
	2017	1 279 032	–	85	–	–	1	–
	2018	1 295 970	–	0	–	–	0	–
	2019	1 312 160	–	0	–	–	0	–
	2020	1 327 999	–	0	–	–	0	–
	2021	1 342 954	–	0	–	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
WESTERN PACIFIC								
Papua New Guinea	2000	5 508 297	442 000	1 462 249	2 655 000	810	3 142	6 990
	2001	5 698 489	492 000	1 443 554	2 578 000	850	3 075	6 550
	2002	5 892 596	387 000	1 235 844	2 243 000	620	2 635	5 730
	2003	6 090 980	436 000	1 333 205	2 406 000	690	2 816	6 210
	2004	6 293 166	603 000	1 708 217	3 070 000	960	3 517	7 610
	2005	6 498 818	465 000	1 413 497	2 580 000	710	2 796	6 060
	2006	6 708 217	530 000	1 481 681	2 668 000	810	2 924	6 280
	2007	6 921 066	390 000	1 251 261	2 275 000	680	2 692	5 850
	2008	7 137 988	381 000	1 180 316	2 137 000	620	2 508	5 510
	2009	7 358 890	594 000	1 563 409	2 760 000	980	3 378	7 180
	2010	7 583 269	381 000	1 079 284	1 913 000	670	2 354	5 120
	2011	7 806 637	324 000	899 054	1 609 000	560	2 032	4 430
	2012	8 026 545	408 000	1 249 648	2 563 000	720	2 739	6 420
	2013	8 245 627	780 000	1 420 220	2 240 000	1 270	3 452	6 740
	2014	8 464 153	943 000	1 613 869	2 520 000	1 240	3 142	6 110
	2015	8 682 174	579 000	884 727	1 249 000	780	1 860	3 410
	2016	8 899 169	819 000	1 208 966	1 658 000	1 070	2 568	4 600
	2017	9 114 796	804 000	1 230 223	1 741 000	1 040	2 510	4 570
	2018	9 329 227	839 000	1 301 773	1 845 000	1 070	2 571	4 710
	2019	9 542 486	784 000	1 124 906	1 490 000	960	2 250	3 970
	2020	9 749 640	1 012 000	1 470 120	1 974 000	1 260	2 962	5 310
	2021	9 949 437	856 000	1 237 112	1 652 000	1 040	2 449	4 340
Philippines	2000	45 273 459	60 000	79 974	103 000	88	204	350
	2001	46 242 054	42 000	56 147	73 000	62	143	250
	2002	47 205 780	53 000	70 585	91 000	77	180	320
	2003	48 168 224	76 000	100 493	128 000	110	257	450
	2004	49 134 961	67 000	91 225	119 000	100	233	410
	2005	50 095 357	60 000	83 163	110 000	73	167	290
	2006	51 048 109	72 000	102 993	137 000	87	203	360
	2007	52 011 873	78 000	112 751	152 000	91	218	390
	2008	52 993 876	50 000	74 621	102 000	59	144	260
	2009	53 978 012	40 000	58 824	80 000	49	116	210
	2010	54 959 319	37 000	53 512	71 000	48	113	200
	2011	55 947 279	17 000	23 918	31 000	20	47	83
	2012	56 931 289	14 000	19 171	25 000	15	35	61
	2013	57 899 838	13 000	17 518	22 000	15	36	63
	2014	58 843 596	10 000	14 318	19 000	13	29	53
	2015	59 834 436	20 000	27 904	37 000	26	63	110
	2016	60 905 260	12 000	17 308	23 000	16	38	70
	2017	61 987 318	12 000	16 586	22 000	15	36	66
	2018	63 050 263	7 700	10 900	15 000	10	25	46
	2019	64 102 545	9 500	13 536	18 000	13	31	56
	2020	65 153 787	11 000	15 096	20 000	14	33	61
	2021	66 134 861	7 500	10 609	14 000	9	22	40
Republic of Korea[1,2]	2000	3 275 201	–	4 183	–	–	0	–
	2001	3 294 535	–	2 556	–	–	0	–
	2002	3 312 446	–	1 799	–	–	0	–
	2003	3 327 781	–	1 171	–	–	0	–
	2004	3 340 909	–	864	–	–	0	–
	2005	3 352 270	–	1 369	–	–	0	–
	2006	3 363 454	–	2 051	–	–	0	–
	2007	3 375 442	–	2 227	–	–	1	–
	2008	3 387 903	–	1 063	–	–	0	–
	2009	3 401 161	–	898	–	–	1	–
	2010	3 416 912	–	1 267	–	–	1	–
	2011	3 441 891	–	505	–	–	2	–
	2012	3 474 392	–	394	–	–	0	–
	2013	3 506 875	–	383	–	–	0	–
	2014	3 539 063	–	557	–	–	0	–
	2015	3 569 608	–	627	–	–	0	–
	2016	3 591 698	–	602	–	–	0	–
	2017	3 605 814	–	436	–	–	0	–
	2018	3 617 383	–	501	–	–	0	–
	2019	3 626 267	–	485	–	–	0	–
	2020	3 629 128	–	356	–	–	0	–
	2021	3 628 109	–	274	–	–	0	–

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WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
WESTERN PACIFIC								
Solomon Islands	2000	425 678	134 000	254 582	419 000	180	476	950
	2001	435 991	153 000	285 929	463 000	200	521	1 040
	2002	446 252	156 000	280 109	455 000	200	513	1 010
	2003	456 603	167 000	239 181	346 000	200	456	830
	2004	467 067	189 000	337 823	543 000	250	652	1 300
	2005	477 661	153 000	286 015	471 000	210	547	1 100
	2006	488 495	150 000	281 888	467 000	210	549	1 120
	2007	499 572	111 000	155 491	223 000	140	310	560
	2008	510 840	67 000	93 119	133 000	80	182	330
	2009	522 554	54 000	75 305	108 000	63	142	260
	2010	534 990	65 000	91 425	130 000	73	163	300
	2011	548 183	44 000	62 676	93 000	48	108	200
	2012	562 085	39 000	52 221	73 000	41	89	160
	2013	576 541	40 000	53 689	75 000	39	83	150
	2014	591 401	26 000	34 803	46 000	26	56	93
	2015	606 533	33 000	39 811	49 000	28	57	92
	2016	621 820	72 000	84 179	101 000	51	103	160
	2017	637 197	80 000	103 587	141 000	66	134	230
	2018	652 656	73 000	86 680	103 000	55	109	170
	2019	668 243	108 000	139 245	188 000	79	158	270
	2020	684 279	98 000	112 768	133 000	63	123	190
	2021	700 772	126 000	151 437	183 000	83	162	260
Vanuatu[2]	2000	192 074	13 000	23 167	38 000	13	34	67
	2001	197 034	13 000	18 702	27 000	11	24	45
	2002	202 125	25 000	36 655	53 000	23	52	96
	2003	207 258	28 000	42 687	64 000	29	68	130
	2004	212 422	22 000	30 560	41 000	21	46	78
	2005	217 632	17 000	25 624	39 000	15	35	64
	2006	222 923	14 000	22 943	35 000	13	30	57
	2007	228 345	15 000	27 312	123 000	13	36	170
	2008	233 952	13 000	26 771	122 000	12	37	170
	2009	239 689	8 100	14 887	25 000	8	22	47
	2010	245 453	15 000	20 972	30 000	12	27	48
	2011	251 294	8 900	11 631	16 000	6	14	24
	2012	257 313	6 400	8 394	11 000	–	0	–
	2013	263 534	4 100	5 326	7 200	–	0	–
	2014	269 927	1 900	2 427	3 300	–	0	–
	2015	276 438	690	807	950	–	0	–
	2016	283 218	3 200	4 173	5 600	–	0	–
	2017	290 239	1 700	2 266	3 100	–	0	–
	2018	297 298	890	1 167	1 600	–	0	–
	2019	304 404	800	1 047	1 400	–	0	–
	2020	311 685	700	910	1 200	–	0	–
	2021	319 137	440	576	780	–	0	–
Viet Nam	2000	58 222 974	158 000	201 414	268 000	190	421	730
	2001	58 824 822	147 000	185 145	240 000	180	380	650
	2002	59 432 490	105 000	131 451	171 000	120	271	460
	2003	60 046 786	78 000	96 592	124 000	92	197	340
	2004	60 662 466	47 000	56 559	72 000	54	115	200
	2005	61 274 810	34 000	40 604	51 000	38	79	130
	2006	61 871 553	37 000	43 620	54 000	43	92	150
	2007	62 468 862	24 000	28 022	34 000	25	53	86
	2008	63 084 224	16 000	17 911	22 000	17	37	60
	2009	63 736 960	21 000	22 853	26 000	22	47	76
	2010	64 420 951	21 000	22 959	26 000	21	45	71
	2011	65 112 329	19 000	20 206	23 000	17	36	56
	2012	65 814 096	22 000	23 838	27 000	20	41	63
	2013	66 526 328	19 000	20 760	23 000	17	34	53
	2014	67 239 562	18 000	19 060	21 000	14	29	44
	2015	67 944 047	10 000	11 283	13 000	7	16	24
	2016	68 633 226	4 600	5 024	5 600	3	7	12
	2017	69 301 322	5 000	5 485	6 100	4	9	14
	2018	69 950 815	3 500	3 777	4 200	2	6	9
	2019	70 586 389	3 600	3 856	4 300	3	6	10
	2020	71 229 019	1 500	1 657	1 900	1	2	3
	2021	71 832 867	420	453	510	–	0	–

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
REGIONAL SUMMARY								
African	2000	566 541 740	195 000 000	211 089 820	229 000 000	815 000	840 915	875 000
	2001	582 446 660	197 000 000	215 879 554	237 000 000	806 000	834 330	873 000
	2002	598 937 190	196 000 000	213 799 385	234 000 000	769 000	795 664	831 000
	2003	615 967 580	199 000 000	216 401 199	237 000 000	748 000	774 451	810 000
	2004	633 618 001	198 000 000	216 335 188	242 000 000	725 000	754 012	807 000
	2005	651 866 078	196 000 000	212 856 354	235 000 000	704 000	729 200	771 000
	2006	670 719 418	195 000 000	212 073 244	234 000 000	696 000	721 873	764 000
	2007	690 210 022	195 000 000	211 773 290	232 000 000	679 000	704 916	742 000
	2008	710 329 157	196 000 000	211 953 110	230 000 000	660 000	684 925	717 000
	2009	731 052 709	199 000 000	215 949 937	237 000 000	643 000	671 222	714 000
	2010	752 483 002	199 000 000	216 716 235	239 000 000	623 000	653 024	700 000
	2011	774 632 776	198 000 000	214 366 744	234 000 000	590 000	616 838	656 000
	2012	797 177 551	199 000 000	214 135 861	233 000 000	556 000	583 635	622 000
	2013	820 127 488	197 000 000	213 649 463	232 000 000	542 000	570 160	613 000
	2014	843 365 783	191 000 000	211 298 150	233 000 000	516 000	549 364	601 000
	2015	866 950 179	192 000 000	211 088 430	232 000 000	509 000	541 632	598 000
	2016	891 196 712	193 000 000	210 772 642	231 000 000	511 000	542 311	600 000
	2017	915 840 445	201 000 000	218 442 674	238 000 000	522 000	555 248	619 000
	2018	940 840 305	198 000 000	215 442 566	236 000 000	508 000	541 171	614 000
	2019	966 465 940	199 000 000	217 915 997	240 000 000	509 000	544 165	628 000
	2020	992 736 767	208 000 000	231 933 554	260 000 000	559 000	599 400	722 000
	2021	1 019 238 524	210 000 000	233 829 474	262 000 000	553 000	593 470	728 000
Americas	2000	109 669 858	1 400 000	1 548 657	1 710 000	776	919	1 124
	2001	111 470 861	1 169 000	1 296 757	1 431 000	699	832	1 039
	2002	113 238 792	1 078 000	1 182 832	1 297 000	622	765	976
	2003	114 966 694	1 067 000	1 159 333	1 262 000	581	725	938
	2004	116 666 896	1 069 000	1 146 570	1 235 000	567	712	919
	2005	118 351 356	1 201 000	1 273 211	1 359 000	539	688	907
	2006	120 011 317	1 033 000	1 097 170	1 175 000	445	584	791
	2007	121 648 634	907 000	988 539	1 073 000	381	504	696
	2008	123 257 009	643 000	696 347	761 000	322	470	699
	2009	124 845 461	635 000	687 600	753 000	322	464	686
	2010	126 403 005	746 000	818 245	901 000	354	502	728
	2011	127 972 394	568 000	615 178	671 000	321	464	674
	2012	129 580 259	545 000	585 401	634 000	308	430	607
	2013	131 176 924	530 000	575 545	630 000	337	470	647
	2014	132 766 381	444 000	475 260	510 000	259	348	449
	2015	134 355 812	531 000	572 722	620 000	288	390	505
	2016	135 910 096	637 000	688 498	749 000	379	530	693
	2017	137 328 934	878 000	946 216	1 032 000	452	665	902
	2018	138 565 250	861 000	929 469	1 014 000	391	572	773
	2019	139 710 625	824 000	894 123	979 000	337	510	703
	2020	140 873 258	599 000	646 320	700 000	296	418	556
	2021	141 983 798	554 000	596 552	646 000	247	334	436
Eastern Mediterranean	2000	341 863 678	5 500 000	6 945 341	11 100 000	8 500	13 609	25 600
	2001	350 735 504	5 600 000	7 169 562	11 900 000	8 900	14 063	25 700
	2002	359 751 191	5 200 000	6 751 568	11 900 000	8 400	13 090	25 900
	2003	368 629 707	5 000 000	6 374 197	11 100 000	7 700	12 228	24 300
	2004	377 175 619	4 200 000	5 215 386	8 900 000	6 600	10 487	20 600
	2005	385 908 992	4 200 000	5 412 749	9 400 000	7 000	11 203	22 200
	2006	395 462 430	4 100 000	5 363 013	10 100 000	7 000	11 315	24 500
	2007	405 585 796	3 800 000	4 737 690	6 500 000	6 100	9 591	14 700
	2008	415 713 313	2 900 000	3 675 847	5 200 000	4 500	7 092	10 800
	2009	425 906 791	2 800 000	3 595 279	5 300 000	4 400	6 862	10 800
	2010	435 916 580	3 400 000	4 477 117	6 400 000	5 500	8 634	13 400
	2011	445 578 067	3 500 000	4 605 018	6 500 000	5 100	7 845	11 500
	2012	454 556 616	3 300 000	4 333 295	6 100 000	5 100	7 954	11 500
	2013	462 332 268	3 300 000	4 155 222	5 600 000	4 900	7 517	10 700
	2014	469 824 969	3 300 000	4 006 998	5 000 000	4 800	7 524	10 800
	2015	477 583 738	3 500 000	4 315 175	5 700 000	5 200	8 209	12 100
	2016	485 733 390	4 300 000	5 360 578	6 900 000	5 900	9 484	14 500
	2017	494 550 984	4 100 000	5 388 975	7 300 000	6 000	10 243	16 800
	2018	504 052 289	4 200 000	5 634 545	7 800 000	6 300	11 137	18 700
	2019	513 985 511	4 200 000	5 727 478	8 200 000	6 700	11 903	20 400
	2020	524 073 331	4 100 000	5 857 293	8 500 000	7 000	12 727	21 600
	2021	534 204 371	4 400 000	6 195 030	9 000 000	7 500	13 413	22 600

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
REGIONAL SUMMARY								
European	2000	29 069 724	–	32 565	–	–	0	–
	2001	29 228 626	–	23 870	–	–	0	–
	2002	29 403 168	–	20 232	–	–	0	–
	2003	29 606 907	–	16 017	–	–	0	–
	2004	29 848 389	–	9 740	–	–	0	–
	2005	30 117 114	–	5 125	–	–	0	–
	2006	30 412 821	–	2 732	–	–	0	–
	2007	30 719 038	–	1 206	–	–	0	–
	2008	31 036 653	–	587	–	–	0	–
	2009	31 392 060	–	282	–	–	0	–
	2010	31 776 699	–	168	–	–	0	–
	2011	32 177 125	–	82	–	–	0	–
	2012	32 601 198	–	31	–	–	0	–
	2013	33 053 808	–	4	–	–	0	–
	2014	33 536 112	–	2	–	–	0	–
	2015	34 022 563	–	0	–	–	0	–
	2016	34 499 249	–	0	–	–	0	–
	2017	34 947 537	–	0	–	–	0	–
	2018	35 358 291	–	0	–	–	0	–
	2019	35 758 503	–	0	–	–	0	–
	2020	36 166 502	–	0	–	–	0	–
	2021	36 567 077	–	0	–	–	0	–
South-East Asia	2000	1 278 989 994	18 500 000	22 845 005	28 800 000	19 000	35 038	54 000
	2001	1 300 990 001	18 800 000	23 135 506	29 100 000	19 000	33 981	52 000
	2002	1 322 946 704	17 800 000	21 909 307	27 700 000	18 000	32 437	50 000
	2003	1 344 613 982	18 600 000	23 099 437	29 100 000	18 000	32 860	50 000
	2004	1 365 910 125	20 200 000	25 375 239	32 500 000	20 000	36 371	56 000
	2005	1 386 715 302	21 100 000	27 163 552	35 900 000	21 000	37 772	61 000
	2006	1 406 971 688	17 500 000	22 532 269	30 500 000	18 000	32 435	52 000
	2007	1 426 866 515	16 900 000	22 023 468	29 900 000	18 000	32 598	53 000
	2008	1 446 440 732	17 600 000	23 238 039	31 900 000	19 000	35 458	58 000
	2009	1 465 841 005	17 900 000	23 692 669	33 200 000	20 000	37 285	63 000
	2010	1 485 377 183	18 700 000	23 982 334	32 100 000	21 000	37 955	60 000
	2011	1 505 013 663	16 000 000	20 591 288	27 700 000	18 000	32 032	51 000
	2012	1 524 559 214	13 900 000	17 733 180	23 600 000	16 000	26 879	42 000
	2013	1 543 823 823	10 400 000	13 184 411	17 400 000	11 000	20 429	32 000
	2014	1 562 491 726	10 000 000	12 808 643	17 000 000	12 000	22 955	38 000
	2015	1 580 600 235	10 400 000	13 239 318	17 600 000	12 000	23 974	39 000
	2016	1 598 773 314	10 100 000	13 708 602	19 500 000	12 000	24 667	42 000
	2017	1 616 651 707	7 800 000	10 243 361	14 100 000	9 000	17 888	30 000
	2018	1 633 707 805	5 400 000	7 538 051	10 300 000	6 000	10 978	18 000
	2019	1 650 038 669	4 600 000	6 429 743	8 800 000	5 000	9 256	15 000
	2020	1 665 413 306	3 600 000	4 998 046	6 700 000	5 000	8 826	15 000
	2021	1 678 483 995	4 000 000	5 383 185	7 300 000	5 000	9 109	15 000
Western Pacific	2000	653 883 215	1 778 000	2 805 163	4 049 000	3 400	6 154	10 100
	2001	659 517 343	1 481 000	2 476 815	3 653 000	2 800	5 275	8 900
	2002	664 966 933	1 329 000	2 192 394	3 223 000	2 500	4 658	7 900
	2003	670 323 405	1 446 000	2 358 767	3 501 000	2 700	5 039	8 600
	2004	675 685 483	1 557 000	2 702 026	4 067 000	2 900	5 623	9 800
	2005	681 096 945	1 350 000	2 301 485	3 499 000	2 300	4 496	7 900
	2006	686 547 801	1 485 000	2 462 793	3 650 000	2 600	4 877	8 300
	2007	692 114 639	981 000	1 847 269	2 893 000	1 800	3 852	7 200
	2008	697 811 578	862 000	1 672 851	2 693 000	1 600	3 552	6 600
	2009	703 667 553	1 251 000	2 225 151	3 412 000	2 200	4 714	8 600
	2010	709 598 266	967 000	1 676 662	2 517 000	1 700	3 488	6 200
	2011	715 484 602	863 000	1 421 659	2 134 000	1 500	2 997	5 400
	2012	721 618 925	877 000	1 697 527	2 977 000	1 400	3 472	7 200
	2013	727 779 079	1 119 000	1 756 383	2 558 000	1 800	3 971	7 200
	2014	733 724 735	1 316 000	2 013 902	2 938 000	1 900	3 793	6 700
	2015	739 470 550	931 000	1 246 766	1 622 000	1 300	2 454	4 000
	2016	745 129 142	1 073 000	1 471 518	1 921 000	1 400	2 954	5 000
	2017	750 857 933	1 145 000	1 575 973	2 101 000	1 500	3 047	5 100
	2018	755 870 299	1 234 000	1 692 724	2 236 000	1 500	2 999	5 100
	2019	760 009 156	1 091 000	1 433 689	1 811 000	1 300	2 558	4 300
	2020	763 423 945	1 195 000	1 649 922	2 152 000	1 400	3 154	5 400
	2021	765 840 463	1 047 000	1 425 928	1 839 000	1 200	2 649	4 600

ANNEX 4 – F. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND ESTIMATED MALARIA CASES AND DEATHS, 2000–2021

WHO region Country/area	Year	Population denominator for incidence and mortality rate	Cases			Deaths		
			Lower	Point	Upper	Lower	Point	Upper
REGIONAL SUMMARY								
Total	2000	2 980 018 209	229 000 000	245 266 552	266 000 000	866 000	896 635	938 000
	2001	3 034 388 995	231 000 000	249 982 065	273 000 000	855 000	888 481	933 000
	2002	3 089 243 978	228 000 000	245 855 718	268 000 000	816 000	846 614	890 000
	2003	3 144 108 275	232 000 000	249 408 950	272 000 000	794 000	825 303	870 000
	2004	3 198 904 513	232 000 000	250 784 149	278 000 000	773 000	807 205	866 000
	2005	3 254 055 787	231 000 000	249 012 476	272 000 000	751 000	783 359	832 000
	2006	3 310 125 475	226 000 000	243 531 222	268 000 000	739 000	771 084	820 000
	2007	3 367 144 644	224 000 000	241 371 462	263 000 000	721 000	751 461	794 000
	2008	3 424 588 442	224 000 000	241 236 782	262 000 000	700 000	731 497	773 000
	2009	3 482 705 579	228 000 000	246 150 919	269 000 000	685 000	720 547	771 000
	2010	3 541 554 735	229 000 000	247 670 761	272 000 000	667 000	703 603	757 000
	2011	3 600 858 627	225 000 000	241 599 970	262 000 000	629 000	660 176	704 000
	2012	3 660 093 763	222 000 000	238 485 295	258 000 000	593 000	622 370	664 000
	2013	3 718 293 390	217 000 000	233 321 029	253 000 000	572 000	602 547	648 000
	2014	3 775 709 706	211 000 000	230 602 955	253 000 000	549 000	583 984	639 000
	2015	3 832 983 077	211 000 000	230 462 411	253 000 000	540 000	576 659	635 000
	2016	3 891 241 903	214 000 000	232 001 838	253 000 000	545 000	579 946	642 000
	2017	3 950 177 540	219 000 000	236 597 200	257 000 000	553 000	587 091	654 000
	2018	4 008 394 239	214 000 000	231 237 356	252 000 000	532 000	566 857	642 000
	2019	4 065 968 404	213 000 000	232 401 031	255 000 000	532 000	568 392	654 000
	2020	4 122 687 109	222 000 000	245 085 135	273 000 000	583 000	624 525	747 000
	2021	4 176 318 228	224 000 000	247 430 170	276 000 000	577 000	618 975	754 000

Data as of 22 November 2022

NMP: national malaria programme; WHO: World Health Organization.

"–" refers to not applicable.

1 The number of indigenous malaria cases registered by the NMPs is reported here without further adjustments.

2 The number of indigenous malaria deaths registered by the NMPs is reported here without further adjustments.

3 Certified malaria free countries are included in this listing for historical purposes.

4 South Sudan became an independent state on 9 July 2011 and a Member State of WHO on 27 September 2011. South Sudan and Sudan have distinct epidemiological profiles comprising high transmission and low transmission areas respectively. For this reason, data up to June 2011 from the Sudanese high transmission areas (10 southern states, which correspond to South Sudan) and low transmission areas (15 northern states which correspond to contemporary Sudan) are reported separately.

5 Data were submitted for Bolivia (Plurinational State of) after the closure of data analysis for the report (total indigenous cases: 11 017 used in burden estimation instead of 9959 in 2021).

Note: Population denominator for incidence and mortality rate is based on the United Nations population, times the proportion of the population at risk at baseline.

ANNEX 4 – G. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND REPORTED MALARIA CASES BY PLACE OF CARE, 2021

WHO region Country/area	Population			
	UN population	At risk (low + high)	At risk (high)	Number of people living in active foci
AFRICAN				
Angola	34 503 776	34 503 776	34 503 776	–
Benin	12 996 895	12 996 895	12 996 895	–
Botswana	2 588 423	1 708 359	109 024	–
Burkina Faso	22 100 684	22 100 684	22 100 684	–
Burundi	12 551 213	12 551 213	12 551 213	–
Cabo Verde	587 925	152 861	0	0
Cameroon	27 198 628	27 198 628	19 311 025	–
Central African Republic	5 457 154	5 457 154	5 457 154	–
Chad	17 179 740	17 007 943	11 571 413	–
Comoros	821 625	821 625	390 929	469 420
Congo	5 835 806	5 835 806	5 835 806	–
Côte d'Ivoire	27 478 248	27 478 248	27 478 248	–
Democratic Republic of the Congo	95 894 120	95 894 120	93 017 296	–
Equatorial Guinea	1 634 466	1 634 466	1 634 466	–
Eritrea	3 620 312	3 620 312	2 570 421	–
Eswatini	1 192 271	333 836	0	–
Ethiopia	120 283 024	81 792 456	32 716 982	–
Gabon	2 341 179	2 341 179	2 341 179	–
Gambia	2 639 916	2 639 916	2 639 916	–
Ghana	32 833 032	32 833 032	32 833 032	–
Guinea	13 531 906	13 531 906	13 531 906	–
Guinea-Bissau	2 060 721	2 060 721	2 060 721	–
Kenya	53 005 616	53 005 616	37 207 292	–
Liberia	5 193 416	5 193 416	5 193 416	–
Madagascar*	28 915 652	28 915 652	25 378 689	–
Malawi	19 889 742	19 889 742	19 889 742	–
Mali	21 904 984	21 904 984	19 966 831	–
Mauritania	4 614 974	4 614 974	2 975 181	–
Mayotte	316 014	69 523	15 800	–
Mozambique	32 077 072	32 077 072	32 077 072	–
Namibia	2 530 151	1 998 819	1 167 943	–
Niger	25 252 722	25 252 722	25 252 722	–
Nigeria	213 401 328	213 401 328	162 991 666	–
Rwanda	13 461 888	13 461 888	13 461 888	–
Sao Tome and Principe	223 107	223 107	223 107	–
Senegal	16 876 720	16 876 720	16 779 341	–
Sierra Leone	8 420 641	8 420 641	8 420 641	–
South Africa	59 392 256	5 939 226	2 375 690	7 022 322
South Sudan[1]	10 748 272	10 748 272	10 748 272	–
Togo	8 644 829	8 644 829	8 644 829	–
Uganda	45 853 776	45 853 776	45 853 776	–
United Republic of Tanzania[2]	63 588 336	63 588 336	46 208 649	–
Mainland	61 788 786	61 788 786	45 105 813	–
Zanzibar	1 799 550	1 799 550	1 102 836	–
Zambia	19 473 124	19 473 124	19 473 124	–
Zimbabwe	15 993 524	12 634 884	4 576 706	4 496 523
AMERICAS				
Belize	400 031	276 021	0	0
Bolivia (Plurinational State of)	12 079 472	5 435 762	301 745	–
Brazil	214 326 224	42 865 245	4 929 503	–
Colombia	51 516 560	11 333 643	5 176 383	2 578 386
Costa Rica	5 153 957	1 803 885	51 539	24 952
Dominican Republic	11 117 873	6 114 830	157 317	–
Ecuador	17 797 736	533 932	162 671	565 066
French Guiana	297 449	163 597	27 454	–
Guatemala	17 608 484	13 206 363	2 402 325	796 086
Guyana	804 567	804 567	87 810	–
Haiti	11 447 569	10 188 336	2 774 776	–
Honduras	10 278 345	9 353 294	2 619 744	124 197

Public sector		Private sector		Community level	
Presumed	Confirmed	Presumed	Confirmed	Presumed	Confirmed
843 346	8 213 612				112 309
177 572	1 932 123	109 708	489 485		454 760
	724		5		
362 794	10 923 336	311 111	620 556		247 746
1 995	5 590 025	783	557 325		468 364
	21 [4]				
49 458	1 787 028	36 156	1 282 493		265 653
190 364	1 653 733	28 118	257 872	2 931	90 544
300 177	1 081 279	54	13 209	93 089	324 051
	5 887		2 831		1 829
131 788 [4]	189 616 [4]				
321 809	6 245 474	17 088	220 519		829 075
3 247 358 [5]	23 249 165 [5]				
573	25 090				18 373
	374		199		8
87 821	1 335 568	2 786	61 583		
76 238 [4]	64 957 [4]				
	75 419		1 452		416
184 130	2 947 600	73 481	871 497	72 347	1 928 488
	1 966 720		1 012		454 642
427 117 [6]	3 828 757 [6]				
56 511	586 821	15 031	223 590		102 025
	2 238 982		100 121		
33 923	5 873 486				1 075 014
341 195	2 863 982	4 512	63 441	11 533	276 707
30 900	18 660				
7 465	8 822 472			3 320	1 273 335
	13 212 [4]				526
615 202	3 973 854				70 853
1 984 856	19 757 602	298 755	1 567 584		
	245 793		266 276		651 601
	2 227				503
6 083	403 393	3 084	11 943	1 756	121 514
74 884	1 669 779	5 505	206 281	9 527	77 842
	5 812				
904 682	1 261 203			227 740	756 024
	181 994		251 937		562 433
488 843	10 158 662	319 525	1 775 936		2 401 789
6 640	3 918 606	2 147	538 212		
6 640	3 913 258	2 147	537 210		
	5 348		1 002		
390 101	5 785 915				983 227
	56 268		2 108		74 761
	0				0
	9 744 [5]		215		
	163 585 [4]				
	73 979 [6]				
	227		5		
	291				
	2 436 [6]				
	143				
	759		2		512
	20 828 [5]		22		
	5 279		1 842		2 392
	701		16		940

ANNEX 4 – G. POPULATION DENOMINATOR FOR CASE INCIDENCE AND MORTALITY RATE, AND REPORTED MALARIA CASES BY PLACE OF CARE, 2021

WHO region Country/area	Population			
	UN population	At risk (low + high)	At risk (high)	Number of people living in active foci
AMERICAS				
Mexico	126 705 136	2 534 103	126 705	197 924
Nicaragua	6 850 540	3 014 238	587 981	593 810
Panama	4 351 267	4 220 729	183 362	–
Peru	33 715 472	13 149 034	1 687 796	–
Suriname	612 985	91 948	26 027	1 261
Venezuela (Bolivarian Republic of)	28 199 868	14 099 934	5 848 229	11 356 587
EASTERN MEDITERRANEAN				
Afghanistan	40 099 464	30 876 587	10 918 282	–
Djibouti	1 105 557	829 168	388 138	–
Iran (Islamic Republic of)	87 923 432	879 234	0	306 646
Pakistan	231 402 112	226 774 070	66 914 548	–
Saudi Arabia*	35 950 396	2 876 032	0	241 840
Somalia	17 065 580	17 065 580	8 685 868	–
Sudan	45 657 200	45 657 200	39 676 106	–
Yemen	32 981 640	21 108 250	12 688 696	–
SOUTH-EAST ASIA				
Bangladesh	169 356 256	18 629 188	2 138 969	–
Bhutan	777 486	575 340	101 073	7 836
Democratic People's Republic of Korea	25 971 908	10 129 044	1 458 842	–
India	1 407 563 904	1 309 034 431	170 751 577	–
Indonesia[3]	273 753 184	273 753 184	17 503 778	–
Myanmar*	53 798 084	32 278 850	8 506 015	–
Nepal*	30 034 988	8 710 147	1 569 928	87 907
Thailand[3]	71 601 104	13 604 210	1 585 248	222 477
Timor-Leste	1 320 942	1 241 685	447 370	–
WESTERN PACIFIC				
Cambodia	16 589 023	11 778 206	7 983 633	22 750
Lao People's Democratic Republic	7 425 057	3 861 030	3 863 554	42 417
Malaysia[3]	33 573 872	1 342 955	1 007 216	508
Papua New Guinea	9 949 437	9 949 437	9 352 470	–
Philippines[3]	113 880 328	66 050 590	7 760 944	417 033
Republic of Korea*	51 830 140	3 628 110	0	–
Solomon Islands	707 851	700 772	700 772	–
Vanuatu	319 137	319 137	277 409	–
Viet Nam	97 468 032	72 126 344	6 625 389	89 500
REGIONAL SUMMARY				
African	1 115 109 208	1 016 683 787	844 534 463	11 988 265
Americas	553 263 535	139 189 461	27 151 367	16 238 269
Eastern Mediterranean	492 185 381	346 066 121	139 271 638	548 486
South-East Asia	2 034 177 856	1 667 956 079	204 062 800	318 220
Western Pacific	331 742 877	169 756 581	37 571 387	572 208
Total	**4 526 478 857**	**3 339 652 029**	**1 252 591 655**	**29 665 448**

RDT: rapid diagnostic test; UN: United Nations; WHO: World Health Organization.

"–" refers to not applicable or data not available.

* Confirmed cases are corrected for double counting of microscopy and RDTs in the public sector unless further specified by the country.

[1] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

[2] Where national data for the United Republic of Tanzania are unavailable, refer to Mainland and Zanzibar.

[3] Figures include non-human malaria cases.

[4] Figures reported for the public sector include cases detected in the private sector.

Public sector		Private sector		Community level	
Presumed	Confirmed	Presumed	Confirmed	Presumed	Confirmed
	275				
	19 050				4 273
	3 077		0		1 287
	18 140				
	47		4		26
	194 057 [6]				
91	58 108	4	3 515	12	24 640
	58 445		471		
	999				
557	229 524	662	169 573		
	2 616 [4]				
37 681	12 967 [5]				
2 312 910	1 619 625				28 120
53 023	128 894	11 495	36 959		14 486
	7 294 [6]				
	23 [4]				
	2 357				
	161 753 [6]				
	228 840		42 684		33 083
	79 001 [6]				
144	275	133	69		29
	2 307		207		765
	0		0		0
	1 732				2 650
	2 247		201		1 478
	3 688 [4]				
103 635	651 963				
	1 329		112		2 856
	14		280		
45 619 [4]	84 139 [4]				
	322				
	452				15
11 343 825	138 955 231	1 227 844	9 387 467	422 243	13 624 412
0	512 618	0	2 106	0	9 430
2 404 262	2 111 178	12 161	210 518	12	67 246
144	481 850	133	42 960	0	33 877
149 254	745 886	0	593	0	6 999
13 897 485	**142 806 763**	**1 240 138**	**9 643 644**	**422 255**	**13 741 964**

Data as of 23 November 2022

[5] Figures reported for the public sector include cases detected at the community level.

[6] Figures reported for the public sector include cases detected at the community level and in the private sector.

Note: Figures include imported cases.

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Algeria[1,2,3]	Suspected cases	12 224	11 974	15 790	12 762	8 690
	Presumed and confirmed	408	191	887	603	266
	Microscopy examined	12 224	11 974	15 790	12 762	8 690
	Microscopy positive	408	191	887	603	266
	RDT examined					
	RDT positive					
	Imported cases	396	187	828	587	260
Angola	Suspected cases	4 591 529	4 469 357	4 849 418	5 273 305	6 134 471
	Presumed and confirmed	3 687 574	3 501 953	3 031 546	3 144 100	3 180 021
	Microscopy examined	1 947 349	1 765 933	2 245 223	3 025 258	3 398 029
	Microscopy positive	1 324 264	1 147 473	1 056 563	1 462 941	1 431 313
	RDT examined	639 476	833 753	1 069 483	1 103 815	1 855 400
	RDT positive	358 606	484 809	440 271	536 927	867 666
Benin	Suspected cases		1 928 016	2 431 902	2 091 263	2 930 569
	Presumed and confirmed	1 873 015	1 786 864	2 069 728	1 717 115	2 122 011
	Microscopy examined		88 134	243 008	291 479	155 205
	Microscopy positive		68 745		99 368	108 714
	RDT examined		475 986	825 005	1 173 271	1 962 591
	RDT positive		354 223	705 839	991 234	1 200 524
Botswana[2]	Suspected cases					
	Presumed and confirmed	12 196	1 138^	308	506	1 485
	Microscopy examined					
	Microscopy positive	1 046	432			
	RDT examined		167			
	RDT positive		3	193	456	1 346
	Imported cases				30	30
Burkina Faso	Suspected cases	6 037 806	5 446 870	7 852 299	7 857 296	9 272 755
	Presumed and confirmed	5 723 481	5 024 697	6 970 700	7 146 026	8 278 408
	Microscopy examined	177 879	400 005	223 372	183 971	198 947
	Microscopy positive	88 540	83 857	90 089	82 875	83 259
	RDT examined	940 985	450 281	4 516 273	4 296 350	6 224 055
	RDT positive	715 999	344 256	3 767 957	3 686 176	5 345 396
Burundi	Suspected cases	5 590 736	4 780 117	4 270 100	7 507 441	7 831 895
	Presumed and confirmed	4 255 301	3 307 158	2 600 286	4 567 428	4 987 388
	Microscopy examined	2 825 558	2 859 720	2 659 372	4 123 012	4 471 998
	Microscopy positive	1 599 908	1 485 332	1 484 676	2 366 134	2 718 391
	RDT examined	273 324	188 476	1 177 132	2 995 339	3 098 808
	RDT positive	163 539	89 905	682 014	1 812 204	2 007 908
Cabo Verde[2,3]	Suspected cases		26 508	8 715	10 621	6 894
	Presumed and confirmed	47	36	36	46	46^
	Microscopy examined			8 715	10 621	6 894
	Microscopy positive	47		36	46	46
	RDT examined		26 508			
	RDT positive		36			46
	Imported cases		29	35	24	20
Cameroon	Suspected cases		3 134 048	3 031 461	4 132 326	3 709 906
	Presumed and confirmed	1 845 691	1 899 928	1 728 723	2 285 412	1 369 518
	Microscopy examined		1 110 308	1 182 610	1 236 306	1 086 095
	Microscopy positive					
	RDT examined		141 686	186 784	653 189	1 254 293
	RDT positive		17 874	66 656	42 581	
Central African Republic	Suspected cases			518 761	546 095	625 301
	Presumed and confirmed	66 484	221 980	500 806	454 532	495 238
	Microscopy examined				63 695	55 943
	Microscopy positive				36 943	41 436
	RDT examined			105 521	191 569	369 208
	RDT positive			87 566	126 758	253 652
Chad	Suspected cases	743 471		722 654		1 737 195
	Presumed and confirmed	544 243	528 454	660 575	1 272 841	1 513 772
	Microscopy examined	89 749		69 789		
	Microscopy positive	75 342	86 348	7 710	206 082	160 260
	RDT examined	309 927	114 122		621 469	1 137 455
	RDT positive	125 106	94 778		548 483	753 772

2015	2016	2017	2018	2019	2020	2021
8 000	6 628	6 469	10 081	8 620	11 197	7 220
747	432	453	1 242	1 014	2 726	1 164
8 000	6 628	6 469	10 081	8 620	11 197	7 220
747	432	453	1 242	1 014	2 726	1 164
727	420	446	1 241	1 014	2 725	1 164
6 839 963	7 649 902	11 050 353	10 870 446	14 341 390	13 232 340	15 624 710
3 254 270	4 301 146	4 500 221	5 928 260	7 530 788	7 156 110	9 169 267
3 345 693	4 183 727	7 493 969	5 066 780	5 643 654	5 216 938	6 663 417
1 396 773	2 058 128	2 199 810	2 442 500	2 557 385	2 359 788	3 424 950
3 009 305	2 959 282	2 931 055	5 025 981	8 221 926	7 456 619	8 117 947
1 372 532	1 736 125	1 675 082	2 708 075	4 497 593	4 239 539	4 900 971
2 733 611	2 184 524	2 705 456	2 880 743	3 958 782	3 572 959	4 226 652
2 042 684	1 667 005	1 968 532	2 255 946	3 084 525*	2 632 324	3 163 648*
296 264	267 405	267 492	349 191	432 001	359 137	552 545
108 061	104 601	208 823	258 519	294 518	242 780	355 271
2 116 289	1 860 904	2 403 344	2 251 418	3 338 134	3 086 562	3 371 041
1 613 565	1 506 189	1 725 089	1 717 293	2 601 360	2 273 685	2 521 097
1 298	12 986	12 605	13 979	16 564	9 148	9 825**
346	725	1 911	585	272	953	729ˆ
	5 178	5 223	872	707		729
						729
1 284	7 806	7 380	13 107	15 857	9 148	9 825
332	723	1 909	585	272	953	729
48	64	62	51	103	69	26
9 783 385	12 006 793	14 811 872	14 931 136	18 116 942	15 357 249	17 892 801
8 286 453	9 799 818	12 255 671	11 991 146	6475027*	11567698*	12 465 543
222 190	191 208	133 101	157 824	270 289	203 529	339 369
92 589	80 077	46 411	56 989	52 582	81 017	187 199
8 290 188	11 795 178	12 980 360	13 061 136	15 997 219	13 680 757	16 879 527
6 922 857	9 699 334	10 510 849	10 221 981	5 824 844	10 519 323	11 604 439
8 761 333	13 022 128	13 956 707	8 734 322	16 214 258	8 571 445	12 379 963
5 512 414	8 902 503	9 259 694	5 149 436	9 983 843	4 732 339	6 618 492
3 254 670	3 941 251	3 814 355	1 542 232	3 858 517	1 786 568	2 667 318
1 964 862	2 520 622	2 269 831	1 148 316	1 759 011	756 441	1 191 319
5 422 959	8 971 550	9 678 610	7 009 165	12 331 431	6 772 641	9 593 269
3 463 848	6 272 554	6 526 121	3 818 195	8 200 522	3 963 662	5 424 395
6 620**	8 906**	16 573**	16 623	7 867**	4 399**	4 327**
27ˆ	77ˆ	446ˆ	21	40ˆ	10	21
3 117	8 393	3 857	16 623	5 596	1 246	4 327
27	77	446	21	40	10	21
6 620	8 906	16 573		7 867	4 399	4 279
27	77	446		40	0	0
20	28	23	18	39	10	20
3 378 923	4 665 318	5 098 975	5 036 256	4 743 338	4 567 624	5 192 692
2 381 592	2 615 750	3 607 898	3 550 183	3 011 133	2 974 819	3 420 788*
1 024 306	1 373 802	627 709	658 017	1 527 436	1 304 972	1 505 989
592 351	810 367	390 130	428 888	1 097 615	956 647	1 075 831
1 166 306	3 151 919	3 108 156	3 085 689	2 716 410	2 840 269	3 335 377
600 930	1 665 786	1 854 658	1 828 745	1 722 188	1 933 546	2 259 343
1 218 246	2 095 095	1 533 258	1 367 986	3 393 641	2 730 158	3 069 218
953 535	1 607 079	1 296 277	995 157	2 708 497*	1 980 804	2 223 562
139 241	189 481	112 007	163 370	265 673	237 910	246 348
106 524	144 924	28 855	117 267	196 413	177 742	189 114
724 303	1 537 852	536 887	1 181 578	2 781 622	2 181 204	2 504 262
492 309	1 094 393	383 058	854 852	2 220 547	1 563 228	1 813 035
1 641 285	2 032 301	2 943 595	1 941 489	2 779 742	2 955 271	2 584 679
1 490 556	1 402 215	1 962 372	1 364 706	1 910 518	1 890 264*	1 811 859
	1 063 293	1 584 525	190 006	211 816	250 117	284 426
149 574	720 765	1 064 354	137 501	152 127	193 816	191 628
937 775	861 561	1 359 070	1 751 483	2 260 256	1 873 598	1 788 058
637 472	574 003	898 018	1 227 205	1 480 402	1 350 378	1 226 911

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Comoros[2]	Suspected cases	159 976	135 248	168 043	185 779	103 545
	Presumed and confirmed	103 670	76 661	65 139	62 565	2 465
	Microscopy examined	87 595	63 217	125 030	154 824	93 444
	Microscopy positive	35 199	22 278	45 507	46 130	1 987
	RDT examined	5 249	20 226	27 714	21 546	9 839
	RDT positive	1 339	2 578	4 333	7 026	216
	Imported cases					
Congo	Suspected cases				209 169	290 346
	Presumed and confirmed	446 656	277 263	120 319	183 026	248 159
	Microscopy examined				69 375	88 764
	Microscopy positive		37 744	120 319	43 232	54 523
	RDT examined					19 746
	RDT positive					11 800
Côte d'Ivoire	Suspected cases		2 607 856	3 423 623	6 003 033	6 418 571
	Presumed and confirmed	1 721 461	2 588 004	2 795 919	4 725 798	4 658 774
	Microscopy examined		49 828	195 546	395 914	568 562
	Microscopy positive	62 726	29 976	107 563	215 104	306 926
	RDT examined			1 572 785	3 405 647	4 904 066
	RDT positive			1 033 064	2 309 222	3 405 905
Democratic Republic of the Congo	Suspected cases	10 568 756	12 018 784	11 993 189	14 877 406	15 064 146
	Presumed and confirmed	9 252 959	9 442 144	9 128 398	11 368 481	10 288 519
	Microscopy examined	3 678 849	4 226 533	4 329 318	4 126 129	3 533 165
	Microscopy positive	2 374 930	2 700 818	2 656 864	2 611 478	2 126 554
	RDT examined	54 728	2 912 088	3 327 071	6 102 683	11 530 981
	RDT positive	42 850	1 861 163	2 134 734	4 108 409	8 161 965
Equatorial Guinea	Suspected cases	83 639	40 704	45 792	59 358	57 129
	Presumed and confirmed	78 095	37 267	20 890	28 438	20 417
	Microscopy examined	42 585	23 004	33 245	27 039	47 322
	Microscopy positive	39 636	20 601	13 196	11 235	17 685
	RDT examined	16 772	2 899	6 826	20 286	9 807
	RDT positive	14 177	1 865	1 973	5 170	2 732
Eritrea	Suspected cases	96 792	97 479	138 982	134 183	186 358
	Presumed and confirmed	53 750	39 567	42 178	34 678	55 491
	Microscopy examined	79 024	67 190	84 861	81 541	63 766
	Microscopy positive	13 894	15 308	11 557	10 890	10 993
	RDT examined		25 570	33 758	39 281	117 635
	RDT positive	22 088	19 540	10 258	10 427	39 541
Eswatini[2]	Suspected cases					
	Presumed and confirmed	1 722	797	626	962	711
	Microscopy examined					
	Microscopy positive	87	130	345	488	711
	RDT examined					
	RDT positive	181	419	217	474	
	Imported cases		170	153	234	322
Ethiopia	Suspected cases	5 420 110	5 487 972	5 962 646	9 243 894	7 457 765
	Presumed and confirmed	4 107 396	3 549 613	3 876 745	3 316 013	2 513 863
	Microscopy examined	2 509 543	3 418 719	3 778 479	8 573 335	7 062 717
	Microscopy positive	1 196 829	1 480 360	1 692 578	2 645 454	2 118 815
	RDT examined					
	RDT positive					
	Imported cases					
Gabon	Suspected cases	233 770		238 483	256 531	256 183
	Presumed and confirmed	185 105	178 822	188 089	185 196	185 996
	Microscopy examined	54 714		66 018	90 185	90 275
	Microscopy positive	12 816		18 694	26 432	27 687
	RDT examined	7 887		4 129	10 132	11 812
	RDT positive	1 120		1 059	2 550	4 213
Gambia	Suspected cases	492 062		862 442	889 494	603 424
	Presumed and confirmed	194 009	268 020	313 469	281 550	168 256
	Microscopy examined	290 842	172 241	156 580	236 329	286 111
	Microscopy positive	52 245	71 588	29 325	65 666	66 253
	RDT examined	123 564		705 862	614 128	317 313
	RDT positive	64 108	196 432	284 144	176 847	102 003

2015	2016	2017	2018	2019	2020	2021
117 762	116 692	229 445	119 592	185 045**	175 364	168 942
2 101	1 734	3 896	19 682	17 697ˆ	4 546*	10 547*
89 634	71 902	130 134	90 956	158 670	133 024	120 785
963	559	1 325	9 197	19 029	3 339	7 631
27 911	44 523	99 311	24 567	46 172	42 340	48 157
921	908	2 571	6 416	20 535	1 207	2 916
				98	0	10
300 592	466 254	322 916	385 729	594 237	146 262	563 787
264 574	374 252	297 652	324 615	545 796	103 692	321 404*
87 547	202 922	153 203	178 017	166 278	80 110	234 919
51 529	134 612	127 939	116 903	117 837	55 348	41 491
	60 927				53 998	197 080
	37 235				36 190	148 125
5 216 344	5 560 136	7 262 684	6 706 148	8 280 575	7 992 806	9 629 227
3 606 725	3 754 504	4 152 065	5 189 974	5 950 336	5 083 548	7 633 965
811 426	975 507	1 221 845	1 132 659	1 447 694	1 437 608	1 572 997
478 870	579 566	588 969	696 124	918 371	932 627	1 089 041
4 174 097	4 584 629	5 923 555	5 042 040	6 152 962	4 837 781	7 197 967
2 897 034	3 174 938	3 445 812	4 070 353	5 016 807	4 048 013	6 206 027
17 617 219	23 443 227	23 195 284	23 833 694	32 067 354	32 954 190	32 438 379
12 538 805	16 888 006	16 888 842	18 208 440	21 608 681*	24 959 997	26 496 523*
2 877 585	2 810 067	1 981 621	1 926 455	2 152 433	2 067 978	2 450 106
1 902 640	1 847 143	1 291 717	995 577	1 128 371	1 214 424	1 646 553
14 739 634	20 566 284	21 117 823	20 671 006	26 963 687	28 054 832	26 740 915
10 636 165	14 973 987	15 501 285	15 976 630	20 480 310	21 376 223	21 602 612
68 058	318 779	91 217	43 533	94 656		
15 142	147 714	15 725	10 926	43 897		
21 831	239 938	13 127	8 395	43 417		
8 564	125 623	6 800	4 135	14 787		
46 227	78 841	78 090	33 174	33 246		
6 578	22 091	8 925	4 827	11 117		
155 782	139 798	205 836	253 687	452 673	346 565	343 054
32 974	80 450	55 588	48 326	93 878	75 756	44 036
59 268	83 599	74 962	70 465	116 666	101 966	98 068
8 332	24 251	14 519	10 325	18 117	17 936	10 114
91 576		129 291	181 336	336 007	241 982	244 413
19 704		39 486	36 115	75 761	56 105	33 349
	1 249	3 212	10 285	34 866	27 979	12 894
475ˆ	317ˆ	1 127ˆ	957ˆ	589	325	581
	1 249	371	1 526	15 434	8 047	8 246
43	141	68	957	207	121	207
		2 841	8 759	19 432	19 932	4 575
452	458	1 594	11	382	204	374
157	67	687	271	337	82	76
5 987 580	6 611 801	6 471 958	5 913 799	6 708 222	7 509 602	6 716 458
2 174 707	1 962 996	1 755 748	1 206 891	1 015 792	1 848 231	1 487 758
5 679 932	6 367 309	6 246 949	5 668 995	6 596 925	7 400 644	6 625 851
1 867 059	1 718 504	1 530 739	962 087	904 495	1 743 755	1 397 151
						836
285 489	202 989	212 092	1 022 022	214 286	206 908	229 360
217 287	161 508	157 639	797 278	142 917	127 500	141 195
79 308	62 658	70 820	264 676	75 819	80 266	104 166
20 390	22 419	28 297	88 112	31 184	33 349	44 330
12 761	2 738	18 877	71 787	47 712	48 330	38 736
3 477	1 496	6 947	23 607	21 998	20 310	20 627
908 082	874 690	656 212	706 868	602 947	537 205	615 187
255 403	164 421	83 668	88 654	53 386	75 801	77 287
272 604	165 793	77 491	171 668	150 585	198 658	116 147
49 649	26 397	11 343	14 510	10 982	22 226	12 753
626 423	707 215	573 093	533 994	452 362	338 547	496 330
196 699	136 342	66 697	72 938	42 404	53 575	64 534

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Ghana	Suspected cases	5 107 626	5 121 411	12 656 535	8 507 245	10 748 502
	Presumed and confirmed	3 900 311	4 207 941	10 754 320	7 259 892	8 566 002
	Microscopy examined	2 031 674	1 172 838	4 219 097	1 394 249	1 987 959
	Microscopy positive	1 029 384	624 756	2 971 699	721 898	970 448
	RDT examined	247 278	781 892	1 438 284	1 496 746	3 610 453
	RDT positive	42 253	416 504	783 467	921 744	2 445 464
Guinea	Suspected cases		1 276 057			
	Presumed and confirmed	1 117 182	1 189 016	1 261 951	775 341	1 595 828
	Microscopy examined		43 549			116 767
	Microscopy positive	20 936	5 450	191 421	63 353	82 818
	RDT examined		139 066			
	RDT positive		90 124	148 837	147 904	577 389
Guinea-Bissau	Suspected cases	195 006	300 233	237 398	238 580	330 533
	Presumed and confirmed	140 143	174 986	129 684	132 176	102 945
	Microscopy examined	48 799	57 698	61 048	58 909	106 882
	Microscopy positive	30 239	21 320	23 547	17 733	35 546
	RDT examined	56 455	139 531	97 047	102 079	218 130
	RDT positive	20 152	50 662	26 834	36 851	61 878
Kenya	Suspected cases	7 557 454	13 127 058	12 883 521	14 742 401	15 204 056
	Presumed and confirmed	6 071 583	11 120 812	9 335 951	9 790 796	9 698 529
	Microscopy examined	2 384 402	3 009 051	4 836 617	6 606 885	7 444 865
	Microscopy positive	898 531	1 002 805	1 426 719	2 060 608	2 415 950
	RDT examined			164 424	719 849	912 217
	RDT positive			26 752	314 521	435 605
Liberia	Suspected cases	3 087 659	2 896 874	2 441 800	2 202 213	2 450 878
	Presumed and confirmed	2 675 816	2 488 331	1 805 546	1 483 676	1 083 513
	Microscopy examined	335 973	728 443	772 362	818 352	1 318 801
	Microscopy positive	212 927	577 641	507 967	496 269	302 708
	RDT examined	998 043	1 601 259	1 276 521	1 144 405	929 788
	RDT positive	709 246	1 343 518	904 662	747 951	578 516
Madagascar[2]	Suspected cases	719 967	805 701	1 066 564	1 156 468	1 357 857
	Presumed and confirmed	293 910	255 814	456 795	472 644	688 852
	Microscopy examined	24 393	34 813	38 453	42 573	37 362
	Microscopy positive	2 173	3 447	3 667	4 947	3 853
	RDT examined	604 114	739 572	974 216	1 074 701	1 102 567
	RDT positive	200 277	221 051	399 233	428 503	467 071
	Imported cases					712
Malawi	Suspected cases		5 734 906	6 528 505	5 787 441	7 703 651
	Presumed and confirmed	6 851 108	5 338 701	4 922 596	3 906 838	5 065 703
	Microscopy examined		119 996	406 907	132 475	198 534
	Microscopy positive		50 526	283 138	44 501	77 635
	RDT examined		580 708	2 763 986	3 029 020	5 344 724
	RDT positive		253 973	1 281 846	1 236 391	2 827 675
Mali	Suspected cases	3 351 419	2 628 593		3 076 029	3 246 800
	Presumed and confirmed	2 191 285	1 961 070	2 204 724	2 510 534	2 593 880
	Microscopy examined					
	Microscopy positive			97 995	190 337	219 637
	RDT examined	1 399 921	974 558		2 072 435	2 692 773
	RDT positive	239 787	307 035	788 487	1 316 603	1 820 216
Mauritania	Suspected cases	239 795	191 726	209 955	190 446	203 991
	Presumed and confirmed	234 041	182 909	206 685	182 947	172 326
	Microscopy examined	5 449	3 752	1 865	5 510	
	Microscopy positive	909	1 130	255	957	
	RDT examined	2 299	7 991	3 293	3 576	47 500
	RDT positive	1 085	1 796	1 633	630	15 835
Mayotte[2]	Suspected cases	2 023	1 214	1 463		
	Presumed and confirmed	396	92	72	82	15
	Microscopy examined	2 023	1 214	1 463		
	Microscopy positive	396	92	72	82	15
	RDT examined					
	RDT positive					
	Imported cases	236	51	47	71	14

2015	2016	2017	2018	2019	2020	2021
15 946 366	15 742 112	19 069 870	15 542 218	11 977 117	10 388 444	12 071 445
11 678 306	11 451 328	13 472 089	11 154 400	6 703 687	5 604 746	6 077 543
2 023 581	2 594 918	2 495 536	2 659 067	3 004 989	3 108 665	3 652 265
934 304	1 189 012	1 089 799	1 105 348	1 160 426	1 401 009	1 327 675
7 901 575	7 124 845	10 105 400	6 660 205	8 383 708	6 847 836	8 057 955
4 722 792	4 239 967	5 913 356	3 826 106	4 954 841	3 771 794	4 419 910
1 254 937	1 503 035	2 134 543	2 608 481	3 733 346	3 431 504	4 162 127
895 016	992 146	1 335 323	1 246 598	2 143 225	2 548 635	2 422 374
78 377	79 233	99 083	131 715	184 697	191 421	234 269
52 211	53 805	64 211	77 119	112 966	117 568	141 621
1 092 523	1 423 802	2 035 460	2 445 164	3 498 748	3 205 353	3 879 319
758 768	938 341	1 271 112	1 137 877	2 030 259	1 891 408	2 280 753
413 727	398 429	498 879	469 640	497 916		
150 085	156 523	152 619	171 075	160 907		
123 810	146 708	157 970	149 423	151 262		
45 789	53 014	53 770	45 564	45 675		
289 917	251 669	340 909	320 217	341 365		
104 296	103 457	98 849	125 511	115 232		
16 037 285	16 290 286	15 362 146	18 435 472	8 911 133	14 060 361	13 748 015
8 219 230	8 647 072	8 462 076	10 875 734	5 019 389*	6 875 369*	4 255 874
7 772 329	6 167 609	5 952 353	4 282 912		6 591 588	7 503 911
1 025 508	1 569 045	2 215 665	827 947	4 656 702	1 646 648	1 496 769
2 087 003	4 540 401	4 554 743	5 594 916	514 579	4 179 731	5 816 987
1 015 769	1 495 751	1 391 361	1 490 143	362 687	2 012 522	2 331 988
2 403 783	3 105 390	2 034 027		1 726 913		1 507 881
1 835 238	2 343 410	1 366 176		1 041 800		983 978
509 062	649 096	715 643		640 901		478 408
305 981	381 781	425 639		325 658		304 818
1 001 194	1 304 021	1 045 323		960 057		957 931
635 730	809 356	667 476		590 187		607 618
2 386 641	2 567 451	2 610 069	2 439 906	2 866 191	3 829 230	4 571 944**
1 366 205	1 216 077	1 163 807	1 078 140	984 304	1 950 471	2 339 103^
39 604	33 085	34 265	43 759	40 619	30 406	12 495
4 748	3 734	5 134	7 400	5 932	5 075	6 759
1 920 489	2 004 313	2 397 849	2 290 797	2 685 182	3 798 824	4 571 944
934 909	682 290	980 718	965 390	964 896	1 945 396	2 339 103
1 167				7 116	1 732	203
8 518 905	9 239 462	10 530 601	11 513 684	10 994 966	12 645 404	13 303 404
4 933 416	5 165 386	5 936 348	5 865 476	5 205 920	7 169 642	6 982 423
216 643	240 212	127 752	129 575	103 754	166 959	173 924
75 923	96 538	46 099	34 735	30 328	81 201	67 963
7 030 084	8 661 237	9 413 944	11 384 109	10 861 320	12 439 185	13 075 023
3 585 315	4 730 835	4 901 344	5 830 741	5 153 779	7 057 864	6 880 537
4 692 412	3 778 535	3 624 885	3 725 896	5 232 430	4 382 988	4 908 357
3 543 576	2 465 914	2 456 639	2 614 104	3 607 237	3 379 651	3 561 370
		397 723	437 903	594 303	736 392	773 071
243 151	235 212	276 673	301 880	468 011	541 755	582 149
3 603 344	3 623 719	3 047 741	3 019 364	4 252 425	2 927 529	3 778 046
2 211 357	2 075 886	2 000 545	2 043 595	2 753 524	2 124 511	2 621 981
233 362	192 980	214 087	221 121	155 658	160 032	96 044
195 740	171 348	182 677	175 841	135 120	144 709	49 560
60 253	50 788	51 515	75 889	35 407	27 748	49 972
22 631	29 156	20 105	30 609	14 869	12 425	18 660
11	28	19	47			
11	28	19	47			
10	10	10	44			

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Mozambique	Suspected cases	6 097 263	7 059 112	6 265 567	8 565 263	12 612 456
	Presumed and confirmed	3 381 371	3 344 413	3 296 332	4 261 529	7 452 733
	Microscopy examined	1 950 933	2 504 720	2 546 213	2 058 998	2 295 823
	Microscopy positive	644 568	1 093 742	886 143	774 891	1 009 496
	RDT examined	2 287 536	2 966 853	2 276 298	5 526 908	10 271 075
	RDT positive	878 009	663 132	967 133	2 507 281	6 397 679
Namibia[2]	Suspected cases	39 855	61 145**	10 844	32 495**	185 078**
	Presumed and confirmed	25 889	14 071^	3 163	4 775^	15 692^
	Microscopy examined	14 522	13 262	7 875	1 507	1 894
	Microscopy positive	556	335	194	136	222
	RDT examined		48 599		32 495	185 078
	RDT positive		1 525		4 775	15 692
	Imported cases					
Niger	Suspected cases	11 231 308	5 315 185	7 818 305	5 584 223	7 100 212
	Presumed and confirmed	4 231 896	4 401 099	6 398 943	4 333 905	5 247 235
	Microscopy examined	165 514	130 658	1 781 505	1 799 299	2 872 710
	Microscopy positive	49 285	68 529	1 119 929	1 176 711	1 953 279
	RDT examined	7 476 672	1 622 013	1 967 117	1 824 610	2 944 035
	RDT positive	593 489	770 056	1 209 331	1 196 880	2 010 489
Nigeria	Suspected cases		5 221 656	11 789 970	21 659 831	20 558 467
	Presumed and confirmed	3 873 463	4 306 945	6 938 519	12 830 911	17 257 495
	Microscopy examined		672 185	1 953 399	1 633 960	1 681 469
	Microscopy positive	523 513				1 233 654
	RDT examined	45 924	242 526	2 898 052	7 194 960	10 191 825
	RDT positive	27 674				7 338 668
Rwanda	Suspected cases	2 883 666	1 802 382	3 095 386	3 064 585	4 178 206
	Presumed and confirmed	669 322	273 293	483 470	962 618	1 623 176
	Microscopy examined	2 708 973	1 602 271	2 904 793	2 862 877	4 010 202
	Microscopy positive	638 669	208 858	422 224	879 316	1 541 189
	RDT examined	174 693	200 111	190 593	201 708	168 004
	RDT positive	30 653	64 435	61 246	83 302	81 987
Sao Tome and Principe[2]	Suspected cases	76 593	117 279	126 897	108 634	91 445
	Presumed and confirmed	3 146	8 442	12 550	9 243	1 754
	Microscopy examined	48 366	83 355	103 773	73 866	33 355
	Microscopy positive	2 233	6 373	10 706	6 352	569
	RDT examined	28 227	33 924	23 124	34 768	58 090
	RDT positive	913	2 069	1 844	2 891	1 185
	Imported cases					
Senegal[2]	Suspected cases	721 687	633 380	686 047	867 157	727 918
	Presumed and confirmed	390 015	328 276	404 762	475 144	296 367
	Microscopy examined	27 793	18 325	19 946	24 205	19 343
	Microscopy positive	16 226	12 770	14 144	17 522	11 262
	RDT examined	634 210	560 898	555 724	734 495	677 832
	RDT positive	314 105	261 349	280 241	349 165	254 362
	Imported cases					
Sierra Leone	Suspected cases	2 327 928	1 150 747	2 579 296	2 576 550	2 647 375
	Presumed and confirmed	934 028	861 491	1 945 859	1 715 851	1 898 852
	Microscopy examined	718 473	46 280	194 787	185 403	66 277
	Microscopy positive	218 473	30 670	104 533	76 077	39 414
	RDT examined	1 609 455	886 994	1 975 972	2 377 254	2 056 722
	RDT positive	715 555	613 348	1 432 789	1 625 881	1 335 062
South Africa[2]	Suspected cases	276 669	382 434	151 344	603 726	540 913
	Presumed and confirmed	8 060	9 866	6 621	8 645	11 705
	Microscopy examined		178 387	121 291	364 021	300 291
	Microscopy positive	3 787	5 986	1 632	2 572	4 101
	RDT examined	276 669	204 047	30 053	239 705	240 622
	RDT positive	4 273	3 880	4 989	6 073	7 604
	Imported cases					
South Sudan[4]	Suspected cases					2 492 473
	Presumed and confirmed	900 283	1 473 653	1 125 039	1 855 501	2 433 991
	Microscopy examined					27 321
	Microscopy positive	900 283	112 024	225 371	262 520	18 344
	RDT examined					102 538
	RDT positive					53 033

2015	2016	2017	2018	2019	2020	2021
15 057 398	17 490 954	17 463 976	18 791 446	21 180 727	19 516 184	19 238 020
8 306 986	10 373 341	9 981 277	10 339 330	11 781 516	11 331 009	10 106 592
2 313 129	1 886 154	1 699 589	1 909 051	1 669 097	1 293 955	833 970
735 750	674 697	700 282	743 435	608 016	473 160	271 441
12 660 097	14 922 332	15 675 711	16 847 537	19 465 040	18 209 905	18 393 265
7 487 064	9 016 176	9 192 319	9 561 037	11 126 910	10 845 525	9 824 366
207 612**	308 414**	616 513**	394 822**	295 367**	258 145**	263 202**
12 050^	24 869^	66 141^	36 451^	3 404^	13 636^	13 738^
1 471	1 778	1 778	1 215	511	809	245
118	329	364	289	301	168	100
207 612	308 414	616 513	394 822	295 367	258 145	263 202
12 050	24 869	66 141	36 451	3 404	13 636	13 738
2 888	3 980	11 874	4 021	1 064	1 305	759
4 671 411	7 347 200	4 013 178	4 810 919	5 582 958	6 343 569	6 472 227
3 937 742	5 166 336	2 761 268	3 358 058	3 771 451	4 377 938	4 659 909
295 229	3 198 194	203 583	213 795	303 115	337 657	264 694
206 660	2 120 515	125 856	121 657	211 783	223 601	198 998
2 830 548	3 240 780	3 809 595	4 285 516	5 279 843	5 915 007	5 624 653
2 185 448	2 137 595	2 635 412	2 924 793	3 559 668	4 154 337	3 845 709
20 243 915	29 113 322	25 106 551	25 381 459	29 489 245	27 370 935	30 202 722
16 702 261	23 956 669	20 219 268	20 482 380	23 376 793	21 580 055	23 608 797
839 849	901 141	1 055 444	1 428 731	3 298 156	3 086 039	3 405 012
556 871	618 363	749 118	1 023 273	2 476 514	2 312 163	2 559 742
10 770 388	17 853 794	16 919 717	18 018 372	22 621 211	21 030 081	24 514 099
7 511 712	12 979 919	12 338 760	13 524 751	17 330 401	16 013 077	18 765 444
6 093 114	7 502 174	11 186 029	9 666 424	8 829 176	6 879 911	5 576 953
2 505 794	3 380 568	5 940 533	4 231 883	3 612 822	2 043 392	1 163 670*
5 811 267	6 603 261	6 637 571	5 501 455	4 576 495	3 181 252	3 175 568
2 354 400	2 916 902	2 927 780	1 657 793	1 144 762	493 480	259 161
281 847	898 913	4 548 458	4 164 969	4 252 681	3 698 659	2 401 385
151 394	463 666	3 012 753	2 574 090	2 468 060	1 549 912	904 509
84 348	121 409	96 612	169 883	202 207	195 365	163 496
2 058	2 238	2 241	2 940	2 742	1 944	2 730
11 941	3 682	2 146	13 186	4 071	30 265	6 739
140	33	109	148	306	1 544	2 397
72 407	117 727	94 466	156 697	198 136	165 100	156 757
1 918	2 205	2 132	2 792	2 436	400	333
2	0	2	3	10	11	11
1 421 221	1 559 054	2 035 693	2 096 124	2 010 398	2 206 842	2 632 540
502 084	356 272	398 377	536 745	359 246	452 984	547 773
26 556	38 748	21 639	12 881	11 356	13 641	15 963
17 846	9 918	10 463	3 997	2 496	3 881	5 222
1 384 834	1 513 574	2 011 383	2 077 442	1 994 504	2 185 530	2 605 654
474 407	339 622	385 243	526 947	352 212	441 432	531 628
0	0	0	292	45	0	0
2 337 297	2 996 959	2 935 447	2 895 596	4 169 146	1 860 018	3 174 623
1 569 606	1 845 727	1 741 512	1 781 855	2 445 392	1 223 397	2 043 818
75 025	120 917	10 910	20 155	140 768	149 100	137 649
37 820	60 458	5 717	8 719	35 055	71 001	71 448
2 176 042	2 805 621	2 834 261	2 827 417	3 990 491	1 212 527	2 947 058
1 445 556	1 714 848	1 645 519	1 725 112	2 372 450	654 005	1 882 454
43 515	63 277	56 257			98 562	99 066**
4 959	4 323	29 615	10 789	13 833	8 126^	5 812^
13 917	20 653				4 654	1 190
785	1 219	9 592	2 666	477	622	1 190
29 598	42 624	56 257			11 982	99 066
4 174	3 104	20 023	8 123	13 356	8 126	6 727
3 568	3 075	6 234	5 742	8 890	3 663	2 854
3 814 332	566 043	5 391 360	6 405 779	5 258 306		4 038 950
3 789 475	555 957	4 054 795	4 697 506	4 064 662	1 805 371*+	3 149 649
22 721	6 954	800 067	1 204	4 689	33 656	300 439
11 272	2 357	335 642	634	1 237	16 535	173 612
26 507	10 751	2 024 503	1 805 912	3 092 697	280 150	2 606 089
13 099	5 262	1 152 363	98 209	1 902 505	192 095	1 843 615

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Togo	Suspected cases	2 035 303	906 276	1 590 266	1 550 804	2 255 010
	Presumed and confirmed	1 441 199	519 452	909 129	965 832	1 524 339
	Microscopy examined	478 354	502 977	579 507	560 538	621 119
	Microscopy positive	206 071	224 619	260 535	272 984	310 207
	RDT examined	1 134 779	390 611	1 010 759	990 266	1 633 891
	RDT positive	812 958	282 145	648 594	692 848	1 214 132
Uganda	Suspected cases	15 320 926	12 362 291	16 845 771	26 145 615	19 201 136
	Presumed and confirmed	13 217 617	11 991 843	13 591 932	16 541 563	13 724 345
	Microscopy examined	3 705 284	385 928	3 466 571	3 718 588	2 048 185
	Microscopy positive	1 628 595	134 726	1 413 149	1 502 362	578 289
	RDT examined	64 607	300 761	2 449 526	7 387 826	7 060 545
	RDT positive	37 987	181 515	1 249 109		3 053 650
United Republic of Tanzania[2]	Suspected cases	15 452 268	15 442 493	14 659 506	15 177 829	25 197 621
	Presumed and confirmed	12 893 899	10 165 442	8 478 109	8 587 728	7 403 952
	Microscopy examined	3 701 608	5 800 195	7 077 411	6 888 029	727 130
	Microscopy positive	1 277 388	1 813 654	1 772 736	1 481 759	572 289
	RDT examined	136 123[$]	1 628 092	1 091 615	1 256 762	17 746 946
	RDT positive	1 974[$]	337 582	214 893	72 931	108 118
	Imported cases				719[$]	1 583[$]
Mainland	Suspected cases	15 180 191	14 986 775	14 122 756	14 649 872	24 880 179
	Presumed and confirmed	12 819 556	10 160 953	8 474 952	8 585 128	7 399 316
	Microscopy examined	3 637 659	5 656 907	6 931 025	6 804 085	592 320
	Microscopy positive	1 277 024	1 813 179	1 772 062	1 481 275	571 598
	RDT examined		1 315 662	701 477	813 103	17 566 750
	RDT positive		333 568	212 636	71 169	106 609
Zanzibar[2]	Suspected cases	272 077	455 718	536 750	527 957	317 442
	Presumed and confirmed	74 343	4 489	3 157	2 600	4 636
	Microscopy examined	63 949	143 288	146 386	83 944	134 810
	Microscopy positive	364	475	674	484	691
	RDT examined	136 123	312 430	390 138	443 659	180 196
	RDT positive	1 974	4 014	2 257	1 762	1 509
	Imported cases				719	1 583
Zambia	Suspected cases					7 859 740
	Presumed and confirmed	4 229 839	4 607 908	4 695 400	5 465 122	5 972 933
	Microscopy examined					
	Microscopy positive					
	RDT examined					5 964 354
	RDT positive					4 077 547
Zimbabwe[2]	Suspected cases	912 618	480 011	734 997	1 128 954	1 504 682
	Presumed and confirmed	648 965[^]	321 901	277 736	423 702	572 944
	Microscopy examined		10 004	7 823	13 949	28 745
	Microscopy positive	249 379	1 966	773	1 069	2 420
	RDT examined	513 032	470 007	727 174	1 115 005	1 453 689
	RDT positive	249 379	319 935	276 963	422 633	548 276
	Imported cases					
AMERICAS						
Argentina[1,2]	Suspected cases	2 547	7 872	7 027	4 913	5 691
	Presumed and confirmed	121	28	16	11	15
	Microscopy examined	2 547	7 872	7 027	4 913	5 691
	Microscopy positive	121	28	16	11	15
	RDT examined					
	RDT positive					
	Imported cases	55	28	16	11	15
Belize[2,3]	Suspected cases	27 366	22 996	20 789	25 351	24 122
	Presumed and confirmed	150	79	37	26	19
	Microscopy examined	27 366	22 996	20 789	25 351	24 122
	Microscopy positive	150	79	37	26	19
	RDT examined					
	RDT positive					
	Imported cases		7	4	4	0
	Relapse cases		0	0	2	0

2015	2016	2017	2018	2019	2020	2021
2 356 048	2 577 029	2 747 984	3 009 800	3 531 375		3 091 060
1 610 711	1 746 334	1 756 582	2 002 877	2 406 091		996 364
643 815	501 516	482 664	446 404	492 629		623 623
317 578	231 919	209 626	229 267	269 526		245 956
1 712 233	2 075 513	2 265 320	2 563 396	3 038 746		2 332 983
1 293 133	1 514 415	1 546 956	1 773 610	2 136 565		750 408
22 952 246	27 257 784	22 319 643	17 111 650	25 756 835	27 434 176	25 048 071
13 696 889	14 008 604	11 667 831	8 522 824	15 592 793	17 475 040£	15 144 755£
3 684 722	4 492 090	5 515 931	1 606 330	4 691 859	4 284 114	4 029 037
1 248 576	1 542 091	1 694 441	458 909	1 622 576	1 647 933	1 513 116
12 983 382	18 492 939	16 803 712	12 741 670	19 454 545	22 004 158	20 210 666
6 164 171	8 193 758	9 973 390	5 300 265	12 359 786	12 548 724	11 131 747
20 829 480	17 881 657	20 276 522	22 784 288	20 981 250	22 471 902	20 794 633
8 406 354	6 624 054	5 988 136	6 219 125	6 003 332	6 015 706	4 465 605
673 223	1 386 389	2 888 538	3 015 052	1 840 897	1 696 487	1 534 975
412 702	1 262 679	916 742	831 903	366 673	296 052	229 485
16 652 731	15 633 676	17 144 755	19 603 825	18 861 368	20 620 288	19 210 871
4 490 126	4 499 783	4 828 165	5 221 811	5 546 911	5 681 861	4 227 333
2 550$			1 754$	3 286$	4 314$	4 319$
20 451 119	17 526 829	19 930 496	22 440 865	20 570 343	22 009 560	20 273 766
8 400 537	6 617 261	5 982 270	6 215 115	5 996 369	6 001 518	4 459 255
532 118	1 285 720	2 826 948	2 937 666	1 768 635	1 627 724	1 480 697
411 741	1 261 650	915 887	830 668	364 890	293 049	228 379
16 416 675	15 379 517	16 861 141	19 338 466	18 711 960	20 344 043	18 784 282
4 486 470	4 494 019	4 823 976	5 219 714	5 541 731	5 670 676	4 222 089
378 361	354 828	346 026	343 423	427 029	462 342	520 867
5 817	6 793	5 866	4 010	6 963	14 188*	6 350
141 105	100 669	61 590	77 386	72 262	68 763	54 278
961	1 029	855	1 235	1 783	3 003	1 106
236 056	254 159	283 614	265 359	149 408	276 245	426 589
3 656	5 764	4 189	2 097	5 180	11 185	5 244
2 550			1 754	3 286	4 314	4 319
8 116 962	9 627 862	10 952 323	10 055 407	11 340 409	15 491 235	13 957 528
5 094 123	5 976 192	6 054 679	5 195 723	5 360 020	8 698 304	7 159 243
			180 697	275 323	398 195	446 750
			49 855	78 474	128 291	117 585
7 207 500	8 502 989	10 403 283	9 718 666	10 852 416	14 513 049	13 120 677
4 184 661	4 851 319	5 505 639	4 989 824	5 068 876	7 992 924	6 651 557
1 693 630	1 499 675	1 828 301	1 293 392	1 324 299	1 389 065	922 001
484 794	384 029	767 069	264 018	308 173	447 381	133 137
55 192	102 566		2 771			
2 415	2 986	3 522				
1 638 438	1 330 069	1 533 030	1 290 621	1 297 197	1 356 433	904 833
482 379	314 003	468 276	264 018	308 173	447 381	133 137
180	358	768	672			
3 862	3 479	2 114	345			
11	9	18^	28	0	0	
3 862	3 479	2 114	345			
11	9	16	28	0	0	
		2				
11	9	18	23			
26 367	20 936	26 995	17 642	19 731	10711**	10 893**
13^	5	9^	7	2	0	0
26 367	20 936	26 995	17 642	19 731	10 711	10 893
13	5	9	7	2	0	0
					114	7 278
5		3			0	0
4	1	2	4	2	0	0
0	0	0	0	0	0	0

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Bolivia (Plurinational State of)[2]	Suspected cases	140 857	150 662	132 904	144 049	124 900
	Presumed and confirmed	13 769	7 143	7 415	7 342	7 401
	Microscopy examined	133 463	143 272	121 944	133 260	124 900
	Microscopy positive	12 252	6 108	6 293	6 272	7 401
	RDT examined	7 394	7 390	10 960	10 789	
	RDT positive	1 517	1 035	1 122	1 070	
	Imported cases					
Brazil[2,5]	Suspected cases	2 711 433	2 477 821	2 349 341	1 893 018	1 756 460
	Presumed and confirmed	334 668	267 146	242 758	206 206+	162 929+
	Microscopy examined	2 711 432	2 476 335	2 325 775	1 873 518	1 744 640
	Microscopy positive	334 667	266 713	237 978	174 048	142 744
	RDT examined	1	1 486	23 566	19 500	11 820
	RDT positive	1	433	4 780	3 719	1 384
	Imported cases				8 923	4 856
	Relapse cases				27 660	20 185
Colombia[2]	Suspected cases	521 342	418 032	416 767	327 055	403 532
	Presumed and confirmed	117 650	64436+	60 179	51 722+	40 768
	Microscopy examined	521 342	396 861	346 599	284 332	325 713
	Microscopy positive	117 637	60 121	50 938	44 293	36 166
	RDT examined		21 171	70 168	42 723	77 819
	RDT positive	13	4 188	9 241	7 403	4 602
	Imported cases					
Costa Rica[2]	Suspected cases	15 599	10 690	7 485	16 774	4 420
	Presumed and confirmed	137	17	8	6	6
	Microscopy examined	15 599	10 690	7 485	16 774	4 420
	Microscopy positive	137	17	8	6	6
	RDT examined					
	RDT positive					
	Imported cases	4	6	1	4	5
	Relapse cases	0	0	0	2	1
Dominican Republic[2]	Suspected cases	469 052**	477 555	506 583	502 683	416 729
	Presumed and confirmed	2 482^	1 616	952	579	496
	Microscopy examined	469 052	421 405	415 808	431 683	362 304
	Microscopy positive	2 482	1 616	952	579	496
	RDT examined	26 585	56 150	90 775	71 000	54 425
	RDT positive	932				
	Imported cases				106	37
	Relapse cases					0
Ecuador[2]	Suspected cases	488 830	460 785	459 157	397 628	370 825
	Presumed and confirmed	1 888	1 233	560	378	242
	Microscopy examined	481 030	460 785	459 157	397 628	370 825
	Microscopy positive	1 888	1 233	560	378	242
	RDT examined	7 800				
	RDT positive					
	Imported cases		14	14	10	
	Relapse cases		0	2	0	
El Salvador[1,2]	Suspected cases	115 256	100 883**	124 885	103 748	106 915
	Presumed and confirmed	26	15^	20	7	8
	Microscopy examined	115 256	100 883	124 885	103 748	106 915
	Microscopy positive	26	15	20	7	8
	RDT examined		1			
	RDT positive		1			
	Imported cases	9	8	7	1	2
French Guiana[2]	Suspected cases	14 373	14 429	13 638	22 327	14 651
	Presumed and confirmed	1 632^	1 209^	900^	875+	448
	Microscopy examined	14 373	14 429	13 638	22 327	14 651
	Microscopy positive	1 085	720	523	321	242
	RDT examined					
	RDT positive	944	704	499	551	206
	Imported cases					
	Relapse cases					
Guatemala[2]	Suspected cases	237 075	195 080	186 645	153 731	250 964**
	Presumed and confirmed	7 384+	6 817	5 346	6 214	4 931
	Microscopy examined	235 075	195 080	186 645	153 731	250 964
	Microscopy positive	7 198	6 817	5 346	6 214	4 931
	RDT examined	2 000				50 025
	RDT positive					
	Imported cases					2

2015	2016	2017	2018	2019	2020	2021
159 167	155 407	151 697	139 938	137 473	136 795	139 279
6 907	5 553	4 587	5 354	9 357	12 187	9 959
159 167	155 407	151 697	139 938	110 028		
6 907	5 553	4 334	5 261	8 118	8 507	7 404
				27 445		
		253	93	1 239	3 680	2 555
33	11	15	12	19	7	0
1 590 403	1 364 912	1 696 063	1 800 465	1 591 308	1 232 321	1 234 266
169 390+	152 160+	238 517+	244 042+	190 740+	172 401	163 585+
1 573 538	1 341 639	1 656 685	1 754 244	1 539 938	1 163 048	1 138 847
139 844	124 210	184 876	181 967	146 868	127 403	119 735
16 865	23 273	39 378	46 221	51 370	69 273	95 419
3 318	5 034	9 549	12 606	10 586	17 785	20 651
4 932	5 068	4 867	6 816	4 165	1 811	1 365
23 229	22 916	44 092	49 469	33 286	27 213	23 199
328 434	296 091	254 380	208 538	295 406	212 399	239 060
55 866+	83 227+	54 102+	63 143+	80 415+	76 236+	73 979+
316 451	242 973	244 732	195 286	283 471	202 736	222 155
48 059	57 515	38 349	42 810	47 806	40 155	34 114
11 983	53 118	9 648	13 252	11 935	9 663	16 905
3 535	5 655	5 056	3 407	3 703	5 284	5 396
7 785	618	1 297	1 948	2 306	457	758
7 373**	5 160**	9 680**	9 000**	10 631	7 754**	12 383**
8^	13^	25^	152^	149	141^	232^
7 373	5 160	9 680	9 000	10 631	4 200	2 001
8	13	25	110	149	141	232
3	2	3	700		3 647	12 383
3	2	3	44		93	128
8	9	13	38	45	34	27
0	0	0	2	4	4	12
317 257**	251 245	226 988**	132 775**	143 366**	59 826**	48 139**
661^	755+	398^	484^	1 314^	829	291
317 257	228 795	226 988	132 775	143 366	59 826	48 139
661	487	398	322	1 314	829	17
7 659	22 450	87 397	42 425	55 000	7 570	26 839
129	80	74	221	1 313		274
30	65	57	51	23	3	7
0	3	0	23	3		
261 824	311 920	306 894	237 995**	177 742	163 990	184 862
686^	1 424	1 380^	1 806^	1 909	2 089+	2 436+
261 824	311 920	306 894	237 995	177 742	163 607	149 568
686	1 424	1 380	1 589	1 428	1 618	1 778
			6 782			35 294
6		6	217	481	383	467
59	233	105	153	106	67	70
					65	183
89 267	81 904	70 022	52 216**	89 992	18 868	
9	14	4	2^	3	0	
89 267	81 904	70 022	52 216	89 992	18 868	
9	14	4	2	3	0	
			1			
			1			
4	1	3	2	3	0	
11 558	9 430				6 238	
434	258	597	546	212§	154	143
11 558	9 430				6 238	
297	173	468	546	178	120	122
137	85	129		34	34	21
60	41	43		36	14	37
0	0	0				32
295 246**	333 535**	372 158**	438 833**	427 239**	319 660**	369 252
5 540^	5 001+	4 124^	3 021^	2 072^	1 058^	1 273
295 246	333 535	372 158	438 833	427 239	319 660	369 252
5 538	4 854	3 744	3 021	2 072	1 058	1 273
6 500	74 859	170 325	75 300	61 275	16 000	
1 298	1	2 078	1 748	1 309	292	
2	1	3	3	3	0	

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Guyana[2]	Suspected cases	212 863	201 693**	196 622	205 903	142 843
	Presumed and confirmed	22 935	29 471^	31 601^	31 479	12 354
	Microscopy examined	212 863	201 693	196 622	205 903	142 843
	Microscopy positive	22 935	29 471	31 601	31 479	12 354
	RDT examined		35			
	RDT positive		35	55		
	Imported cases					
Haiti	Suspected cases	270 427	184 934	167 772	171 409	261 403
	Presumed and confirmed	84 153	34 350	27 866	26 543	17 696
	Microscopy examined	270 427	184 934	167 726	165 823	134 766
	Microscopy positive	84 153	34 350	27 866	26 543	10 893
	RDT examined			46	5 586	126 637
	RDT positive					6 803
Honduras[2]	Suspected cases	152 961**	152 451**	155 165**	144 436**	151 420**
	Presumed and confirmed	9 745	7 618^	6 439^	5 364^	3 380^
	Microscopy examined	152 961	152 451	155 165	144 436	151 420
	Microscopy positive	9 745	7 618	6 439	5 364	3 380
	RDT examined	1 500	4 000	4 000	237	1 427
	RDT positive		49	10	64	102
	Imported cases					2
	Relapse cases					
Mexico[2]	Suspected cases	1 192 081	1 035 424	1 025 659	1 017 508	900 578
	Presumed and confirmed	1 233	1 130	842	499	666
	Microscopy examined	1 192 081	1 035 424	1 025 659	1 017 508	900 578
	Microscopy positive	1 233	1 130	842	499	666
	RDT examined					
	RDT positive					
	Imported cases	7	6	9	4	10
	Relapse cases	0	0	0	0	0
Nicaragua[2]	Suspected cases	554 414	536 105	552 722	539 022	605 357
	Presumed and confirmed	692	925	1 235	1 196	1 163
	Microscopy examined	535 914	521 904	536 278	519 993	605 357
	Microscopy positive	692	925	1 235	1 196	1 163
	RDT examined	18 500	14 201	16 444	19 029	
	RDT positive					
	Imported cases				34	21
Panama[2]	Suspected cases	141 038	116 588	107 711	93 624	80 701
	Presumed and confirmed	418	354	844	705	874
	Microscopy examined	141 038	116 588	107 711	93 624	80 701
	Microscopy positive	418	354	844	705	874
	RDT examined					
	RDT positive					
	Imported cases				9	10
	Relapse cases				0	0
Paraguay[1,2,3]	Suspected cases	62 178	48 611	31 499	24 806	24 832
	Presumed and confirmed	29	10	15	11	8
	Microscopy examined	62 178	48 611	31 499	24 806	24 832
	Microscopy positive	29	10	15	11	8
	RDT examined					
	RDT positive					
	Imported cases	9	9	15	11	8
Peru[2]	Suspected cases	744 627**	702 894**	758 723**	863 790**	864 413**
	Presumed and confirmed	31 545^	25 005^	31 436	48 719	65 252
	Microscopy examined	744 627	702 894	758 723	863 790	864 413
	Microscopy positive	31 545	25 005	31 436	48 719	65 252
	RDT examined	23	58	562	858	1 634
	RDT positive	1	34			
	Imported cases					
Suriname[2]	Suspected cases	17 902	16 160	22 134	19 736	33 097
	Presumed and confirmed	1 771+	795+	569+	729	401
	Microscopy examined	16 533	15 135	17 464	13 693	17 608
	Microscopy positive	1 574	751	306	530	98
	RDT examined	1 369	1 025	4 670	6 043	15 489
	RDT positive	190	20	248	199	303
	Imported cases				204	
	Relapse cases					

2015	2016	2017	2018	2019	2020	2021
132 941	117 483	100 308	101 346	103 836	72821**	89 809
9 984	11 108^	13 936^	17 038^	18 826	17 230^	20 850*
132 941	110 891	100 105	95 986	85 736	49 496	63 165
9 984	10 906	13 734	15 607	13 840	8 932	11 785
	6 592	203	5 360	18 100	27 116	26 622
	1 724	242	3 570	4 986	10 025	9 065
	411					
330 603	459 959	330 738**	287 522**	266 675	245 202	198 881
17 583^	21 430^	19 135^	8 828^	10 687	22 996+	9 513^
69 659	61 428	62 539	59 803	35 144	7 855	18 130
5 224	4 342	2 119	1 586	765	1 446	674
260 944	398 531	301 812	253 001	231 531	226 374	180 751
12 702	23 325	18 309	8 232	9 922	21 541	9 333
152 730**	173 651**	148 160**	142 780**	142 870**	10 350	165 853**
3 555^	4 097^	1 283^	653^	391^	913^	1 657^
150 854	167 836	148 160	142 780	142 870		151 244
3 555	4 097	1 283	653	391	913	1 657
4 928	20 745	25 870	31 556	18 754	10 350	14 609
79	657	263	454	193	539	968
0	3	10	21	61	98	107
			3		17	19
867 853**	798 568**	644 174**	548 247	531 471**	242 200	298 496
551^	596^	765^	803^	641^	369	275
867 853	798 568	644 174	548 247	531 471	242 200	298 496
551	596	765	836	641	369	275
7	6	6		161		
7	6	6		3		
34	45	29	23	22	10	31
0	0	5	10	1	2	2
604 418	554 415	663 132	831 077**	1 029 288	947 451	1 158 806
2 308	6 284	10 952	15 934^	13 226	31 763	23 323
604 418	553 615	660 452	831 077	1 001 225	884 821	1 158 806
2 308	6 284	10 952	15 934	12 337	18 799	16 684
	800	2 680	44 905	28 063	56 397	
			2 885	889	6 731	6 639
29	12	3	17	26	25	64
64 511	50 772	38 270**	23 383**	22 171	14 809	18 779**
562^	811^	689^	715^	1 597++	2 203++	4 364^
64 511	50 772	38 270	23 383	18 217	7 027	6 105
562	811	689	715	1 209	1 358	649
		829	1 141	3 954	7 782	17 239
3	5	689	424	388	2 109	4 253
16	42	40	31	15	10	7
0	0	0	0	130	135	192
6 687**	3 192**	8 014**		11 415	11 221	11 073**
8^	10^	5^	0	2	1	4^
6 687	3 192	8 014		11 336	11 196	11 073
8	10	5	0	1	1	4
10	1	1 267		79	25	153
1	1	2		1	0	3
8	10	5	0	2	1	4
865 980**	566 230	388 699**	304 785**	243 240		412 933
66 609^	56 671	55 367^	45 619^	24 483	15 847	18 140
865 980	566 230	388 699	304 785	243 240		412 933
66 609	56 671	55 367	45 619	24 483	15 847	18 140
18 133		13 924	160 000			
463		2 325	1 000			
	48	57	176	159	25	65
15 236	23 444	22 302	19 836	20 743	14 057**	16 597**
376	332+	551^	235	215	244	77^
15 083	14 946	12 536	11 799	13 702	13 798	16 592
345	315	412	218	209	238	77
153	8 498	9 766	8 037	7 041	14 043	16 513
31	11	160	17	6	6	76
295	251	414	198	111	88	53
0	3	0	7	0	3	0

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Venezuela (Bolivarian Republic of)[2]	Suspected cases	400 495	382 303	410 663	476 764	522 617
	Presumed and confirmed	45 155	45 824	52 803	80 320	91 918
	Microscopy examined	400 495	382 303	410 663	476 764	522 617
	Microscopy positive	45 155	45 824	52 803	80 320	91 918
	RDT examined					
	RDT positive					
	Imported cases				1 677	1 210
	Relapse cases					
EASTERN MEDITERRANEAN						
Afghanistan	Suspected cases	865 181	936 252	847 933	817 606	881 515
	Presumed and confirmed	392 864	482 748	391 365	326 593	317 608
	Microscopy examined	524 523	531 053	511 408	507 145	514 466
	Microscopy positive	69 397	77 549	54 840	46 114	83 920
	RDT examined	17 592			36 833	155 919
	RDT positive	401			6 851	22 558
Djibouti	Suspected cases		354	1 412	7 189	39 284
	Presumed and confirmed	1 010	230	27	1 684	9 439
	Microscopy examined		124	1 410	7 189	39 284
	Microscopy positive	1 010		22	1 684	9 439
	RDT examined					
	RDT positive			3		
Iran (Islamic Republic of)[2,3]	Suspected cases	614 817	530 470	479 655	385 172	468 513
	Presumed and confirmed	3 031	3 239	1 629	1 374	1 243
	Microscopy examined	614 817	530 470	479 655	385 172	468 513
	Microscopy positive	3 031	3 239	1 629	1 374	1 243
	RDT examined					
	RDT positive					
	Imported cases	1 184	1 529	842	853	867
	Relapse cases			19	14	11
Pakistan	Suspected cases	8 601 835	8 418 570	8 902 947	7 682 166	8 375 256
	Presumed and confirmed	4 281 356	4 065 802	4 285 449	3 465 620	3 655 975
	Microscopy examined	4 281 346	4 168 648	4 497 330	3 786 216	4 179 468
	Microscopy positive	220 870	287 592	250 526	183 091	183 180
	RDT examined	279 724	518 709	410 949	704 978	804 680
	RDT positive	19 721	46 997	40 255	91 557	81 687
Saudi Arabia[2,3]	Suspected cases	944 723	1 062 827	1 186 179	1 309 783	1 249 752
	Presumed and confirmed	1 941	2 788	3 406	2 513	2 305
	Microscopy examined	944 723	1 062 827	1 186 179	1 309 783	1 249 752
	Microscopy positive	1 941	2 788	3 406	2 513	2 305
	RDT examined					
	RDT positive					
	Imported cases	1 912	2 719	3 324	2 479	2 254
Somalia	Suspected cases	223 981	99 403	53 658	88 734	92 103
	Presumed and confirmed	24 833	41 167	23 202	9 135^	26 419
	Microscopy examined	20 593	26 351		19 542	12 450
	Microscopy positive	5 629	1 627		841	245
	RDT examined	203 388	35 236	37 273	67 464	64 480
	RDT positive	19 204	1 724	6 817	7 407	11 001
Sudan	Suspected cases	2 398 239	2 929 578	2 438 467	2 197 563	
	Presumed and confirmed	1 465 496	1 214 004	964 698	989 946	1 207 771
	Microscopy examined					
	Microscopy positive	625 365	506 806	526 931	592 383	579 038
	RDT examined	1 653 300	2 222 380	2 000 700	1 800 000	788 281
	RDT positive	95 192				489 468
Yemen	Suspected cases	835 018	804 401	888 952	927 821	821 618
	Presumed and confirmed	198 963	142 152	165 687	149 451	122 812
	Microscopy examined	645 463	645 093	685 406	723 691	643 994
	Microscopy positive	78 269	60 751	71 300	63 484	51 768
	RDT examined	97 289	108 110	150 218	157 457	141 519
	RDT positive	28 428	30 203	41 059	39 294	34 939

2015	2016	2017	2018	2019	2020	2021
625 174	852 556	1 144 635	699 130	1 104 736	655 707	600 242**
137 996	301 466	525 897	522 059+	492 753+	232 757^	194 057
625 174	852 556	1 144 635	699 130	1 040 683	655 707	342 616
137 996	301 466	525 897	404 924	398 285	197 466	113 863
						257 626
			48 117	64 053	69 884	80 194
1 594	1 948	2 941	2 125	1 848	1 356	829
	58 390	111 360	106 886	87 029	31 308	12 806
939 964	1 055 368	1 143 511	1 240 523	1 008 487	943 267	917 108
383 008	436 017	413 536	299 863	174 894	105 445	86 370
538 789	598 556	611 904	665 200	561 160	449 875	483 806
103 377	151 528	194 866	104 960	71 389	38 923	35 149
138 026	262 028	431 157	524 149	446 293	389 994	433 195
16 482	89 705	118 220	143 729	102 471	66 372	51 114
10 586	19 492	75 594	104 800	214 101	268 147**	218 591
9 557	13 822	14 810	25 319	49 402*	73 535^	58 916
10 502	19 492	24 504			42 250	50 157
1 764	2 280	1 283			11 633	13 210
		51 090	104 800	214 101	268 147	168 434
7 709	11 542	13 527	25 319	49 402	73 535	45 706
610 337	418 125	383 397	477 914**	455 855**	388 232	275 419**
799	705	939	625^	1 190^	1 051^	999
610 337	418 125	383 397	477 914	454 322	334 861	275 419
799	705	939	625	1 190	1 046	994
			64 061	101 803	53 371	25 025
			436	1 089	516	5
632	611	868	602	1 107	878	821
2	3	0	3	0	2	0
8 943 120	8 216 519	8 200 987	7 226 725	8 157 351	7 172 956	7 789 443
3 778 090	2 126 497	2 209 708	1 069 052	413 533	372 416	400 316
4 620 326	5 091 840	4 539 957	4 324 570	4 855 044	3 607 265	4 231 801
138 130	157 554	132 580	119 099	125 804	83 859	86 319
748 563	1 327 187	1 821 139	2 207 613	3 302 307	3 564 489	3 556 423
65 729	171 451	237 237	255 411	287 729	287 969	312 778
1 306 700	1 267 933	1 073 998	1 015 953	1 118 706**	703 048**	1 164 803
2 620	5 382	3 151	2 711	2 152^	3 658^	2 616
1 306 700	1 267 933	1 073 998	1 015 953	1 118 706	403 972	429 910
2 620	5 382	3 151	2 711	2 152	3 658	1 091
				1 118 706	399 076	212 908
				2 152	3 205	1 525
2 537	5 110	2 974	2 517	2 029	3 453	2 470
119 008	205 753	228 912	253 220	332 935**	337 965	376 167
39 169	58 021	37 156	31 030	65 375^	27 333	50 648
				59 494		32 175
				11 615		4 463
100 792	183 360	226 894	253 211	332 935	337 965	298 929
20 953	35 628	35 138	31 021	39 687	27 333	8 504
4 101 841	4 199 740	3 691 112	9 760 505	7 642 050	8 211 933	8 145 586
1 102 186	897 194	1 642 058	3 627 586	3 568 941	3 412 499	3 960 655
3 586 482	3 236 118	2 426 329	6 668 355	4 797 856	5 568 277	4 742 722
586 827	378 308	588 100	1 262 210	1 408 242	1 262 841	1 309 893
	632 443	422 841	1 113 247	1 027 264	929 551	1 056 085
	187 707	212 016	386 473	343 769	435 553	337 852
711 680	1 217 602	1 659 798	779 312	1 283 681	1 280 190	1 573 986
104 831	145 627	143 333	233 143	216 763	202 671	244 857
561 644	960 860	1 070 020	419 415	841 358	791 049	772 511
42 052	45 886	28 936	64 233	104 350	97 008	83 436
121 464	210 815	589 778	284 654	391 459	450 541	736 957
34 207	53 814	114 397	93 667	61 549	67 058	96 903

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
EUROPEAN						
Armenia[1,2]	Suspected cases	31 026				
	Presumed and confirmed	1		4	0	1
	Microscopy examined	31 026				
	Microscopy positive	1		4		1
	RDT examined					
	RDT positive					
	Imported cases	1		4	0	1
Azerbaijan[2]	Suspected cases	456 652	449 168	497 040	432 810	399 925
	Presumed and confirmed	52	8	4	4	2
	Microscopy examined	456 652	449 168	497 040	432 810	399 925
	Microscopy positive	52	8	4	4	2
	RDT examined					
	RDT positive					
	Imported cases	2	4	1	4	2
Georgia[2]	Suspected cases	2 368	2 032	1 046	192	440
	Presumed and confirmed	0	6	5	7	5
	Microscopy examined	2 368	2 032	1 046	192	440
	Microscopy positive	0	6	5	7	5
	RDT examined					
	RDT positive					
	Imported cases	0	5	4	7	5
	Relapse cases					
Kyrgyzstan[2]	Suspected cases	30 190	27 850	18 268	54 249	35 600
	Presumed and confirmed	6	5	3	4	0
	Microscopy examined	30 190	27 850	18 268	54 249	35 600
	Microscopy positive	6	5	3	4	0
	RDT examined					
	RDT positive					
	Imported cases	3	5	3	4	0
Tajikistan[2]	Suspected cases	173 523	173 367	209 239	213 916	200 241
	Presumed and confirmed	116	100	54	25	7
	Microscopy examined	173 523	173 367	209 239	213 916	200 241
	Microscopy positive	116	100	54	25	7
	RDT examined					
	RDT positive					
	Imported cases	4	22	11	10	5
Türkiye[2]	Suspected cases	507 841	421 295	337 830	255 125	189 854
	Presumed and confirmed	90	132	595	285	254
	Microscopy examined	507 841	421 295	337 830	255 125	189 854
	Microscopy positive	90	132	595	285	254
	RDT examined					
	RDT positive					
	Imported cases	81	128	376	251	249
	Relapse cases	9	4	0	34	0
Turkmenistan[1,2]	Suspected cases	81 784				
	Presumed and confirmed	0	0	0	0	0
	Microscopy examined	81 784				
	Microscopy positive					
	RDT examined					
	RDT positive					
	Imported cases	0	0	0	0	0
Uzbekistan[1,2]	Suspected cases	921 364	886 243	805 761	908 301	812 347
	Presumed and confirmed	6	1	1	3	1
	Microscopy examined	921 364	886 243	805 761	908 301	812 347
	Microscopy positive	6	1	1	3	1
	RDT examined					
	RDT positive					
	Imported cases	2	1	1	3	1

	2015	2016	2017	2018	2019	2020	2021
	1 213	465	350	320		121	
	2	2	2	6		3	
	1 213	465	350	320		121	
	2	2	2	6		3	
	2	2	2	6		3	
	405 416	465 860	373 562	358 009			
	1	1	1	2	0		
	405 416	465 860	373 562	358 009			
	1	1	1	2	0		
	1	1	1	2			
	294	318	416	286	335	237	
	6	7	9	9	8	4	
	294	318	416	286	335	237	
	6	7	9	9	8	4	
	5	7	8	9	8	4	
			1				
	75 688	62 537	8 459	7 709	46 384	18 717	
	1	6	2	0	1	0	
	75 688	62 537	8 459	7 709	46 384	18 717	
	1	6	2	0	1	0	
	0	0	0				
	0	0	0				
	1	6	2	0	1	0	
	188 341**	198 766**	191 284**		209 830	159 124	
	4^	1^	3^		3	0	
	188 341	198 766	191 284		207 821	159 124	
	4	1	3		3	0	
	42 056	34 570	41 218		2 009		
	4	1	3				
	4	1	3		3		
	211 740	144 499	115 557	95 877	59 429	54 586	
	224	209	214	238	279	135	
	211 740	144 499	115 557	95 877	59 429	54 586	
	224	209	214	238	279	135	
	221	208	214	237	277	133	
	0	0	0				
	83 675	85 536	84 264	85 722	78 903	71 887	
	0	0	0	0	3	0	
	83 675	85 536	84 264	85 722	78 903	71 887	
				0	3	0	
	0	0	0	0	3	0	
	800 912	797 472	655 112	650 616	669 373	552 458	
	0	0	0	0	1	2	
	800 912	797 472	655 112	650 616	669 373	552 458	
	0	0	0	0	1	2	
	0	0	0	0	1	2	

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
SOUTH-EAST ASIA						
Bangladesh[2]	Suspected cases	467 767	390 930	372 806	418 755	630 181
	Presumed and confirmed	62 378	52 601	29 518	26 891	57 480
	Microscopy examined	308 326	270 253	253 887	290 496	418 519
	Microscopy positive	20 519	20 232	9 901	7 303	13 628
	RDT examined	152 936	119 849	118 919	128 259	211 662
	RDT positive	35 354	31 541	19 617	19 588	43 852
	Imported cases					
Bhutan[2]	Suspected cases	54 760	44 494	42 512	31 632	33 586
	Presumed and confirmed	487	207	82	45	48
	Microscopy examined	54 709	44 481	42 512	31 632	33 586
	Microscopy positive	436	194	82	45	48
	RDT examined					
	RDT positive					
	Imported cases			0	23	34
	Relapse cases			0		0
Democratic People's Republic of Korea[2]	Suspected cases	27 019	27 857	40 925	72 719	38 878
	Presumed and confirmed	15 392	18 104	23 537	15 673	11 212
	Microscopy examined	25 147	26 513	39 238	71 453	38 201
	Microscopy positive	13 520	16 760	21 850	14 407	10 535
	RDT examined					
	RDT positive					
India[2]	Suspected cases	119 279 429	119 470 044	122 170 278	127 891 198	138 628 331
	Presumed and confirmed	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	Microscopy examined	108 679 429	108 969 660	109 044 798	113 109 094	124 066 331
	Microscopy positive	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	RDT examined	10 600 000	10 500 384	13 125 480	14 782 104	14 562 000
	RDT positive					
Indonesia[2,6]	Suspected cases	1 591 179	1 212 799	1 900 725	1 708 161	1 550 296
	Presumed and confirmed	465 764	422 447	417 819	343 527	252 027
	Microscopy examined	1 335 445	962 090	1 429 139	1 447 980	1 300 835
	Microscopy positive	465 764	422 447	417 819	343 527	252 027
	RDT examined	255 734	250 709	471 586	260 181	249 461
	RDT positive					
	Imported cases					
Myanmar[2]	Suspected cases	1 277 568	1 210 465	1 424 004	1 300 556	1 567 095
	Presumed and confirmed	693 124	567 452	481 242	333 871	205 658
	Microscopy examined	275 374	312 689	265 135	138 473	151 258
	Microscopy positive	103 285	91 752	75 220	26 509	12 010
	RDT examined	729 878	795 618	1 158 831	1 162 083	1 415 837
	RDT positive	317 523	373 542	405 984	307 362	193 648
	Imported cases					
	Relapse cases					
Nepal[2]	Suspected cases	213 353	188 702	276 752	168 687	200 631
	Presumed and confirmed	96 383	71 752	71 410	37 336	26 556
	Microscopy examined	102 977	95 011	152 780	100 336	127 130
	Microscopy positive	3 115	1 910	1 659	1 197	1 499
	RDT examined	17 887	25 353	55 792	32 989	48 444
	RDT positive	779	1 504	1 571	777	
	Imported cases		1 079	1 026		667
Sri Lanka[1,2,3]	Suspected cases	1 001 107	985 060	957 155	1 249 846	1 078 884
	Presumed and confirmed	736	175	93	95	49
	Microscopy examined	1 001 107	985 060	948 250	1 236 580	1 069 817
	Microscopy positive	736	175	74	93	45
	RDT examined			8 905	13 266	9 067
	RDT positive			19	2	4
	Imported cases	52	51	70	95	49
	Relapse cases				0	0
Thailand[2,6]	Suspected cases	1 777 977	1 450 885	1 272 324	1 927 585	1 833 061
	Presumed and confirmed	32 480	24 897	46 895	41 602	41 218
	Microscopy examined	1 695 980	1 354 215	1 130 757	1 830 090	1 756 528
	Microscopy positive	22 969	14 478	32 569	33 302	37 921
	RDT examined	81 997	96 670	141 567	97 495	76 533
	RDT positive	9 511	10 419	14 326	8 300	3 297
	Imported cases					
	Relapse cases					

2015	2016	2017	2018	2019	2020	2021
786 830	993 589	986 442	1 300 691	1 507 230	1 416 473	1 470 849
39 719	27 737	29 247	10 523	17 225	6 130	7 294
527 659	573 540	613 304	800 251	750 657	611 307	370 589
6 621	3 217	3 325	1 135	1 311	262	458
259 171	420 049	373 138	500 440	756 573	805 166	1 100 260
33 098	24 520	25 922	9 388	15 914	5 868	6 836
129	109	19	41	6	2	6
74 087	118 841	120 667	133 498	119 975	31 522	25 510
104	74	51^	54	42^	54	23
26 149	23 442	22 885	19 778	18 973	6 246	8 742
84	59	51	49	38	46	23
47 938	95 399	97 782	113 720	101 002	25 276	16 768
20	15	11	5	37	8	0
70	56	38	34	30	9	13
0	0	0	0	0	0	1
91 007	205 807	189 357	685 704	461 998	357 778	45 711
7 409	5 113	4 626	3 698	1 869	1 819	2 357
29 272	22 747	16 835	28 654	3 255	3 681	45 711
7 010	4 890	4 463	3 446	886	1 162	2 357
61 348	182 980	172 499	657 050	458 743	354 097	0
12	143	140	252	983	657	0
140 841 230	144 539 608	125 977 799	124 613 482	134 230 349	97 177 024	114 400 959
1 169 261	1 087 285	844 558	429 928	338 494	186 532	161 753
121 141 970	124 933 348	110 769 742	111 123 775	113 969 785	73 294 318	87 951 904
1 169 261	1 087 285	306 768	230 432	132 750	65 468	67 604
19 699 260	19 606 260	15 208 057	13 489 707	20 260 564	23 882 706	26 440 073
		537 790	199 496	205 744	121 064	94 149
1 567 450	1 457 858	1 441 679	1 700 094	2 491 516	1 940 676	2 128 771
217 025	218 450	261 617	222 345	250 646	254 055	304 607
1 224 504	1 092 093	1 045 994	1 322 026	1 899 437	1 367 987	1 399 683
217 025	218 450	261 617	190 782	212 997	192 769	216 744
342 946	365 765	395 685	378 068	592 079	516 167	640 609
			31 563	37 649	61 286	87 863
			11	61	38	27
2 657 555	3 185 245	3 368 697	3 183 758	3 708 802	3 665 239	1 958 385**
182 465^	110 146	85 019	76 518	56 410^	58 836^	79 001^
98 014	122 078	107 242	58 126	50 902	57 950	43 929
6 453	6 717	4 648	2 577	1 050	2 167	2 669
2 559 541	3 063 167	3 261 455	3 125 632	3 666 973	3 627 732	1 919 075
176 163	103 429	80 371	73 941	55 590	57 009	76 377
					9	1
					140	12
131 654	146 705	165 640**	256 020	224 726	158 776	159 912**
19 171^	10 687	3 610^	3 031	1 438	674	650^
63 946	84 595	163 323	160 904	92 367	31 304	24 221
1 112	1 009	1 293	1 158	102	29	18
49 649	52 432	97 870	93 378	131 631	127 228	159 635
725		449	135	608	401	373
521	502	670	539	579	357	359
1 157 366	1 090 743	1 104 333	1 149 897	1 164 914**	820 210	680 386
36	41	57	52	54^	30	26
1 142 466	1 072 396	1 089 290	1 129 070	1 164 914	810 205	673 744
35	40	38	52	54	30	26
14 900	18 347	15 043	20 827	20 745	10 005	6 642
1	1	19	0	2	0	0
36	41	57	48	53	30	25
0	0	0	3	0	0	0
1 537 430	1 619 174	1 268 976	976 482	937 053	800 012	651 385
24 155	17 800	11 440	6 750	5 421	3 940	3 279
1 358 953	1 302 834	1 117 648	908 540	856 893	716 060	546 749
14 750	11 301	7 154	5 171	4 170	2 792	2 227
178 477	316 340	151 328	67 942	80 160	83 952	104 636
9 405	6 499	4 286	1 579	1 251	1 148	1 052
9 890	5 724	4 020	1 618	1 342	798	800
0	0				0	1

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
SOUTH-EAST ASIA						
Timor-Leste[2,3]	Suspected cases		143 690	118 120	122 008	86 597
	Presumed and confirmed	119 074	36 153	6 148	1 042	347
	Microscopy examined					
	Microscopy positive					
	RDT examined	48 042	127 272	117 180	121 991	86 592
	RDT positive	48 139	19 735	5 208	1 025	342
	Imported cases					
	Relapse cases					
WESTERN PACIFIC						
Cambodia[5]	Suspected cases	411 104	356 606	300 344	207 483	356 027
	Presumed and confirmed	181 857	106 905	74 628	46 890	70 304
	Microscopy examined	90 175	86 526	80 212	54 716	48 591
	Microscopy positive	14 277	13 792	10 124	4 598	5 288
	RDT examined	235 536	270 080	215 055	149 946	306 310
	RDT positive	82 187	93 113	59 427	39 471	63 890
	Imported cases					
	Relapse cases					
China[1,2]	Suspected cases	7 118 649	9 190 401	6 918 770	5 555 001	4 403 633
	Presumed and confirmed	9 973	4 498	2 716	4 246	3 080
	Microscopy examined	7 115 784	9 189 270	6 918 657	5 554 960	4 403 633
	Microscopy positive	7 108	3 367	2 603	4 205	3 080
	RDT examined					
	RDT positive					
	Imported cases	2 118	2 059	2 399	4 051	3 026
Lao People's Democratic Republic[2]	Suspected cases	340 119	244 956	336 783	359 143	313 859
	Presumed and confirmed	22 879	17 532	46 153	39 589	50 674
	Microscopy examined	212 202	167 125	192 594	225 795	153 198
	Microscopy positive	6 619	6 223	13 206	11 487	10 629
	RDT examined	127 917	77 831	144 189	133 348	160 661
	RDT positive	16 260	11 309	32 947	28 102	40 045
	Imported cases					
	Relapse cases					
Malaysia[2,3,6]	Suspected cases	1 619 074	1 600 439	1 566 872	1 576 012	1 443 958
	Presumed and confirmed	6 650	5 306	4 725	3 850	3 923
	Microscopy examined	1 619 074	1 600 439	1 566 872	1 576 012	1 443 958
	Microscopy positive	6 650	5 306	4 725	3 850	3 923
	RDT examined					
	RDT positive					
	Imported cases	831	1 142	924	865	766
	Relapse cases				32	0
Papua New Guinea	Suspected cases	1 505 393	1 279 140	1 113 528	1 520 167	1 015 615
	Presumed and confirmed	1 379 787	1 151 343	878 371	1 176 874	707 716
	Microscopy examined	198 742	184 466	156 495	139 972	83 257
	Microscopy positive	75 985	70 603	67 202	70 658	68 118
	RDT examined	20 820	27 391	228 857	519 446	538 678
	RDT positive	17 971	13 457	82 993	245 467	245 918
Philippines[2,6]	Suspected cases	314 788	329 665	360 126	353 823	339 319
	Presumed and confirmed	19 648	9 648	9 107	8 926	6 099
	Microscopy examined	301 031	327 060	332 063	317 360	287 725
	Microscopy positive	18 560	9 552	7 133	5 826	3 618
	RDT examined	13 211	2 540	27 042	35 257	51 582
	RDT positive	542	31	953	1 894	2 469
	Imported cases					68
	Relapse cases					
Republic of Korea[2]	Suspected cases					
	Presumed and confirmed	1 772	838	555	443	635
	Microscopy examined					
	Microscopy positive	1 772	838	555	443	635
	RDT examined					
	RDT positive					
	Imported cases	56	64	47	50	78
	Relapse cases			4		

2015	2016	2017	2018	2019	2020	2021
90 818	114 383	115 008	144 061	217 129	103 614**	122 955**
80	95	30	8	9^	14^	0
					35 256	27 731
					14	0
90 818	114 382	115 008	144 061	217 129	103 614	122 955
80	94	30	8	9	3	0
	10	13	7	9	7	0
	1	1	0	0	0	0
332 613	298 108	376 702	282 295	596 009	790 800	832 846
68 109	43 380	76 804	62 582	32 197	9 964	4 382
49 357	42 802	38 188	42 834	38 964	20 956	4 705
7 423	3 695	5 908	8 318	2 635	693	235
283 256	255 306	338 514	239 461	557 045	769 844	828 141
60 686	39 685	70 896	54 264	29 562	9 271	4 147
				1	2	0
				0	0	1 978
4 052 616	3 194 915	2 409 286	1 904 290	1 680 801	1 274 340	
3 279	3 151	2 672	2 511	2 487	1 051	
4 052 588	3 194 915	2 409 280	1 904 290	1 680 796	1 274 340	
3 251	3 151	2 666	2 511	2 482	1 051	
3 212	3 149	2 663	2 511	2 486	1 050	
284 361	240 505	234 365	287 984	567 650	576 026	643 583
36 078	15 509	8 435	9 038	6 692	3 498	3 926
133 363	113 198	116 343	89 811	128 387	87 957	63 095
6 198	2 367	1 575	1 093	898	297	185
150 998	127 307	118 022	198 173	439 263	488 069	580 488
29 880	13 142	6 860	7 945	5 794	3 201	3 741
			0	0	4	28
			2	0	0	0
1 066 470	1 153 108	1 046 163	1 070 356	1 072 252	901 799	519 557
2 311	2 302	4 114	4 630	3 941	2 839	3 688
1 066 470	1 153 108	1 046 163	1 070 356	1 072 252	901 799	519 557
2 311	2 302	4 114	4 630	3 941	2 839	3 688
435	428	423	485	630	177	111
	0	0	0	0	0	0
996 660	1 246 456	1 432 082	1 513 776	1 279 574	1 589 675	1 473 179
620 785	785 120	892 235	940 693	646 648	932 973	755 598
112 864	146 242	139 910	121 766	72 636	50 564	48 691
64 719	80 472	70 449	59 652	39 684	26 925	20 632
609 442	849 913	888 815	967 566	1 206 938	1 356 392	1 320 853
281 712	454 347	418 429	456 597	606 964	723 329	631 331
315 010	321 848	398 759	443 997	343 174	235 560	222 002
11 445	6 690	6 806	4 641	5 778	6 120	4 297
224 843	255 302	171 424	122 502	170 887	103 488	107 525
5 694	2 860	889	569	1 370	1 229	641
90 132	66 536	227 335	321 495	172 287	132 072	114 477
5 716	3 820	5 917	4 072	4 408	4 891	3 656
85	55	69	82	95	26	35
0		0	0	1	3	1
	673	515	576	559**	434	294**
692^	662^	515^	576^	559^	390	294^
	673	515	576	559	386	294
692	662	515	576	559	386	294
				94		94
452	454	372	429	94		94
79	71	79	75	74	29	20
11	16	18	28	0	6	

ANNEX 4 – H. REPORTED MALARIA CASES BY METHOD OF CONFIRMATION, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
WESTERN PACIFIC						
Solomon Islands	Suspected cases	284 931	254 506	249 520	245 014	233 803
	Presumed and confirmed	95 006	80 859	57 296	53 270	51 649
	Microscopy examined	212 329	182 847	202 620	191 137	173 900
	Microscopy positive	35 373	23 202	21 904	21 540	13 865
	RDT examined	17 300	17 457	13 987	26 216	26 658
	RDT positive	4 331	3 455	2 479	4 069	4 539
Vanuatu[2]	Suspected cases	55 161	38 150	39 047	32 716	40 333
	Presumed and confirmed	20 982	7 263	4 812	2 883	1 314
	Microscopy examined	29 180	19 183	16 981	15 219	18 135
	Microscopy positive	4 013	2 077	733	767	190
	RDT examined	14 816	17 883	21 786	17 497	22 198
	RDT positive	5 804	4 102	3 799	2 116	1 124
	Imported cases					
	Relapse cases					
Viet Nam[2]	Suspected cases	2 803 918	3 312 266	3 436 534	3 115 804	2 786 135
	Presumed and confirmed	54 297	45 588	43 717	35 406	27 868
	Microscopy examined	2 760 119	2 791 917	2 897 730	2 684 996	2 357 536
	Microscopy positive	17 515	16 612	19 638	17 128	15 752
	RDT examined	7 017	491 373	514 725	412 530	416 483
	RDT positive					
	Imported cases					

REGIONAL SUMMARY (presumed and confirmed malaria cases)	2010	2011	2012	2013	2014
African	104 478 030	102 278 324	113 761 255	125 732 311	135 095 910
Americas	677 583	495 221	471 841	468 931	410 975
Eastern Mediterranean	6 369 494	5 952 130	5 835 463	4 946 316	5 343 572
European	271	252	666	328	270
South-East Asia	3 085 804	2 504 444	2 144 568	1 681 812	1 696 800
Western Pacific	1 792 851	1 429 780	1 122 080	1 372 377	923 262
Total	**116 404 033**	**112 660 151**	**123 335 873**	**134 202 075**	**143 470 789**

RDT: rapid diagnostic test; WHO: World Health Organization.

* The country reported double counting of RDTs and microscopy but did not indicate the number of cases double counted. Confirmed cases have not been corrected.

** Suspected cases are less than presumed+microscopy examined+rdt examined due to double counting of tests by microscopy and RDT.

^ Confirmed cases are corrected for double counting of microscopy and RDTs.

[+] Incomplete laboratory data. Confirmed cases reported by the country exceed microscopy positive + RDT positive.

[++] Unresolved data quality issues between total confirmed and total classified cases.

[£] Confirmed cases reported through outpatients + inpatients are used instead of laboratory confirmed cases.

[$] Data are available for Zanzibar only.

[§] Imported cases are not included in total confirmed cases.

Between 2010 and 2018 suspected cases were calculated based on the formula suspected = presumed+microscopy examined+rdt examined, unless reported retrospectively by the country. From 2019 onwards, suspected cases were reported by countries. If data quality issues were detected, suspected cases were recalculated applying the same formula used in 2010–2018.

2015	2016	2017	2018	2019	2020	2021
192 044	274 881	238 814	244 523	271 754	240 199	253 419
50 916	84 514	68 712	72 430	86 122	90 830	129 758
124 376	152 690	89 061	89 169	79 694	66 824	114 187
14 793	26 187	15 978	17 825	18 239	19 621	45 185
40 750	92 109	133 560	142 115	178 705	160 182	93 613
9 205	28 245	36 541	41 366	54 528	58 016	38 954
16 044	24 232	34 152	26 931	23 531	29 362	24 748
845	2 531	1 228	644	576	507	322
4 870	6 704	9 187	5 935	4 596	2 941	1 564
15	225	120	53	26	22	34
10 900	17 249	24 965	20 996	11 318	26 421	23 184
556	2 027	1 108	591	550	485	288
	0	1	12	9	14	10
	2	0	0	0	0	0
2 673 662	2 497 326	2 616 257	1674897**	1 969 919**	2 053 578	2 053 889
19 252	10 446	8 411^	6 870^	5 987^	1 733^	467
2 204 409	2 082 986	2 009 233	1 674 897	1 914 379	1 521 490	852 340
9 331	4 161	4 548	4 813	4 765	1 309	448
459 332	408 055	603 161	492 270	504 431	532 088	218 230
		1 594	1 848	3 243	1 168	19
			1 681	1 565	46	90

142 473 526	160 847 397	164 222 522	157 996 344	168 282 485	168 364 949	174 962 186
479 057	651 224	932 341	930 469	848 994	589 418	524 158
5 420 260	3 683 265	4 464 691	5 289 329	4 492 250	4 198 608	4 805 377
238	226	231	255	295	144	
1 659 425	1 477 428	1 240 255	752 907	671 608	512 084	558 990
813 712	954 305	1 069 932	1 104 615	790 987	1 049 905	902 732
150 846 218	**167 613 845**	**171 929 972**	**166 073 919**	**175 086 619**	**174 715 108**	**181 753 443**

Data as of 23 November 2022

[1] Certified malaria free countries are included in this listing for historical purposes.

[2] Cases include imported and/or introduced cases.

[3] There were no indigenous cases in 2021.

[4] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

[5] In 2021, more than one third of cases were due to relapses.

[6] Figures include non-human malaria cases (*Plasmodium knowlesi*).

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Algeria[1]	Indigenous cases	1*	1*	55*	8*	0*
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases	396	187	828	587	260
Angola	Indigenous cases	1 682 870	1 632 282	1 496 834	1 999 868	2 298 979
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Benin	Indigenous cases		422 968	705 839	1 090 602	1 309 238
	Total *P. falciparum*		68 745			1 044 235
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Botswana	Indigenous cases	1 046	432	193	456	1 346
	Total *P. falciparum*	1 046	432	193	456	1 346
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases				30	30
Burkina Faso	Indigenous cases	804 539	428 113	3 858 046	3 769 051	5 428 655
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Burundi	Indigenous cases	1 763 447	1 575 237	2 166 690	4 178 338	4 726 299
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Cabo Verde	Indigenous cases	47	7*	1*	22*	26*
	Total *P. falciparum*	47	7	1	22	26
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases		29	35	24	20
	Total introduced cases					0
Cameroon	Indigenous cases		17 874	66 656	42 581	
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Central African Republic	Indigenous cases			87 566	163 701	295 088
	Total *P. falciparum*					295 088
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Chad	Indigenous cases	200 448	181 126	7 710	754 565	914 032
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Comoros	Indigenous cases	36 538	24 856	49 840	53 156	2 203
	Total *P. falciparum*	33 791	21 387	43 681	45 687	2 203
	Total *P. vivax*	528	334	637	72	
	Total mixed cases					
	Total other cases	880	557		363	
	Imported cases					

2015	2016	2017	2018	2019	2020	2021
0*	0*	0*	0*	0*	0*	0*
727	420	446	1 241	1 014	2 725	1 164
2 769 305	3 794 253	3 874 892	5 150 575	7 054 978	6 599 327	8 325 921
1 721 626	1 610 790	1 933 912	1 975 812	2 895 878	2 516 465	2 876 368
1 268 347	1 324 576	1 696 777	1 768 450	2 895 878	2 516 465	2 876 368
284**	659**	1 847**	534*	169*	884*	703*
278	640	1 831	534	169	884	703
		4				
	12	3				
48	64	62	51	103	69	26
7 015 446	9 779 411	10 557 260	10 278 970	5 877 426	10 600 340	11 791 638
				5 877 426	10 248 510	11 791 638
5 428 710	8 793 176	8 795 952	4 966 511	9 959 533	4 720 103	6 615 714
					3 963 662	5 424 395
7*	49*	423*	2*	0*	0*	0*
7	49	423	2	0	0	0
20	28	23	18	39	10	20
0	0	0	1	1	0	1
1 193 281	2 476 153	2 244 788	2 257 633	2 819 803	2 890 193	3 335 174
592 351	1 675 264	1 191 257	1 249 705	2 318 830	2 890 193	3 335 174
598 833	1 239 317	411 913	972 119	2 416 960	1 740 970	2 002 149
598 833	1 032 764	383 309	972 119	2 416 960	1 740 970	2 002 149
787 046	1 294 768	1 962 372	1 364 706	1 632 529	1 544 194	1 418 539
				1 480 402		1 418 539
1 884	1 467	3 896	15 613	17 599**	4 546*	10 537*
1 300	1 066	2 274	15 613	17 599	4 546	10 537
				98	0	10

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Congo	Indigenous cases		37 744	120 319	43 232	66 323
	Total *P. falciparum*		37 744	120 319	43 232	66 323
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Côte d'Ivoire	Indigenous cases	62 726	29 976	1 140 627	2 524 326	3 712 831
	Total *P. falciparum*				2 506 953	3 712 831
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Democratic Republic of the Congo	Indigenous cases	2 417 780	4 561 981	4 791 598	6 719 887	10 288 519
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Equatorial Guinea	Indigenous cases	53 813	22 466	15 169	16 405	20 417
	Total *P. falciparum*	53 813	22 466	15 169	16 405	17 452
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Eritrea	Indigenous cases	35 982	34 848	21 815	21 317	50 534
	Total *P. falciparum*	9 785	10 263	12 121	12 482	23 787
	Total *P. vivax*	3 989	4 932	9 204	7 361	6 780
	Total mixed cases	63	94	346	1 391	166
	Total other cases	57	19	0	83	35
Eswatini	Indigenous cases	268	379**	409**	728**	389**
	Total *P. falciparum*	87	189	192	268	389
	Total *P. vivax*					
	Total mixed cases					
	Total other cases				1	
	Imported cases		170	153	234	322
Ethiopia	Indigenous cases	1 196 829	1 480 360	1 692 578	2 645 454	2 118 815
	Total *P. falciparum*	732 776	814 547	946 595	1 687 163	1 250 110
	Total *P. vivax*	390 252	665 813	745 983	958 291	868 705
	Total mixed cases	73 801				
	Total other cases					
	Imported cases					
Gabon	Indigenous cases	13 936		19 753	28 982	31 900
	Total *P. falciparum*	2 157			26 432	26 117
	Total *P. vivax*	720				
	Total mixed cases	55				
	Total other cases	2 015				1 570
Gambia	Indigenous cases	116 353	268 020	313 469	242 513	168 256
	Total *P. falciparum*	64 108	190 379	271 038	240 792	99 976
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Ghana	Indigenous cases	1 071 637	1 041 260	3 755 166	1 643 642	3 415 912
	Total *P. falciparum*	926 447	593 518	3 755 166	1 629 198	3 415 912
	Total *P. vivax*					
	Total mixed cases					
	Total other cases	102 937	31 238			
Guinea	Indigenous cases	20 936	95 574	340 258	211 257	660 207
	Total *P. falciparum*	20 936	5 450	191 421	63 353	660 207
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Guinea-Bissau	Indigenous cases	50 391	71 982	50 381	54 584	97 424
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					

2015	2016	2017	2018	2019	2020	2021
51 529	171 847	127 939	116 903	117 837	91 538	189 616
51 529	171 847	127 939	116 903	117 837	91 538	189 616
3 375 904	3 754 504	4 034 781	4 766 477	5 935 178	4 980 640	7 295 068
3 375 904	3 471 024	3 274 683	4 766 477	5 935 178	4 980 640	7 295 068
12 538 805	16 821 130	16 793 002	16 972 207	21 608 681	22 590 647	23 249 165
		16 793 002	16 972 207	21 608 681	22 590 647	23 249 165
15 142	147 714	15 725	8 962	25 904		
28 036	24 251	54 005	46 440	93 878	74 041	43 463
14 510	20 704	21 849	16 553	75 568	66 600	37 696
4 780	2 999	9 185	6 108	15 790	7 119	5 613
70	543	429	268	2 340	300	120
12	5	23	26	180	22	34
318*	250*	440*	686*	235*	233*	505**
318	250	440	686	235	233	505
157	67	687	271	337	82	76
1 867 059	1 718 504	1 530 739	962 087	904 495	1 743 755	1 396 315**
1 188 627	1 142 235	1 059 847	859 675	738 155	1 340 869	912 075
678 432	576 269	470 892	102 412	166 340	263 877	252 589
					30 051	14 380
					108 958	90 607
						836
23 867	23 915	35 244	111 719	53 182	53 659	64 957
	23 915	35 244	111 719	52 811	53 659	64 957
				371		
246 348	162 739	78 040	87 448	53 386	75 801	77 287
240 382	153 685	69 931	87 448	53 386	75 801	77 287
5 657 096	5 428 979	7 003 155	4 931 454	6 115 267	5 172 803	5 747 585
4 319 919	4 421 788	4 266 541	4 808 163	6 075 297	5 137 777	5 719 704
	83 654	82 153		28 952		
	29 725	27 245	27 635	11 018	35 026	27 881
810 979	992 146	1 335 323	1 214 996	2 143 225	2 008 976	2 422 374
810 979	992 146	1 335 323	1 214 996	2 143 225	2 008 976	2 422 374
150 085	156 471	152 619	171 075	160 907		
96 520	97 889	89 784	125 511	115 232		

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Kenya	Indigenous cases	898 531	1 002 805	1 453 471	2 375 129	2 851 555
	Total *P. falciparum*	898 531	1 002 805	1 453 471	2 335 286	2 808 931
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Liberia	Indigenous cases	922 173	1 921 159	1 412 629	1 244 220	881 224
	Total *P. falciparum*	212 927	577 641	1 407 455	1 244 220	864 204
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Madagascar	Indigenous cases	202 450	224 498	402 900	433 450	470 212**
	Total *P. falciparum*				2 020	
	Total *P. vivax*				24	
	Total mixed cases					
	Total other cases					
	Imported cases					712
Malawi	Indigenous cases		304 499	1 564 984	1 280 892	2 905 310
	Total *P. falciparum*			1 564 984	1 280 892	2 905 310
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Mali	Indigenous cases	239 787	307 035	886 482	1 506 940	2 039 853
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Mauritania	Indigenous cases	1 994	2 926	1 888	1 587	15 835
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Mayotte	Indigenous cases	237***	50***	29***	11**	1*
	Total *P. falciparum*	138	38	21	9	1
	Total *P. vivax*	3	2	2		
	Total mixed cases			4		
	Total other cases					
	Imported cases	236	51	47	71	14
	Total introduced cases					
Mozambique	Indigenous cases	1 522 577	1 756 874	1 853 276	3 282 172	7 407 175
	Total *P. falciparum*	878 009	663 132	927 841	2 998 874	7 117 648
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Namibia	Indigenous cases	556	1 525	194	4 775	15 692
	Total *P. falciparum*	556	335	194	136	15 692
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases					
Niger	Indigenous cases	642 774	838 585	2 329 260	2 373 591	3 963 768
	Total *P. falciparum*	601 455	757 449	2 185 060	2 306 354	3 828 486
	Total *P. vivax*					
	Total mixed cases	17 123	21 370	22 399	46 068	78 102
	Total other cases					
Nigeria	Indigenous cases	551 187				8 572 322
	Total *P. falciparum*	523 513				
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					

2015	2016	2017	2018	2019	2020	2021
2 041 277	3 064 796	3 607 026	2 318 090	5 019 389	3 659 170	3 828 757
1 499 027	2 783 846	3 215 116	1 521 566	5 019 389	3 659 170	3 828 757
941 711	1 191 137	1 093 115		915 845		912 436
	809 356			915 845		912 436
938 490**	686 024	985 852	972 790	963 712**	969 096**	970 625**
		2 224			1 949 964	
		5			253	
		15				
					254	
1 167				7 116	1 732	203
3 661 238	4 827 373	4 947 443	5 865 476	5 184 107	7 139 065	6 948 500
3 585 315	4 730 835	4 901 344	5 830 741	4 287 578	7 057 864	6 880 537
2 454 508	2 311 098	2 277 218	2 345 475	3 221 535	2 666 266	3 204 130
				3 165 483	2 666 266	3 204 130
22 631	29 156	20 105	30 609	14 869	12 425	18 660
1*	18*	9*	3*			
	12					
10	10	10	44			
	5					
8 222 814	9 690 873	9 892 601	10 304 472	11 734 926	11 318 685	10 095 807
7 718 782	8 520 376	8 921 081	9 292 928	11 734 926	11 318 685	10 095 807
9 162*	19 510*	54 268*	30 567*	2 376*	12 331**	12 979*
9 162	19 510	54 268	30 567	2 340	12 331	12 979
				6		
2 888	3 980	11 874	4 021	1 064	1 305	759
2 392 108	4 258 110	2 761 268	3 046 450	3 771 451	4 377 938	4 044 707
2 267 867	3 961 178	2 638 580	3 046 450	3 748 155	4 154 337	4 044 707
4 133	186 989			23 296		
8 068 583	13 598 282	13 087 878	14 548 024	19 806 915	18 325 240	21 325 186
		1 515 920	13 524 751	920 398	15 251 460	18 765 444

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Rwanda	Indigenous cases	669 322	273 293	483 470	962 618	1 623 176
	Total *P. falciparum*	638 669	208 858	483 470	962 618	1 623 176
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Sao Tome and Principe	Indigenous cases	3 146	8 442	12 550	9 243	1 754
	Total *P. falciparum*	2 219	6 363	10 700	9 242	1 754
	Total *P. vivax*	14	4	1	1	
	Total mixed cases					
	Total other cases		6			
	Imported cases					
Senegal	Indigenous cases	330 331	274 119	294 385	366 687	265 624
	Total *P. falciparum*	330 331	274 119	294 385	366 687	265 624
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases					
Sierra Leone	Indigenous cases	934 028	644 018	1 537 322	1 701 958	1 374 476
	Total *P. falciparum*	218 473	30 670	1 537 322	1 701 958	1 374 476
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
South Africa	Indigenous cases	8 060	9 866	6 621	8 645	11 705
	Total *P. falciparum*	2 181	4 206	4 565	8 645	11 563
	Total *P. vivax*		14	5		
	Total mixed cases	12				
	Total other cases	5	15			
	Imported cases					
South Sudan[2]	Indigenous cases	900 283	112 024	225 371	262 520	71 377
	Total *P. falciparum*		112 024	225 371	262 520	71 377
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Togo	Indigenous cases	1 019 029	506 764	909 129	965 832	1 524 339
	Total *P. falciparum*	1 018 801	506 741	909 120	965 824	1 524 322
	Total *P. vivax*					
	Total mixed cases					
	Total other cases	228	23	9	8	17
Uganda	Indigenous cases	1 666 582	316 241	2 662 258	1 502 362	3 631 939
	Total *P. falciparum*	1 565 348	316 241	2 662 258	1 502 362	3 631 939
	Total *P. vivax*	15 812				
	Total mixed cases	47 435				
	Total other cases					
United Republic of Tanzania	Indigenous cases	1 279 362	2 151 236	1 987 629	1 554 117**	680 442**
	Total *P. falciparum*	1 279 362	1 817 668	1 774 792	71 132	108 844
	Total *P. vivax*					
	Total mixed cases			201[$]		
	Total other cases					
	Imported cases				719[$]	1583[$]
	Total introduced cases					
Mainland	Indigenous cases	1 277 024	2 146 747	1 984 698	1 552 444	678 207
	Total *P. falciparum*	1 277 024	1 813 179	1 772 062	69 459	106 609
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Zanzibar	Indigenous cases	2 338	4 489	2 931	1 673*	2 235*
	Total *P. falciparum*	2 338	4 489	2 730	1 673	2 235
	Total *P. vivax*					
	Total mixed cases			201		
	Total other cases					
	Imported cases				719	1 583

2015	2016	2017	2018	2019	2020	2021
2 505 794	3 380 568	5 940 533	4 231 883	3 612 822	2 043 392	1 163 670
		2 927 780	1 657 793	3 612 822	2 043 392	1 163 670
2 056**	2 238	2 239**	2 937**	2 732**	1 933**	2 719**
2 055	2 238	2 239	2 937	2 447	1 933	2 719
1						0
2	0	2	3	10	11	11
492 253	349 540	395 706	530 652**	354 663**	445 313	536 850
492 253	349 540	395 706	530 652	354 663	445 313	536 850
0	0	0	292	45	0	0
1 483 376	1 775 306	1 651 236	1 733 831	2 407 505	725 006	1 953 902
1 483 376	1 775 306	1 651 236	1 733 831	2 407 505	725 006	1 953 902
4 959	4 323	23 381*	9 562***	4 821***	4 463***	2 958***
4 344	4 323	23 381	9 540	3 096	3 173	1 032
5						
3						
5						
3 568	3 075	6 234	5 742	8 890	3 663	2 854
24 371	7 619	1 488 005	98 843	1 903 742	661 922	2 017 227
24 371	7 619	1 488 005	3 242	1 902 505	145 954	1 943 519
					2 205	43 197
					3 851	30 511
1 610 711	1 746 334	1 756 582	2 002 877	2 406 091		996 364
1 610 568	1 746 101	1 756 331	2 002 712	2 402 967		995 655
143	233	251	165	3 124		709
7 412 747	9 735 849	11 667 831	5 759 174	13 982 362	16 329 136	14 336 387
7 137 662	9 385 132	11 667 831	5 759 174	13 982 362	16 329 136	14 336 387
4 900 278**	5 762 462	5 744 907	6 051 844**	5 908 168**	5 969 953**	4 452 499**
413 633	5 015[$]	1 733[$]	1 462[$]	1 338[$]	5 674 847	4 452 135
				12[$]		
	89[$]	1 606[$]		132[$]	2 000[$]	363[$]
		10[$]		65[$]	208[$]	
2 550[$]			1 754[$]	3 286[$]	4 314[$]	4 319[$]
			0[$]	0[$]	0[$]	
4 898 211	5 755 669	5 739 863	6 050 382	5 906 621	5 963 725	4 450 468
411 741					5 670 676	4 450 468
2 067**	6 793	5 044	1 462*	1 547*	6 228*^	2 031*
1 892	5 015	1 733	1 462	1 338	4 171^	1 667
				12		
	89	1 606	0	132	2 000	363
		10	0	65	208	
2 550			1 754	3 286	4 314	4 319

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AFRICAN						
Zambia	Indigenous cases					4 077 547
	Total *P. falciparum*					4 077 547
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Zimbabwe	Indigenous cases	249 379	321 901	277 736	423 702	550 696
	Total *P. falciparum*	249 379	321 901	277 736	423 702	538 351
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases					
AMERICAS						
Argentina[1]	Indigenous cases	54*	0*	0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	14				
	Total mixed cases					
	Total other cases					
	Imported cases	55	28	16	11	15
	Total introduced cases	11	0	0	0	0
Belize	Indigenous cases	150	72*	33*	20*	19*
	Total *P. falciparum*					
	Total *P. vivax*	149	72	33	20	19
	Total mixed cases	1				
	Total other cases					
	Imported cases		7	4	4	0
Bolivia (Plurinational State of)	Indigenous cases	13 769	7 143	7 415	7 342	7 401
	Total *P. falciparum*	1 165	370	337	959	325
	Total *P. vivax*	12 569	6 756	7 067	6 346	7 060
	Total mixed cases	35	17	11	37	16
	Total other cases					
	Imported cases					
Brazil	Indigenous cases	334 668	267 146	242 758	169 623**	137 888**^
	Total *P. falciparum*	47 407	32 029	31 913	25 928	21 156^
	Total *P. vivax*	283 435	231 368	203 018	137 887	115 809^
	Total mixed cases	3 642	3 606	7 722	5 015	894
	Total other cases	183	143	104	51	38
	Imported cases				8 923	4 856
Colombia	Indigenous cases	117 650	64 436	60 179	51 722	40 768
	Total *P. falciparum*	32 900	14 650	15 215	17 650	20 067
	Total *P. vivax*	83 255	44 701	44 283	33 345	20 129
	Total mixed cases	1 434	754	672	690	567
	Total other cases	48	16	9	11	5
	Imported cases					
Costa Rica	Indigenous cases	110*	10*	6*	0*	0*
	Total *P. falciparum*					
	Total *P. vivax*	110	10	5		
	Total mixed cases					
	Total other cases					
	Imported cases	4	6	1	4	5
	Total introduced cases	23	1	0	0	0
Dominican Republic	Indigenous cases	2 482	1 616	952	473*	459*
	Total *P. falciparum*	2 480	1 614	950	473	459
	Total *P. vivax*	2	2	2		
	Total mixed cases					
	Total other cases					
	Imported cases				106	37

2015	2016	2017	2018	2019	2020	2021
4 184 661	4 851 319	5 505 639	5 039 679	5 147 350	8 121 215	6 769 142
4 184 661	4 851 319	5 505 639	5 039 679	5 147 350	8 121 215	6 769 142
484 614**	316 631**	471 030**	263 346**	308 173	447 381	133 137
393 886	282 616	319 146	183 755	308 173	447 381	133 137
180	358	768	672			
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
11	9	18	23			
0	0	0	0			
9*	4*	7*	3*	0*	0*	0*
			1	0	0	0
9	4	5	2	0	0	0
		2				0
4	1	2	4	2	0	0
6 874*	5 542*	4 572**	5 342*	9 338*	12 180**	9 959*
77	4			31	66	165
6 785	5 535	4 572	5 342	9 299	12 107	9 729
12	3			5	7	65
33	11	15	12	19	7	0
141 229**	124 177*	189 559*	187 757*	153 294*	143 395*	139 021*
14 762	13 160	18 614	17 861	15 137	21 437	21 612
122 746	110 340	169 887	168 552	136 947	119 911	115 258
701	669	1 032	1 333	1 189	2 040	2 135
37	8	26	11	21	7	16
4 932	5 068	4 867	6 816	4 165	1 811	1 365
55 334*	82 609*	52 805*	61 195*	78 109*	75 779**	73 221**
27 875	47 232	29 558	29 953	40 074	21 935	19 847
19 002	32 635	22 132	30 063	37 197	22 260	18 424
739	2 742	1 115	1 179	838	787	468
0	0	0	0	0	0	9
7 785	618	1 297	1 948	2 306	457	758
0*	4*	12*	70*	95*	90*	189***
			9	8	2	15
	4	12	61	87	88	171
8	9	13	38	45	34	27
0	0	0	0	5	17	4
631*	690*	341*	433*	1 291*	826*	284*
631	690	341	433	1 291	826	284
30	65	57	51	23	3	7

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Ecuador	Indigenous cases	1 888	1 219*	544*	368*	242
	Total *P. falciparum*	258	290	78	160	40
	Total *P. vivax*	1 630	928	466	208	202
	Total mixed cases					
	Total other cases					
	Imported cases		14	14	10	
El Salvador[1]	Indigenous cases	17*	7*	13*	6*	6*
	Total *P. falciparum*					
	Total *P. vivax*	17	7	13	6	6
	Total mixed cases					
	Total other cases					
	Imported cases	9	8	7	1	2
French Guiana	Indigenous cases	1 632^	1 209^	900^	875	448
	Total *P. falciparum*	987^	584^	382^	304	136
	Total *P. vivax*	476^	339^	257^	220	129
	Total mixed cases	561	496	381	348	182
	Total other cases	5	5	2	0	1
	Imported cases					
Guatemala	Indigenous cases	7 384	6 817	5 346	6 214*	4 929*
	Total *P. falciparum*	30	64	54	101	24
	Total *P. vivax*	7 163	6 707	5 278	6 062	4 838
	Total mixed cases	5	3	14	51	67
	Total other cases					
	Imported cases					2
Guyana	Indigenous cases	22 935	29 471	31 601	31 479	12 354
	Total *P. falciparum*	11 244	15 945	16 695	13 655	3 943
	Total *P. vivax*	8 402	9 066	11 225	13 953	7 173
	Total mixed cases	3 157	4 364	3 598	3 770	1 197
	Total other cases	132	96	83	101	41
	Imported cases					
Haiti	Indigenous cases	84 153	34 350	27 866	26 543	17 696
	Total *P. falciparum*	84 153	32 969	25 423	20 957	17 696
	Total *P. vivax*	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
Honduras	Indigenous cases	9 745	7 618	6 439	5 364	3 378**
	Total *P. falciparum*	866	581	559	1 073	528
	Total *P. vivax*	8 759	7 013	5 856	4 245	2 813
	Total mixed cases	120	24	24	46	37
	Total other cases					
	Imported cases					2
	Total introduced cases					
Mexico	Indigenous cases	1 226*	1 124*	833*	495*	656*
	Total *P. falciparum*					
	Total *P. vivax*	1 226	1 124	833	495	656
	Total mixed cases					
	Total other cases					
	Imported cases	7	6	9	4	10
	Total introduced cases	0	0	0	0	0
Nicaragua	Indigenous cases	692	925	1 235	1 162*	1 142*
	Total *P. falciparum*	154	150	236	208	155
	Total *P. vivax*	538	775	999	954	985
	Total mixed cases					2
	Total other cases					
	Imported cases				34	21
Panama	Indigenous cases	418	354	844	696*	864*
	Total *P. falciparum*	20	1	1		
	Total *P. vivax*	398	353	843	696	864
	Total mixed cases					
	Total other cases					
	Imported cases				9	10
	Total introduced cases				0	0

2015	2016	2017	2018	2019	2020	2021
618*	1 191*	1 275*	1 653*	1 803*	1 934*	2 175*
184	403	309	149	211	214	445
434	788	963	1 504	1 592	1 715	1 728
		3			5	2
59	233	105	153	106	67	70
5*	12*	0*	0*	0*	0*	
5	12	0	0	0	0	
4	1	3	2	3	0	
374**	217**	554**	546	212*	140**	74*
61	55	62	49	17	3	1
194	95	368	496	193	137	72
119	67	124		0	0	0
			1	2	0	1
60	41	43		36	14	37
5 538*	5 000**	4 121**	3 018*	2 069*	1 058*	1 273*
43	4	0		0	0	0
5 487	4 849	4 121	3 018	2 069	1 058	1 273
8	0	0		0	0	
2	1	3	3	3	0	
9 984	10 697**	13 936	17 038	18 826	17 230	20 850
3 219	3 576	5 141	6 033	5 737	5 544	5 994
6 002	6 081	7 645	9 854	11 940	10 901	13 963
731	781	1 078	1 086	1 110	757	846
32	57	72	65	39	28	47
	411					
17 583	21 430	19 135	8 828	10 687	22 996	9 513
17 583	21 430	19 135	8 828	10 687	22 996	9 513
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
3 555	4 094**	1 273**	632**	330**	815*	1 550**
902	1 310	128	55	11	223	657
2 626	2 744	1 145	576	319	576	879
27	40	0	1	0	7	8
0	3	10	21	61	98	107
0	0	0	0	0	5	10
517*	551*	736*	803*	618*	356*	242*
517	551	736	803	618	356	242
34	45	29	23	22	10	31
0	0	0	0	1	0	
2 279*	6 272*	10 949*	15 917*	13 200*	25 505*	23 259*
338	1 285	1 836	1 319	2 398	11 250	10 454
1 937	4 965	9 080	14 553	10 679	13 421	10 364
4	22	33	45	123	834	441
29	12	3	17	26	25	64
546*	769*	649*	684*	1 756*	1 946*	4 354****^
	21	1	0	12	9	10^
546	748	648	684	1 744	1 937	4 883^
			0	23	0	2
				0	0	0
16	42	40	31	15	10	7
0	0	0	0	68	111	3

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
AMERICAS						
Paraguay[1]	Indigenous cases	20*	1*	0*	0*	0*
	Total *P. falciparum*					
	Total *P. vivax*	20	1			
	Total mixed cases					
	Total other cases					
	Imported cases	9	9	15	11	8
	Total introduced cases	9	0	0	0	0
Peru	Indigenous cases	31 545	25 005	31 436^	48 719^	65 252*
	Total *P. falciparum*	2 291	2 929	3 399^	7 890^	10 416
	Total *P. vivax*	29 168	21 984	28 030^	40 829^	54 819
	Total mixed cases	83	89	102	213	
	Total other cases	3	3	7	11	17
	Imported cases					
Suriname	Indigenous cases	1 771	795	569	525**§	401
	Total *P. falciparum*	638	331	161	322	165
	Total *P. vivax*	817	382	180	322	78
	Total mixed cases	83	21	13	85	158
	Total other cases	36	17	2		
	Imported cases				204	
	Total introduced cases					
Venezuela (Bolivarian Republic of)	Indigenous cases	45 155	45 824	52 803	78 643*	90 708*
	Total *P. falciparum*	10 629	9 724	10 978	22 777	21 074
	Total *P. vivax*	32 710	34 651	39 478	50 938	62 850
	Total mixed cases	286	909	2 324	4 882	6 769
	Total other cases	60	6	23	46	15
	Imported cases				1 677	1 210
	Total introduced cases					
EASTERN MEDITERRANEAN						
Afghanistan	Indigenous cases	69 798	77 549	54 840	52 965	106 478
	Total *P. falciparum*	6 142	5 581	1 231	1 877	3 000
	Total *P. vivax*	63 255	71 968	53 609	43 369	58 362
	Total mixed cases					
	Total other cases					
Djibouti	Indigenous cases	1 010		25	1 684	9 439
	Total *P. falciparum*	1 010		20		
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Iran (Islamic Republic of)	Indigenous cases	1 847*	1 632*^	756*^	480*^	358*^
	Total *P. falciparum*	166	152^	44^	72^	21^
	Total *P. vivax*	1 656	1 502^	711^	426^	351^
	Total mixed cases	25	56	32	22	4
	Total other cases					
	Imported cases	1 184	1 529	842	853	867
	Total introduced cases		78	12	26	7
Pakistan	Indigenous cases	240 591	334 589	290 781^	274 648	264 867
	Total *P. falciparum*	73 857	73 925	95 095^	46 974	33 340
	Total *P. vivax*	143 136	205 879	228 215^	215 655	221 816
	Total mixed cases			2 901	12 019	9 711
	Total other cases					
Saudi Arabia	Indigenous cases	29*	69*	82*	34*	30*
	Total *P. falciparum*	29	69	82	34	30
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
	Imported cases	1 912	2 719	3 324	2 479	2 254
	Total introduced cases	0	0	0	0	21

2015	2016	2017	2018	2019	2020	2021
0*	0*	0*	0*	0*	0*	0*
8	10	5	0	2	1	4
0	0	0		0	0	0
61 865*	56 623*	55 367*	45 443*	24 324*	15 822*	18 075*
12 569	15 319	13 173	9 438	4 724	3 198	3 584
49 287	41 287	42 044	36 005	19 600	12 624	14 490
						0
9	17	2				1
	48	57	176	159	25	65
81*	78*	137**	37**	104**	156**	22*
17	6	33	5	0	0	0
61	69	99	12	104	156	22
3	1	5	1	0	0	0
295	251	414	198	111	88	53
0	0	0	1	0	0	2
136 402*	240 613*	411 586*	404 924*	398 285*	190 314*	174 409*
24 018	46 503	69 076	71 504	64 307	33 887#	23 428
100 880	179 554	316 401	307 622	308 132	151 783#	143 287
11 491	14 531	26 080	25 789	25 846	11 795#	7 693
13	25	29	9		1#	1
1 594	1 948	2 941	2 125	1 848	1 356	829
	513	1	1	1	7 152	4 556
119 859	241 233	313 086	248 689	173 860	105 295	86 263
4 004	6 369	6 907	6 437	2 701	2 691	3 921
82 891	132 407	154 468	166 583	170 747	102 316	82 094
	311	403	473	412	288	248
9 473	13 822	14 810	25 319	49 402	73 535	58 916
	11 781	9 290	16 130	36 025	46 537	44 385
	2 041	5 381	9 189	13 377	26 998	14 531
167*	81*	57*	0*	0*	0*	0*
8	0	2	0	0	0	0
157	79	55	0	0	0	0
1	2		0	0	0	0
632	611	868	602	1 107	878	821
24	8	13	20	85	171	178
203 859	329 005	369 817	374 510	413 533	371 828	399 097
28 311	43 821	54 407	55 639	87 169	74 899	94 543
167 460	260 477	300 623	314 572	323 355	293 077	301 169
8 088	24 707	14 787	4 299	3 009	3 852	3 385
83*	272*	177*	61*	38*	83*	0*
83	270	172	57	38	83	0
	2	5	4			0
2 537	5 110	2 974	2 517	2 029	3 453	2 470
0	0	0	133	85	122	146

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
EASTERN MEDITERRANEAN						
Somalia	Indigenous cases	24 833	3 351	6 817	7 407	11 246
	Total *P. falciparum*	5 629			830	462
	Total *P. vivax*	0			11	28
	Total mixed cases					
	Total other cases					
Sudan	Indigenous cases	720 557	506 806	526 931	592 383	1 068 506
	Total *P. falciparum*					
	Total *P. vivax*					
	Total mixed cases					
	Total other cases					
Yemen	Indigenous cases	106 697	90 954	112 359	102 778	86 707
	Total *P. falciparum*	77 271	59 689	109 504	102 369	86 428
	Total *P. vivax*	966	478	398	408	267
	Total mixed cases	30	7	2		12
	Total other cases	2	33	4		
EUROPEAN						
Armenia[1]	Indigenous cases	0*		0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	1		4	0	1
Azerbaijan	Indigenous cases	50*	4*	3*	0*	0*
	Total *P. falciparum*					
	Total *P. vivax*	50	4	3	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	2	4	1	4	2
Georgia	Indigenous cases	0*	0*	0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	0	5	4	7	5
	Total introduced cases	0	1	1	0	0
Kyrgyzstan[1]	Indigenous cases	3*	0*	0*	0*	0*
	Total *P. falciparum*		0	0	0	0
	Total *P. vivax*	3	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	3	5	3	4	0
Tajikistan	Indigenous cases	112*	78*	28*	4*	2*
	Total *P. falciparum*	1	5			
	Total *P. vivax*	111	73			
	Total mixed cases					
	Total other cases					
	Imported cases	4	22	11	10	5
	Total introduced cases	0	0	15	11	0
Türkiye	Indigenous cases	0*	0*	0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	81	128	376	251	249
	Total introduced cases	0	0	219	0	5
Turkmenistan[1]	Indigenous cases	0*	0*	0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	0	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	0	0	0	0	0

2015	2016	2017	2018	2019	2020	2021
20 953	35 628	35 138	31 021	39 687	27 333	12 967
		2 657		36 766		10 919
		825		2 921		2 048
586 827	566 015	800 116	1 648 683	1 752 011	1 698 394	1 647 745
	333 009	580 145	1 286 915	1 363 507	1 272 738	1 182 363
	82 175	58 335	143 314	194 904	170 202	175 590
	32 557	82 399	187 270	193 600	143 066	160 222
76 259	99 700	143 333	157 900	165 899	164 066	180 339
75 898	45 469	109 849	112 823	163 941	162 318	173 922
334	347	1 833	970	1 802	1 684	4 343
27	70	2 322	63	114	3	46
			69	42	61	2 028
0*	0*	0*	0*	0	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
2	2	2	6		3	
0*	0*	0*	0*	0*		
0	0	0	0	0		
0	0	0	0	0		
0	0	0	0	0	0	
1	1	1	2			
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
5	7	8	9	8	4	
0	0	0				
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
1	6	2	0	1	0	
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
4	1	3	0	3		
0	0	0				
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
221	208	214	237	277	133	
3	1	0	1	2	2	
0*	0*	0*	0*			
0	0	0	0			
0	0	0	0			
0	0	0	0			
0	0	0	0			
0	0	0	0	3	0	

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
EUROPEAN						
Uzbekistan[1]	Indigenous cases	3*	0*	0*	0*	0*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	3	0	0	0	0
	Total mixed cases	0	0	0	0	0
	Total other cases	0	0	0	0	0
	Imported cases	2	1	1	3	1
	Total introduced cases	1	0	0	0	0
SOUTH-EAST ASIA						
Bangladesh	Indigenous cases	55 873	51 773	29 518	26 891	57 480
	Total *P. falciparum*	52 012	49 084	27 651	25 815	41 261
	Total *P. vivax*	3 824	2 579	1 699	983	3 348
	Total mixed cases	37	110	168	93	12 871
	Total other cases					
	Imported cases					
Bhutan	Indigenous cases	436	194	82*	15*	19*
	Total *P. falciparum*	140	87	33	6	11
	Total *P. vivax*	261	92	47	9	8
	Total mixed cases	35	15			
	Total other cases					
	Imported cases			0	23	34
	Total introduced cases			0		0
Democratic People's Republic of Korea	Indigenous cases	13 520	16 760	21 850*	14 407*	10 535*
	Total *P. falciparum*	0	0	0	0	0
	Total *P. vivax*	13 520	16 760	21 850	14 407	10 535
	Total mixed cases					
	Total other cases					
India	Indigenous cases	1 599 986	1 310 656	1 067 824	881 730	1 102 205
	Total *P. falciparum*	830 779	662 748	524 370	462 079	720 795
	Total *P. vivax*	765 622	645 652	534 129	417 884	379 659
	Total mixed cases	3 585	2 256	9 325	1 767	1 751
	Total other cases					
Indonesia	Indigenous cases	465 764	422 447	417 819	343 527	252 027
	Total *P. falciparum*	220 077	200 662	199 977	170 848	126 397
	Total *P. vivax*	187 583	187 989	187 583	150 985	107 260
	Total mixed cases	21 964	31 535	29 278	20 352	16 410
	Total other cases	2 547	2 261	981	1 342	1 960
	Imported cases					
Myanmar	Indigenous cases	420 808	465 294	481 204	333 871	205 658
	Total *P. falciparum*	388 464	433 146	314 676	222 770	138 311
	Total *P. vivax*	29 944	28 966	135 386	98 860	61 830
	Total mixed cases	2 054	3 020	31 039	12 216	5 511
	Total other cases	346	162	103	25	6
	Imported cases					
Nepal	Indigenous cases	3 894	2 335**	2 204**	1 974	832*
	Total *P. falciparum*	550	240	184	273	81
	Total *P. vivax*	2 349	1 208	888	1 659	693
	Total mixed cases	216	30		22	58
	Total other cases					
	Imported cases		1 079	1 026		667
Sri Lanka[1]	Indigenous cases	684*	124*	23*	0*	0*
	Total *P. falciparum*	6	3	4	0	0
	Total *P. vivax*	668	119	19	0	0
	Total mixed cases					
	Total other cases					
	Imported cases	52	51	70	95	49
	Total introduced cases				0	0

2015	2016	2017	2018	2019	2020	2021
0*	0*	0*	0*	0*	0*	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	1	2	
0	0	0				
39 590**	27 628**	29 228**	10 482**	17 219**	6 128**	7 288**
26 453	17 269	23 315	8 470	14 752	4 744	4 992
4 000	3 297	4 442	1 672	2 126	1 245	1 953
9 137	7 062	1 471	340	341	139	343
129	109	19	41	6	2	6
34*	15*	11*	6*	2*	22*	9*
13	1	0	1	0	0	1
21	13	11	5	2	22	7
0	1	0	0	0	0	1
70	56	38	34	30	9	13
0	3	13	14	10	23	0
7 022	5 033	4 603	3 698	1 869	1 819	2 357
0	0	0	0	0	0	0
7 022	5 033	4 603	3 598	1 869	1 819	2 357
1 169 261	1 087 285	844 558	429 928	338 494	186 532	161 753*
774 627	706 257	525 637	204 733	154 645	117 567	100 442
390 440	375 783	315 028	222 730	181 514	67 444	60 187
4 194	5 245	3 893	2 465	2 295	1 520	1 124
					1	
217 017**	218 449**	261 557**	222 125**	250 553**	254 001**	304 579**
103 315	118 844	143 926	116 035	142 036	141 807	152 724
94 267	81 748	95 694	84 862	86 742	83 743	114 301
13 105	16 751	18 899	18 383	18 707	25 148	31 893
1 387	1 106	1 818	2 585	3 057	3 288	5 658
			11	61	38	27
182 465^	110 146	85 019	76 518	56 410^	58 827**§	79 000**
110 449^	62 917	50 730	38 483	23 017^	15 191	14 614
65 536^	43 748	32 070	36 502	32 788^	43 578	63 909
6 624	3 476	2 214	1 530	606	407	523
7	5	5	3	4	0	0
					9	1
591*	507*	623*	493*	127*	73*	32*
67	61	25	5	9	5	3
504	433	587	488	118	68	29
20	13	11	0	0		0
521	502	670	539	579	357	359
0*	0*	0*	0*	0*	0*	0*
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
36	41	57	48	53	30	25
0	0	0	1	0	0	0

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
SOUTH-EAST ASIA						
Thailand	Indigenous cases	32 480	24 897	46 895	41 602	41 218
	Total *P. falciparum*	9 401	5 710	11 553	14 449	13 743
	Total *P. vivax*	13 401	8 608	17 506	15 573	20 513
	Total mixed cases	147	147		196	588
	Total other cases	20	13		3 084	3 077
	Imported cases					
Timor-Leste	Indigenous cases	48 139	19 735	5 208	1 025	342
	Total *P. falciparum*	36 239	14 261	1 962	373	118
	Total *P. vivax*	11 432	3 754	2 288	512	139
	Total mixed cases	468	1 720	958	140	85
	Total other cases					
	Imported cases					
	Total introduced cases					
WESTERN PACIFIC						
Cambodia	Indigenous cases	96 464	106 905	69 551	44 069	69 178
	Total *P. falciparum*	8 213	7 054	14 896	7 092	8 332
	Total *P. vivax*	4 794	5 155	19 575	11 267	10 356
	Total mixed cases	1 270	1 583	4 971	2 418	6 464
	Total other cases	0	0	0	0	0
	Imported cases					
China[1]	Indigenous cases	4 990*	1 308*	244*	83*	53*
	Total *P. falciparum*	1 269	57	16	11	6
	Total *P. vivax*	3 675	677	179	67	45
	Total mixed cases	26	1	5	1	
	Total other cases	0	0	0	0	0
	Imported cases	2 118	2 059	2 399	4 051	3 026
Lao People's Democratic Republic	Indigenous cases	22 879	17 532	46 153	39 589	50 674
	Total *P. falciparum*	22 452	16 556	37 685	25 441	25 317
	Total *P. vivax*	403	962	7 594	13 067	23 763
	Total mixed cases	24	0	873	1 079	1 593
	Total other cases	0	10	0	2	0
	Imported cases					
	Total introduced cases					
Malaysia	Indigenous cases	5 194*	3 954*	3 662*	1 028*	596*
	Total *P. falciparum*	1 344	973	894	422	177
	Total *P. vivax*	3 387	1 750	915	385	241
	Total mixed cases	145	120	48	42	33
	Total other cases	0	0	0	0	0
	Imported cases	831	1 142	924	865	766
	Total introduced cases	107	124	35	26	8
Papua New Guinea	Indigenous cases	93 956	84 060	150 195	316 125	314 036
	Total *P. falciparum*	56 735	59 153	58 747	119 469	120 641
	Total *P. vivax*	13 171	9 654	7 108	7 579	78 846
	Total mixed cases	4 089	1 164		1 279	79 574
	Total other cases	1 990	632	0	0	2 125
Philippines	Indigenous cases	19 102	9 583	8 086	7 720	6 019**
	Total *P. falciparum*	11 824	6 877	4 774	4 968	3 760
	Total *P. vivax*	2 885	2 380	2 189	1 357	834
	Total mixed cases	214	166		83	235
	Total other cases	175	127	0	0	74
	Imported cases					68
Republic of Korea	Indigenous cases	1 267*	505*	394*	383*	557*
	Total *P. falciparum*					
	Total *P. vivax*				383	557
	Total mixed cases					
	Total other cases	0	0	0	0	0
	Imported cases	56	64	47	50	78
	Total introduced cases	1	0	0		

2015	2016	2017	2018	2019	2020	2021
14 265**	12 076**	7 416**	5 110**	4 065**	3 123**	2 426**
3 301	1 774	846	447	391	155	53
4 655	5 765	4 802	3 575	2 752	2 892	2 313
122	109	36	34	25	16	9
12	1 244	10	21	30	58	42
9 890	5 724	4 020	1 618	1 342	798	800
80	81*	16*	0*	0*	3*	0*
33	46	4	0	0	2	0
24	7	3	0	0	0	0
23	28	9	0	0	1	0
0	0	0	0	0	0	0
	10	13	7	9	7	0
	2	0	1	0	4	0
68 109	43 380	76 804	62 582	32 196**	9 962**	4 382
17 830	12 156	20 328	10 525	4 833	1 073	342
13 146	9 816	15 207	30 680	26 871	8 722	4 018
2 954	1 520	1 397	1 080	492	167	17
0	0	0	0	0	0	5
				1	2	0
39*	1*	0*	0*	0*	0*	
1	0	0	0	0	0	
26	1	0	0	0	0	
0	0	0	0	0	0	
6	0	0	0	0	0	
3 212	3 149	2 663	2 511	2 486	1 050	
36 078	15 509	8 435	9 022****§	6 691****	3 489****	3 897****
14 439	5 737	4 169	4 828	2 168	1 573	1 339
20 815	9 441	4 104	4 099	4 444	1 879	2 536
823	329	162	111	79	37	22
0	0	0	2	0	0	0
			0	0	4	28
			16	1	5	1
242**	266*	85*	0*	0*	0*	0*
110	67	18	0	0	0	0
84	178	59	0	0	0	0
22	9	1	0	0	0	0
26	12	7	0	0	0	0
435	428	423	485	630	177	111
	16	0	21	96	54	2
346 431	534 819	488 878	516 249	646 648	750 254	651 963
118 452	183 686	163 160	174 818	181 463	189 397	181 927
62 228	95 328	113 561	138 006	163 237	186 981	172 964
115 157	197 711	200 186	201 658	299 869	372 257	296 710
1 950	1 772	1 433	1 767	2 079	1 619	362
11 325**	6 625**	6 737**	4 559**	5 681**^	6 094**^	4 262**
4 769	5 282	3 258	1 310	5 034^	5 234^	3 347
755	816	551	116	537^	736^	703
195	388	83	22	80	88	185
87	139	40	47	48	37	27
85	55	69	82	95	26	35
627*	602*	436*	501*	485*	356*	274*
0	0	0	0	0	0	0
627	602	436	501	485	356	274
0	0	0	0	0	0	0
0	0	0	0	0	0	0
79	71	79	75	74	29	20
0	0	0	0	0		

ANNEX 4 – I. REPORTED MALARIA CASES BY SPECIES, 2010–2021

WHO region Country/area		2010	2011	2012	2013	2014
WESTERN PACIFIC						
Solomon Islands	Indigenous cases	39 704	26 657	24 383	25 609	18 404
	Total *P. falciparum*	22 892	14 454	14 748	13 194	9 835
	Total *P. vivax*	12 281	8 665	9 339	11 628	7 845
	Total mixed cases	200	83	232	446	724
	Total other cases	0	0	0	0	0
Vanuatu	Indigenous cases	9 817	6 179	4 532	2 883	1 314
	Total *P. falciparum*	1 545	770	1 257	1 039	279
	Total *P. vivax*	2 265	1 224	1 680	1 342	703
	Total mixed cases	193	81	470	0	0
	Total other cases	10	2	0	0	0
	Imported cases					
	Total introduced cases					
Viet Nam	Indigenous cases	17 515	16 612	19 638	17 128	15 752
	Total *P. falciparum*	12 763	10 101	11 448	9 532	8 245
	Total *P. vivax*	4 466	5 602	7 220	6 901	7 220
	Total mixed cases	286	909	970	695	287
	Total other cases	0	0	0	0	0
	Imported cases					

P.: *Plasmodium*; RDT: rapid diagnostic test; WHO: World Health Organization.

* Reported indigenous cases.

** Indigenous cases = confirmed cases – imported cases.

*** Unclassified cases are reclassified as indigenous cases.

**** Indigenous cases = confirmed cases – imported and introduced cases.

$ Zanzibar only.

^ Data discrepancies between total indigenous cases and sum of species are due to the use of different data sources, differences in classification of mixed infections, failure to update species data following data audit or inability to adjust species for double counting of RDTs and microscopy.

§ No adjustment for imported and/or introduced cases due to incomplete information, data quality issues or use of different data sources for imported and introduced cases.

Species include introduced cases.

Indigenous cases do not include non-human malaria cases or introduced cases.

[1] Certified malaria free countries are included in this listing for historical purposes.

[2] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

2015	2016	2017	2018	2019	2020	2021
23 998	54 432	52 519	59 191	72 767	77 637	84 139
10 478	16 607	15 400	15 771	15 595	14 753	22 057
12 150	33 060	30 169	35 072	47 164	52 039	57 095
1 370	4 719	6 917	8 341	9 979	10 813	4 943
0	46	33	7	27	32	44
571	2 243****	1 227**	632**	567**	493**§	312**
150	186	273	42	36	38	0
273	1 682	798	590	531	469	312
0	0	0	0	0	0	0
0	0	0	0	0	0	0
	0	1	12	9	14	10
	9	0	0	0	0	0
9 331	4 161	4 548	3 132*^	3 200**§	1 376*	377*
4 327	2 323	2 858	2 966^	3 110	792	142
4 756	1 750	1 608	1 751^	1 514	573	233
234	73	70	83	33	11	0
14	15	12	0	10	0	2
			1 681	1 565	46	90

Data as of 22 November 2022

ANNEX 4 – J. REPORTED MALARIA DEATHS, 2010–2021

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AFRICAN												
Algeria[1]	1	0	0	0	0	0	0	0	0	0	0	0
Angola	8114	6909	5736	7300	5714	7832	15997	13967	11814	18691	11757	13676
Benin	964	1753	2261	2288	1869	1416	1646	2182	2138	2589	2336	2956
Botswana	8	8	3	7	22	5	3	17	9	7	11	5
Burkina Faso	9024	7001	7963	6294	5632	5379	3974	4144	4294	1060	3983	4355
Burundi	2677	2233	2263	3411	2974	3799	5853	4414	2481	3316	2276	2292
Cabo Verde[2]	1	1	0	0	1	0	1	2	0	0	0	0
Cameroon	4536	3808	3209	4349	4398	3440	2639	3195	3256	4510	4121	3782
Central African Republic	526	858	1442	1026	635	1763	2668	3689	1292	2017	1779	2412
Chad	886	1220	1359	1881	1720	1572	1686	2088	1948	3374	2955	3065
Comoros	53	19	17	15	0	1	0	3	8	0	7	3
Congo		892	623	2870	271	435	733	229	131	107	99	252
Côte d'Ivoire	1023	1389	1534	3261	4069	2604	3340	3222	3133	1693	1316	1276
Democratic Republic of the Congo	23476	23748	21601	30918	25502	39054	33997	27458	18030	13072	18636	22729
Equatorial Guinea	30	52	77	66		28	109			15		
Eritrea	27	12	30	6	15	12	21	8	5	3	3	6
Eswatini	8	1	3	4	4	5	3	20	2	3	2	5
Ethiopia	1581	936	1621	358	213	662	510	356	158	213	173	175
Gabon	182	74	134	273	159	309	101	218	591	314	224	244
Gambia	151	440	289	262	170	167	79	54	60	41	73	42
Ghana	3859	3259	2855	2506	2200	2137	1264	599	428	336	308	277
Guinea	735	743	979	108	1067	846	867	1174	1267	1881	1119	1117
Guinea-Bissau	296	472	370	418	357	477	191	296	244	288		
Kenya	26017	713	785	360	472	15061	603			858	742	753
Liberia	1422		1725	1191	2288	1379	1259	758		602		248
Madagascar	427	398	552	641	551	841	443	370	927	657	674	547
Malawi	8206	6674	5516	3723	4490	3799	4000	3613	2967	2341	2517	2368
Mali	3006	2128	1894	1680	2309	1544	1344	1050	1001	1454	1698	1480
Mauritania	60	66	106	46	19	39	315	67				
Mayotte												
Mozambique	3354	3086	2818	2941	3245	2467	1685	1114	968	734	563	408
Namibia	63	36	4	21	61	32	65	57	58	6	35	14
Niger	3929	2802	2825	2209	2691	2778	2226	2316	3576	4449	5849	4430
Nigeria	4238	3353	7734	7878	6082	9330	7397	8720	14936	26540	1811	7828
Rwanda	670	380	459	409	496	516	715	376	341	224	149	60
Sao Tome and Principe	14	19	7	11	0	0	1	1	0	0	0	1
Senegal	553	472	649	815	500	526	325	284	555	260	373	399
Sierra Leone	8188	3573	3611	4326	2848	1107	1345	1298	1949	2771	1648	2107
South Africa	83	54	72	105	174	110	34	301	69	79	38	56
South Sudan[3]	1053	406	1321	1311				3483	1191	4877	244	4220
Togo	1507	1314	1197	1361	1205	1127	847	995	905	1275	929	809
Uganda	8431	5958	6585	7277	5921	6100	5635	5111	3302	5027	4252	3158
United Republic of Tanzania	15915	11806	7828	8528	5373	6315	5046	3685	2753	1171	2569	1920
Mainland	15867	11799	7820	8526	5368	6313	5045	3684	2747	1163	2549	1916
Zanzibar	48	7	8	2	5	2	1	1	6	8	20	4
Zambia	4834	4540	3705	3548	3257	2389	1827	1425	1209	1339	1972	1503
Zimbabwe	255	451	351	352	406	200	351	527	192	266	400	131

ANNEX 4 – J. REPORTED MALARIA DEATHS, 2010–2021

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AMERICAS												
Argentina[1]	0	0	0	0	0	0	0	0	0			
Belize[2]	0	0	0	0	0	0	0	0	0	0	0	0
Bolivia (Plurinational State of)[2]	0	0	0	0	1	0	0	0	0	0		0
Brazil[2]	76	70	60	40	36	35	35	34	56	37	51	58
Colombia	42	23	24	10	17	18	36	19	9	3	5	11
Costa Rica[2]	0	0	0	0	0	0	0	0	0	0	0	0
Dominican Republic	15	10	8	5	4	3	1	1	1	4	2	1
Ecuador[2]	0	0	0	0	0	0	0	0	0	0	3	0
El Salvador[1]	0	0	0	0	0	0	0	0	0	0	0	
French Guiana	1	2	2	3	0	0	0	0	0	0	0	
Guatemala[2]	0	0	0	1	1	1	0	0		0	0	0
Guyana	24	36	35	14	11	12	13	11	6	15	13	16
Haiti	8	5	6	10	9	15	13	12	19	7	11	16
Honduras[2]	3	2	1	1	2	0	0	1	1	0	0	0
Mexico[2]	0	0	0	0	0	0	0	0	0	0	0	0
Nicaragua[2]	1	1	2	0	0	1	2	1	3	1	0	0
Panama[2]	1	0	1	0	0	0	0	0	0	0	0	0
Paraguay[1]	0	0	0	0	0	0	0	0	0	0	0	0
Peru	0	1	7	4	4	5	7	10	4	5	1	6
Suriname[2]	1	1	0	1	1	0	0	1	0	0	0	0
Venezuela (Bolivarian Republic of)	18	16	10	38	44	79	140	340	257	118	31	18
EASTERN MEDITERRANEAN												
Afghanistan[2]	22	40	36	24	32	49	47	10	1	0	0	0
Djibouti	0	0	0	17	28	23	5			0		19
Iran (Islamic Republic of)[2]	0	0	0	0	0	0	0	0	0	0	0	0
Pakistan[2]		4	260	244	56	34	33	113	102	0	80	0
Saudi Arabia[2]	0	0	0	0	0	0	0	0	0	0	0	0
Somalia[2]	6	5	10	23	14	27	13	20	31	20	5	0
Sudan	1023	612	618	685	823	868	698	1534	3129	1663	701	1679
Yemen	92	75	72	55	23	14	65	37	57	5	6	25
SOUTH-EAST ASIA												
Bangladesh	37	36	11	15	45	9	17	13	7	9	9	9
Bhutan[2]	2	1	1	0	0	0	0	0	0	0	0	0
Democratic People's Republic of Korea[2]	0	0	0	0	0	0	0	0	0	0	0	0
India	1018	754	519	440	562	384	331	194	96	77	93	90
Indonesia	432	388	252	385	217	157	161	47	34	49	32	48
Myanmar	788	581	403	236	92	37	21	30	19	14	10	11
Nepal	6	2	0	0	0	0	3	0	0	0	0	1
Sri Lanka[1]	0	0	0	0	0	0	0	0	0	0	0	0
Thailand[2]	80	43	37	47	38	33	27	15	15	13	3	0
Timor-Leste[2]	58	16	6	3	1	0	0	0	0	0	0	0

ANNEX 4 – J. REPORTED MALARIA DEATHS, 2010–2021

WHO region Country/area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
WESTERN PACIFIC												
Cambodia[2]	151	94	45	12	18	10	3	1	0	0	0	0
China[1]	19	33	0	0	0	0	0	0	0	0	0	
Lao People's Democratic Republic[2]	24	17	44	28	4	2	1	2	6	0	0	1
Malaysia[4]	13	11	11	10	4	4	2	12	12	6	5	13
Papua New Guinea	616	523	381	307	203	163	306	273	216	180	188	201
Philippines	30	12	16	12	10	20	7	4	2	9	3	3
Republic of Korea[2]	1	2	0	0	0	0	0	0	0	0	0	0
Solomon Islands	34	19	18	18	23	13	20	27	7	14	3	9
Vanuatu[2]	1	1	0	0	0	0	0	0	0	0	0	0
Viet Nam[2]	21	14	8	6	6	3	3	6	1	0	0	0
REGIONAL SUMMARY												
African	150 383	104 057	104 113	116 354	99 380	127 603	111 145	102 886	88 188	108 460	77 641	91 109
Americas	190	167	156	127	130	169	247	430	356	190	117	126
Eastern Mediterranean	1 143	736	996	1 048	976	1 015	861	1 714	3 320	1 688	792	1 723
South-East Asia	2 421	1 821	1 229	1 126	955	620	560	299	171	162	147	159
Western Pacific	910	726	523	393	268	215	342	325	244	209	199	227
Total	**155 047**	**107 507**	**107 017**	**119 048**	**101 709**	**129 622**	**113 155**	**105 654**	**92 279**	**110 709**	**78 896**	**93 344**

Data as of 22 November 2022

E-2025: eliminating countries for 2025; *P.*: *Plasmodium*; WHO: World Health Organization.

[1] Certified malaria free countries are included in this listing for historical purposes.

[2] There were no indigenous malaria deaths in 2021.

[3] In May 2013, South Sudan was reassigned to the WHO African Region (WHA resolution 66.21, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R21-en.pdf).

[4] All malaria deaths reported between 2018 and 2021 and 11 deaths in 2017 were due to infection with *P. knowlesi*.

Notes:

There have been no indigenous deaths reported in the WHO European Region since 2010.

Reported indigenous deaths are shown for countries where 100% of cases have been investigated and classified, which may vary from year to year. The majority of these are E-2025 countries. For countries where case investigations are not carried out, all deaths are assumed to be indigenous.

ANNEX 4 – K. METHODS FOR TABLES A-D-G-H-I-J

Annex 4 – A. Policy adoption, 2021

Information on existing policies and whether they were implemented in 2021 was reported by national malaria programmes (NMPs). Policy implementation in 2021 was adjusted for the following variables, based on whether supporting data were available and reported by NMPs to the world malaria report database: distribution of insecticide-treated mosquito nets (ITNs) or long-lasting insecticidal nets (LLINs) through antenatal care (ANC), the Expanded Programme on Immunization or mass campaigns, indoor residual spraying (IRS), intermittent preventive treatment of malaria in pregnancy (IPTp), seasonal malaria chemoprevention (SMC), rapid diagnostic tests (RDTs) used at community level and artemisinin-based combination therapies (ACTs) used for the treatment of *Plasmodium falciparum*. IPTp is applicable in only 43 countries and SMC in only 34 countries; a setting of "not applicable" was automatically applied to countries where these interventions are not applicable.

Annex 4 – D. Commodities distribution and coverage, 2019–2021

See notes for **Fig. 7.1**, **Fig. 7.2**, **Fig. 7.3** and **Fig. 7.6**. Data sources for the number of malaria cases treated with ACTs were from NMP reports captured in the world malaria report database or, where such data were unavailable, from reports submitted to the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund). Missing data for ACT distributions or any first-line treatment courses delivered (including ACTs) were calculated based on the ratio of distributions to the number of patients treated from the previous year, multiplied by the number of patients treated in the current year. Where these data were not available, the number of patients treated was used as a proxy for distributions. In some countries, numbers of ACT distributions were used to replace missing information on any first-line treatment courses delivered (including ACTs).

Annex 4 – G. Population denominator for case incidence and mortality rate, and reported malaria cases by place of care, 2021

Presumed and confirmed cases were reported by health sector (public, private and community). Where data could not be separated into health sectors they are shown for the public sector, indicating which data have been combined. Presumed cases were reported through outpatient registers. Confirmed cases were reported through a laboratory, unless indicated by the country that confirmed cases from the outpatient register should be used, owing to incomplete or inaccurate laboratory data. Confirmed cases were corrected for double counting of microscopy and RDT where the exact number of double counted cases was known. If the health sector where double counting occurred was not indicated, then data were combined, adjusted and displayed in the public sector.

Annex 4 – H. Reported malaria cases by method of confirmation, 2010–2021

Presumed and confirmed cases were calculated based on the sum of confirmed cases from the laboratory (adjusted for double counting) or the outpatient register (see notes on **Table G**) and the presumed cases reported from the outpatient register. Confirmed cases include indigenous, imported, introduced, relapsing and recrudescent cases, as well as all species, including non-human malaria *P. knowlesi*. Between 2010 and 2018, suspected cases were calculated based on the formula "suspected = presumed + microscopy examined + RDT examined", unless reported retrospectively by the country. From 2019 onwards, suspected cases were reported by countries. If data quality issues were detected, suspected cases were recalculated applying the formula used in 2010–2018. Suspected cases were adjusted for double counting of RDT and microscopy examined, if indicated by the country (e.g. if 100% of patients were examined by microscopy and RDT then suspected = presumed+RDT examined).

Annex 4 – I. Reported malaria cases by species, 2010–2021

Indigenous cases and species were reported based on the following: total confirmed cases, where no case investigations and case classifications had been carried out; total confirmed cases minus imported and introduced cases, where data were available; and reported indigenous cases for countries that were part of the eliminating countries for 2025 (E-2025) initiative and where the number of cases classified equalled the total number of confirmed cases. *P. knowlesi* cases were excluded in all three approaches. For Costa Rica (2021) and South Africa (2018–2021) unclassified cases were reclassified as indigenous and added to the reported indigenous cases.

Annex 4 – J. Reported malaria deaths, 2010–2021

All malaria deaths were reported except those in E-2025 countries and other countries where 100% of cases are investigated and classified – in which case, indigenous deaths are shown. The proportion of cases that are investigated and classified can vary from year to year.

Notes

map
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