THE BEHAVIOURAL INSIGHTS TEAM

malaria consortium
disease control, better health

Behavioural Insights to accelerate net use
The Be In A Net project

Summary of a proposal from Malaria Consortium and The Behavioural Insights Team (BIT)

Summary

Malaria continues to be a major public health problem in sub Saharan Africa. Over the last two decades insecticide-treated nets (ITNs) have been distributed as a method to prevent malaria and are responsible for 68% of the cases averted between 2000 and 2015. However, the consistent use of ITNs among communities is low, which limits the impact of this intervention and poses a barrier to the elimination of the disease. To optimise the impact of ITNs, we will apply behavioural science to ITN campaign activities to provide a low-cost solution for increasing consistent use of ITNs. The two and a half year project, timed to coincide with distribution campaigns in 2023 and 2024, will explore the current behaviours around ITN use in Nigeria and Uganda, and work with communities in these countries to create an appropriate intervention to encourage ITN use. We will then evaluate the intervention through a cluster randomised control trial, producing high-quality data to support uptake of the intervention by country programmes. ITNs are the most widely used method of vector control, therefore the findings of this work will have global importance.

Background

Malaria continues to be a major cause of child morbidity and mortality in endemic countries, with 247 million infections causing 619,000 deaths in 2021.[1] In the same year, Nigeria and Uganda ranked first and third for malaria morbidity and first and eighth for malaria mortality, respectively[2]. Over the last two decades global funders and public health organisations have made significant commitments to combat malaria, with a large focus on distributing insecticide-treated nets (ITNs). Since 2005, around 2.5 billion ITNs have been distributed for malaria prevention globally and major stakeholders, such as The Global Fund and PMI, continue to make new multimillion dollar investments.[3]

ITNs are the most widely used malaria vector control intervention and play a crucial role in reducing transmission. It is estimated that ITNs accounted for 68% of malaria cases averted in sub-Saharan Africa between 2000 and 2015.[4] Despite this impressive impact, the true potential of this intervention is constrained by a gap between efficacy seen in trials and effectiveness of ITNs in real-world settings. For example, in some areas where there is high coverage of ITNs this is not translating into a reduction in malaria transmission.

[1] World malaria report 2022. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
[2] World malaria report 2022. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
[3] World malaria report 2022. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
[4] Bhatt, S., Weiss, D., Cameron, E. et al. The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015. *Nature.* 2015; 526, 207–211.

ITN impact challenges

There are a number of reasons why ITNs are not achieving optimal impact. These include limited access, low usage of ITNs, and environmental factors that can impact the effectiveness of ITNs, as well as biological threats, such as insecticide resistance. Here we describe in more detail the factors that affect access and use of ITN.

Limited access

Limited access can be due to:

Inadequate distribution and targeting strategies

Inefficient distribution systems and inadequate targeting strategies may result in ITNs not reaching the most vulnerable populations, such as pregnant women and young children.

Availability and affordability

Lack of availability and affordability of ITNs can hinder their widespread use, particularly in low-income communities or remote areas.

Low net retention

Although the WHO recommends the distribution of ITNs every three years, the delivery of an ITN does not necessarily lead to the retention of that net for the three-year period. Growing evidence suggests that, in some settings, nets are discarded much more quickly, with the average net discard 1.9 years after distribution (fig. 1)[5] much sooner than they are replaced by distribution campaigns.[6,7,8,9] In fact, in some cases net loss starts almost immediately after distribution and retention further wanes over time[10].

[5] Bertozzi-Villa A, Bever CA, Koenker H, Weiss DJ, Vargas-Ruiz C, Nandi AK et al. Maps and metrics of insecticide-treated net access, use, and nets-per-capita in Africa from 2000–2020. *Nat Commun.* 2021;12:3589.
[6] Kilian A, Obi E, Mansiangi P, Abílio AP, Haji KA, Blaufuss S et al. Variation of physical durability between LLIN products and net use environments: summary of findings from four African countries. *Malar J.* 2021;20:26.
[7] Obi E, Okoh F, Blaufuss S, Olapeju B, Akilah J, Okoko OO et al. Monitoring the physical and insecticidal durability of the long-lasting insecticidal net DawaPlus® 2.0 in three States in Nigeria. *Malar J.* 2020;19:124.
[8] Mansiangi P, Umesumbu S, Etewa I, Zandibeni J, Bafwa N, Blaufuss S et al. Comparing the durability of the long-lasting insecticidal nets DawaPlus® 2.0 and DuraNet© in northwest Democratic Republic of Congo. *Malar J.* 2020;19:189.
[9] Gnanguenon V, Azondekon R, Oke-Agbo F, Beach R, Akogbeto M. Durability assessment results suggest a serviceable life of two, rather than three, years for the current long-lasting insecticidal (mosquito) net (LLIN) intervention in Benin. *BMC Infect Dis*. 2014;14:69.
[10] Bertozzi-Villa A, Bever CA, Koenker H, Weiss DJ, Vargas-Ruiz C, Nandi AK et al. Maps and metrics of insecticide-treated net access, use, and nets-per-capita in Africa from 2000–2020. *Nat Commun.* 2021;12:3589.

Figure 1 Median LLIN retention time by country, ordered highest to lowest. Dots show mean parameter values, and vertical bars indicate 95% CI width. Source: Bertozzi-Villa et al. (2021).[11]

Several factors contribute to net loss. Some evidence suggests that ITNs are sometimes given away to family members who do not live in the household[12,13] and in some areas ITNs are sold or exchanged for other commodities.[14] Net loss can also be due to the appearance of holes in the nets which leads to a perception that the net is no longer effective[15]. The appearance of holes and loss of net durability can be caused by damage when hanging, frequent washing and improper storage, where the net is exposed to sunlight or rodents.[16]

Low use rates

Across sub-Saharan Africa, surveys estimate that the use of existing ITNs varies considerably, from 15% in Eswatini to 90% in Mali (table 1).[17] These rates also mask subnational variation. For example, in Uganda, the national use rate is 74%, however, this varies from 52% in Karamoja to 81% in Teso and Tororo regions.[18] Similarly in Nigeria, the national use rate is 75% but rates vary from 27% in Imo state to 92% in Borno state.[19]

Table 1. National rate of access and use of ITNs in 32 countries in sub-Saharan Africa[20]

[11] Bertozzi-Villa A, Bever CA, Koenker H, Weiss DJ, Vargas-Ruiz C, Nandi AK et al. Maps and metrics of insecticide-treated net access, use, and nets-per-capita in Africa from 2000–2020. *Nat Commun.* 2021;12:3589.
[12] Koenker H, Kilian A, Zegers de Beyl C, Onyefunafoa EO, Selby RA, Abeku T et al. What happens to lost nets: a multi-country analysis of reasons for LLIN attrition using 14 household surveys in four countries. *Malar J.* 2014;13:464.
[13] Castellanos ME, Rodas S, Juárez JG, Lol JC, Chanquin S, Morales Z, Vizcaino L, Smith SC, Vanden Eng J, Woldu HG, Lenhart A. Evaluation of the durability of long-lasting insecticidal nets in Guatemala. *Malar J.* 2021;Dec;20(1):1-4.
[14] Brooks HM, Jean Paul MK, Claude KM, Mocanu V, Hawkes MT. Use and disuse of malaria bed nets in an internally displaced persons camp in the Democratic Republic of the Congo: a mixed-methods study. *PloS one*. 2017;Sep 26;12(9):e0185290.
[15] Koenker H, Kilian A, Zegers de Beyl C, Onyefunafoa EO, Selby RA, Abeku T et al. What happens to lost nets: a multi-country analysis of reasons for LLIN attrition using 14 household surveys in four countries. *Malar J.* 2014;13:464.
[16] Wheldrake A, Guillemois E, Arouni H, Chetty V, Russell SJ. The causes of holes and loss of physical integrity in long-lasting insecticidal nets. *Malar J.* 2021;20:45.
[17] ICF, 2015. The DHS Program STATcompiler. Funded by USAID. http://www.statcompiler.com. July 3 2023
[18] Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF. *Uganda malaria indicator survey 2018–19.* Kampala: Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF; 2020.
[19] National Malaria Elimination Programme (NMEP) [Nigeria], National Population Commission (NPC) [Nigeria], and ICF. 2022. *Nigeria Malaria Indicator Survey 2021 Final Report*. Abuja, Nigeria, and Rockville, Maryland, USA: NMEP, NPC, and ICF.
[20] ICF, 2015. The DHS Program STATcompiler. Funded by USAID. http://www.statcompiler.com. July 3 2023.

Country	Survey	Persons with access to an ITN	Existing ITNs used last night
Angola	2015-16 DHS	19.7	71.0
Benin	2017-18 DHS	77.2	73.4
Burkina Faso	2017-18 MIS	54.5	76.0
Burundi	2016-17 DHS	32.3	86.9
Cameroon	2018 DHS	58.5	76.2
Chad	2014-15 DHS	61.2	48.6
Comoros	2012 DHS	41.2	92.0
Congo	2011-12 DHS	22.6	89.2
Congo Democratic Republic	2013-14 DHS	46.5	82.8
Cote d'Ivoire	2011-12 DHS	49.0	58.8
Eswatini	2006-07 DHS	2.3	15.0
Ethiopia	2005 DHS	1.5	61.2
Gabon	2012 DHS	26.9	86.6
Gambia	2019-20 DHS	60.8	55.0
Ghana	2019 MIS	66.7	50.1
Guinea	2021 MIS	41.9	72.0
Kenya	2020 MIS	39.6	80.2
Liberia	2019-20 DHS	39.7	74.7
Madagascar	2021 DHS	48.4	77.3
Malawi	2017 MIS	63.1	76.8
Mali	2021 MIS	72.2	90.6
Mauritania	2019-21 DHS	19.5	42.0
Mozambique	2018 MIS	68.5	85.4
Namibia	2013 DHS	18.1	21.1
Niger	2021 MIS	80.2	81.1
Nigeria	2021 MIS	43.1	75.1
Rwanda	2019-20 DHS	50.8	78.0
Sao Tome and Principe	2008-09 DHS	51.0	82.0
Senegal	2020-21 MIS	57.8	81.4
Sierra Leone	2019 DHS	46.8	89.5
Tanzania	2017 MIS	62.5	66.7
Togo	2017 MIS	82.3	52.3
Uganda	2018-19 MIS	71.5	74.3
Zambia	2018 DHS	59.9	64.2
Zimbabwe	2015 DHS	37.2	18.8

High access and low use

In many countries where ITNs are distributed free of charge, low use rates are limiting the effectiveness of this core intervention. Even when nets are available to household members, they are

not used 100% of the time, with factors such as age, season, gender and perception of malaria risk affecting usage.[21,22,23,24] Reasons often given for low use rates where access is high include: perceived discomfort, lack of awareness of the benefits, cultural beliefs and practices, misconceptions and fears about ITNs and their safety, a lack of community engagement, inconsistent or incorrect use (table 2). In addition, studies have documented the seasonal variation in use. Lower use rates are reported in the dry season when the perception of malaria risk is lower and the temperature discourages use as it is uncomfortable to sleep under ITNs in hot weather[25].

Table 2: Barriers to ITN usage

Category	Examples
ITN design or quality	● Nets trap heat and reduce airflow, making it hard to sleep.[26] ● Uncomfortable material, leading to rashes or skin discomfort.[27] ● Poor quality, leading to rips and tears. ● Inappropriate shape for room type (i.e., rectangular design for round rooms).[28] ● Requires accompanying accessories to hang the net (which are not always provided).
Alternative use of ITN	● Usage for other household purposes (e.g., ceiling cover, curtain, tablecloth).[29] ● Usage for income-generating purposes (e.g., fishing, crop protection).[30]
Misperception of risks and benefits	● Underestimation of ITN effectiveness.[31] ● Underestimation of malaria incidence and/or mortality rates.[32] ● Reduced risk perception due to decreased malaria prevalence and mosquito (biting) density.[33]
Other constraints	● Unable/no place to hang the net[34]

[21] Noor AM, Kirui VC, Brooker SJ, Snow RW. The use of insecticide treated nets by age: implications for universal coverage in Africa. *BMC Public Health*. 2009;9:369.
[22] Olapeju B, Choiriyyah I, Lynch M, Acosta A, Blaufuss S, Filemyr E et al. Age and gender trends in insecticide-treated net use in sub-Saharan Africa: a multi-country analysis. *Malar J.* 2018;17:423.
[23] Fernando SD, Abeyasinghe RR, Galappaththy GN, Gunawardena N, Ranasinghe AC, Rajapaksa LC. Sleeping arrangements under long-lasting impregnated mosquito nets: differences during low and high malaria transmission seasons. *Trans R Soc Trop Med Hyg.* 2009;103:1204–10.
[24] Koenker H, Taylor C, Burgert-Brucker CR, Thwing J, Fish T, Kilian A. Quantifying seasonal variation in insecticide-treated net use among those with access. *Am J Trop Med Hyg.* 2019;101:371–82.
[25] Koenker, H., Kumoji, E.K., Erskine, M. et al. Reported reasons for non-use of insecticide-treated nets in large national household surveys, 2009–2021. *Malar J.* 2023;22, 61.
[26] Ahorlu, C.S., Adongo, P., Koenker, H. *et al.* Understanding the gap between access and use: a qualitative study on barriers and facilitators to insecticide-treated net use in Ghana. *Malar J.* 2019;18, 417.
[27] Ahorlu CS, Adongo P, Koenker H, Zigirumugabe S, Sika-Bright S, Koka E, Tabong PT, Piccinini D, Segbaya S, Olapeju B, Monroe A. Understanding the gap between access and use: a qualitative study on barriers and facilitators to insecticide-treated net use in Ghana. *Malar J.* 2019;Dec 12;18(1):417.
[28] Taremwa IM, Ashaba S, Ayebazibwe C, Kemeza I, Adrama HO, Omoding D, Yatuha J, Hilliard R. Mind the gap: scaling up the utilization of insecticide treated mosquito nets using a knowledge translation model in Isingiro district, rural south western Uganda. *Health Psychology and Behavioral Medicine*. 2020;Jan 1;8(1):383-97.
[29] Baume CA, Reithinger R, Woldehanna S. Factors associated with use and non-use of mosquito nets owned in Oromia and Amhara regional states, Ethiopia. *Malar J.* 2009 Dec;8:1-1.
[30] Larsen DA, Welsh R, Mulenga A, Reid R. Widespread mosquito net fishing in the Barotse floodplain: evidence from qualitative interviews. *PLoS One.* 2018;May 2;13(5):e0195808.
[31] Agence Nationale de la Statistique et de la Démographie (ANSD) [Sénégal], et ICF. 2019. *Sénégal : Enquête Démographique et de Santé Continue (EDS-Continue 2019)*. Rockville, Maryland, USA : ANSD et ICF.
[32] Institut national de la Statistique (INS) [Guinée], et ICF. 2021. *Enquête sur les indicateurs du paludisme et de l'anémie en Guinée 2021*. Rockville, Maryland, USA : INS et ICF.
[33] National Population Commission (NPC) [Nigeria] and ICF. 2019. *Nigeria Demographic and Health Survey 2018.* Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF
[34] Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF. *Uganda malaria indicator survey 2018–19.* Kampala: Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF; 2020.

	• Net is torn[35]
Social norms	• Community disapproval[36] • Low usage amongst peers[37]

Current strategies to improve ITN coverage

Many countries are making efforts to tackle the barriers to access through regular distribution campaigns. In particular, Uganda have made huge efforts over the last decade to achieve universal coverage of ITNs, with campaigns in 2013, 2017, 2020 and 2023, distributing 22 million,[38] 24 million,[39] 27.5 million,[40] and 28.5 million[41] ITNs, respectively. Over this time period household access to an ITN has risen from 16% in 2006 to 80% in 2018.[42] However, in some areas of the country, for example Karamoja region, malaria prevalence in children under five remains over 30%.[43] Similarly, Nigeria has made great efforts to increase the coverage of ITNs across the country. However, in some areas where there is high coverage of ITNs there is also the highest malaria prevalence (fig. 2 and 3).[44] This creates an impact paradox.

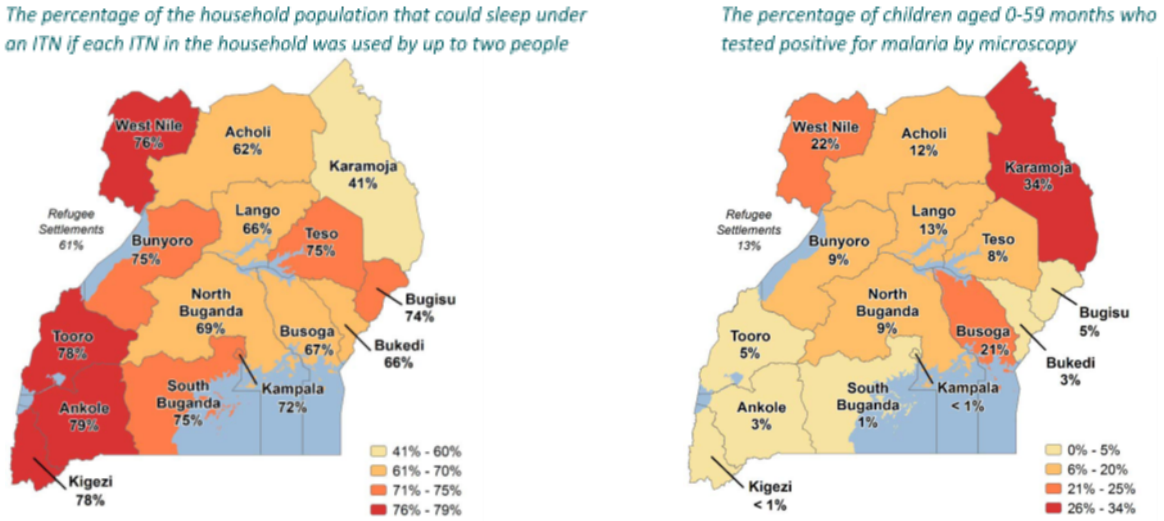

Figure 2 ITN coverage and prevalence of malaria in Uganda by region. Source: Uganda MIS 2018-2019.[45]

[35] Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), and ICF. 2017. *Tanzania Malaria Indicator Survey 2017.* Dar es Salaam, Tanzania, and Rockville, Maryland, USA: MoHCDGEC, MoH, NBS, OCGS, and ICF.

[36] Monroe, A., Harvey, S.A., Lam, Y. et al. "People will say that I am proud": a qualitative study of barriers to bed net use away from home in four Ugandan districts. *Malar J*. 2014 ;13, 82.

[37] Monroe, A., Harvey, S.A., Lam, Y. et al. "People will say that I am proud": a qualitative study of barriers to bed net use away from home in four Ugandan districts. *Malar J.* 2014;13, 82.

[38] World Health Organization Africa. Uganda launches the second campaign for universal coverage of long-lasting insecticidal nets. 2017. Available at: https://www.afro.who.int/news/uganda-launches-second-campaign-universal-coverage-long-lasting-insecticidal-nets

[39] Wanzira H, Katamba H, Rubahika D. Use of long-lasting insecticide-treated bed nets in a population with universal coverage following a mass distribution campaign in Uganda. *Malar J.* 2016;15:311.

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[41] Pace. AMF-PACE UGANDA Pre-Distribution Monitoring Activities of the LLIN Campaign. Available at: https://pace.org.ug/pdm-activities-of-the-llin-campaign/. [Accessed: 3 July 2023].

[42] Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF. *Uganda malaria indicator survey 2018–19*. Kampala: Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF; 2020.

[43] Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF. *Uganda malaria indicator survey 2018–19.* Kampala: Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF; 2020.

[44] National Malaria Elimination Programme (NMEP) [Nigeria], National Population Commission (NPC) [Nigeria], and ICF. 2022. *Nigeria Malaria Indicator Survey 2021 Final Report.* Abuja, Nigeria, and Rockville, Maryland, USA: NMEP, NPC, and ICF.

[45] Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF. *Uganda malaria indicator survey 2018–19*. Kampala: Uganda National Malaria Control Division, Uganda Bureau of Statistics, and ICF; 2020.

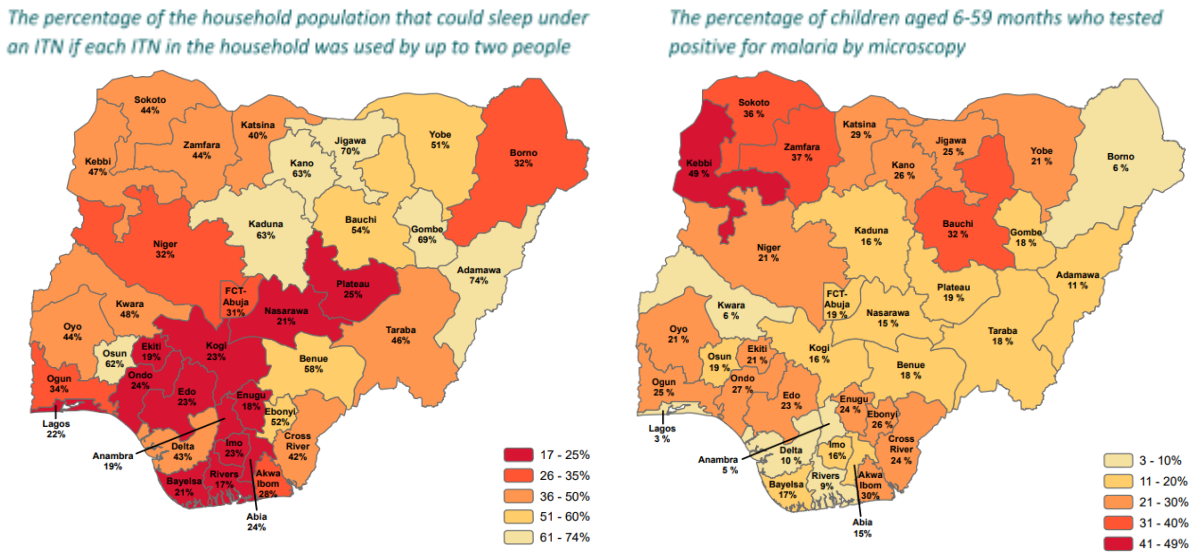

Figure 3 ITN coverage and prevalence of malaria in Nigeria by state. Source: Nigeria MIS 2021.[46]

Current strategies to improve ITN retention and use

Studies on improving net durability have shown that improving net care and storage are effective ways to improve retention. However, this area of work requires more attention. A number of studies have also been conducted to identify barriers that inhibit ITN use. However, there is limited research available on effective solutions that tackle this issue, particularly when access is no longer a barrier. This challenge is one fundamentally rooted in changing human behaviour and therefore requires a behaviourally-informed approach.

Many ITN distribution campaigns include a communication component to encourage ITN use (box 1). These communications happen before, during and after distribution but do not always continue after the post-implementation activities have been completed. Evidence suggests that embedding behavioural change elements into these communications can increase ITN usage by 12-17 percentage points[47] [48] [49]. However, much more could be done to refine existing behavioural change communications by drawing on state-of-the-art methods from behavioural science and leverage a wider range of behavioural interventions to help address this issue.

[46] National Malaria Elimination Programme (NMEP) [Nigeria], National Population Commission (NPC) [Nigeria], and ICF. 2022. *Nigeria Malaria Indicator Survey 2021 Final Report.* Abuja, Nigeria, and Rockville, Maryland, USA: NMEP, NPC, and ICF.

[47] Bowen, H. L. Impact of a mass media campaign on bed net use in Cameroon. *Malar j*. 2013;12(1), 1-18.

[48] Boulay, M., Lynch, M., & Koenker, H. Comparing two approaches for estimating the causal effect of behaviour-change communication messages promoting insecticide-treated bed nets: an analysis of the 2010 Zambia malaria indicator survey. *Malar j.* 2014;13, 1-8.

[49] Kilian, A., Lawford, H., Ujuju, C. N., Abeku, T. A., Nwokolo, E., Okoh, F., & Baba, E. The impact of behaviour change communication on the use of insecticide treated nets: a secondary analysis of ten post-campaign surveys from Nigeria. *Malar j.* 2016;15(1), 1-16.

*Box SEQ Box * ARABIC 1 Examples of current community engagement activities to foster ITN utilisation and care practices*

National Level Activities

- Public Awareness Campaigns: Launch mass media campaigns leveraging national television and radio networks to disseminate key messages about the importance of ITNs, proper usage, care practices, and the consequences of misuse.
- Stakeholder Collaboration: Collaborate with various stakeholders such as the Ministry of Health, non-governmental organisations, and the private sector to facilitate the development of a unified and impactful message.
- National Events: Utilise national events, such as World Malaria Day, to heighten awareness about the significance of ITNs in the fight against malaria.

District Level Activities

- Workshops and Training Programs: Conduct training programs for healthcare professionals, community leaders, and other key players to ensure accurate, consistent information is disseminated at the community level.
- School Programs: Implement educational programs in schools that cover the importance of ITNs, correct usage and care practices.
- Roadside Promotions: Use banners, posters, and billboards along key roads to reiterate the importance of ITNs and dissuade misuse.

Community Level Activities

- Community Dialogues: Host regular community dialogues where community members can voice their concerns, share their experiences, and learn from each other.
- Interpersonal Communication (IPC) Sessions: Facilitate IPC sessions to educate individuals and families about the importance of ITNs, proper care practices, and the negative impacts of misuse.
- Local Drama Groups: Engage local drama groups to perform plays and skits highlighting the importance of ITNs in malaria prevention.

Our proposal

Our project aims to increase the consistent use of ITNs in communities where access to ITNs is already high. We focus on areas where access is not the barrier as these communities already meet two of COM-B criteria (capability and opportunity). Our intervention will therefore focus on the motivations that drive or inhibit the target behaviour of net use. In addition, our intervention aims to increase consistent use throughout the year where current research shows use rates are heavily affected by seasonality and time since a campaign.

To increase ITN use we will conduct a three-phase project. During phase one, we will explore current use behaviours and the barriers that inhibit net use in the target communities, to understand the problem in depth. In phase two, we will combine behavioural insights with local knowledge to co-create solutions that will encourage consistent use of nets by developing prototypes and gathering user feedback. Phase three will then evaluate the impact of the finalised intervention on ITN use through a cluster randomised control trial (cRCT).

To our knowledge this is the first attempt to systematically apply and evaluate behavioural insights for increasing ITN use. The approach is therefore a first-of-its-kind, combining expertise on behavioural science with local knowledge to optimise an existing intervention through tools co-created with communities. Collaborating with local stakeholders will ensure the intervention works in practice and not just in theory. Furthermore, creating ownership in communities and national stakeholders from project inception will increase the chance of successful uptake after completion. This project will bring new insights on current ITN rollout practices and entry points for improvement as well as documenting actual ITN use rates and an in-depth understanding of

behaviours around use. This collection of high-quality data will also further understanding of the relationship between ITN use and malaria transmission.

This project seeks to improve the impact of an already widely deployed intervention. The success of this project will allow global stakeholders to amplify the effectiveness of existing commitments to combat malaria and directly increase the number of lives saved through their work. The success of this project could also serve as a pathfinder for the optimisation of other existing interventions that have received limited uptake, for example intermittent preventive treatment in pregnancy.

This proposal brings together two organisations uniquely placed to deliver this project: Malaria Consortium, one of the world's leading non-profit organisations specialising in the prevention, management, control, and elimination of malaria and other communicable diseases and BIT, the global leaders on application of behavioural approaches to public policy challenges. Both organisations have extensive experience in conducting complex research and evaluations in low- and middle-income countries.

BIT is the world's first "nudge unit" and a global pioneer in the application of insights from behavioural science to improve policy and programs and deliver positive results. Since 2010, BIT has completed over 1,500 research and evaluation projects in behaviour change in more than 75 countries, with more than 200 related to public health in developing contexts. BIT has substantial experience implementing complex field RCTs, having designed and conducted over 1,000 evaluations.

Malaria Consortium is present in 12 countries globally and over the last two decades the organisation has worked collaboratively with communities, all levels of governments, public and private sector partners, including local civil society, community-based and ethnic organisations, to improve the lives of all in Africa and Asia. The experience and connections brought by Malaria Consortium will ensure this project has high-quality implementation and a pathway for research uptake.

Study areas

The project will be conducted in Uganda and Nigeria. These countries were chosen as both countries have high ITN coverage and low net use rates and are conducting ITN campaigns in late 2023 and early 2024. In addition, Malaria Consortium's East and Southern Africa and West and Central Africa regional offices are based in Uganda and Nigeria, respectively. The presence of existing experts in research, programming and implementation and the consistent role Malaria Consortium have played in ITN campaigns in these countries will support the operational feasibility of delivering this project.

Malaria Consortium has previously conducted studies on ITN use in Nigeria and Uganda which will provide a foundation for this work:

Secondary Analysis of Behavioural Aspects of Net Hanging and Use from Post-campaign Surveys (2009-2012) in Ten States in Nigeria: As part of the second round of ITN mass campaigns in Nigeria a secondary analysis of data from ten post-campaign surveys was carried out to assess the campaign outcomes, including detailed information on net hanging, net use, and information of behaviour change communication exposure and message recall. The analysis was conducted across ten states in Nigeria – five northern and five southern – between 2009 (first campaigns) and 2012. The purpose of the analysis was to assess:

- The level of exposure to BCC messages existed after the previous campaigns
- The channels of communications worked best in which circumstances
- The exposure to messages and recall of the content
- The relationship between recall and positive attitudes and practices of households use of nets

Post-distribution monitoring of ITNs in Uganda: The post-distribution monitoring project tracked the ownership, use and condition of the ITNs in the 58 districts where AMF-funded nets were distributed. Community health workers, known as village health teams in Uganda, visited randomly sampled villages between February 2018 and April 2020 — six, nine, 12, 18, 24 and 30 months after the ITN distribution. Over a period of 30 months the project evaluated coverage, use and care of ITNs in over 400,000 households across over 1,600 villages in Eastern and Western Uganda.

Timing

The timing of the project has important implications. Since ITNs are primary tool for reducing malaria transmission, any delays in optimisation of this intervention also delay elimination of the disease. Furthermore, any delay to elimination provides an opportunity for the parasite to evolve and develop resistance to drugs used to treat the malaria. In addition, by conducting this research now we can capitalise of the ITN distribution campaigns taking place in late 2023 and early 2024. The findings of the project will then be ready for round eight of national Global Fund applications where the tool could be budgeted for and rolled out in the following ITN distributions.

Methodology

Project inception:

The project inception phase will be conducted to understand the ITN landscape, and engage key stakeholders at national and subnational levels to build awareness of the project and lay the foundations for uptake of the results. In this phase, we will:

- Complete project set up tasks
- Conduct stakeholder mapping to identify the key stakeholders in each country
- Conduct national and subnational stakeholder engagement meetings to build awareness of the project and policy uptake expectations
- Conduct a rapid assessment of which ITNs have been deployed in each area of the country to determine the study sites for the research phases

Phase one: Exploratory research to uncover barriers and enablers, and refine target behaviours

In phase one we will conduct exploratory research to understand in depth the factors that affect ITN use. In this phase, we will:

- Conduct a desk review to synthesise the existing evidence from the academic and grey literature on barriers to usage
- Analyse data from past household surveys
- Conduct first-hand qualitative research, including semi-structured in-depth interviews and focus group discussions with members of the target communities to fill research gaps in the existing evidence on barriers, using purposive sampling to ensure representative and inclusive participation
- Directly observe the user journey that community members take to access, hang, and maintain nets to identify points of friction in the process
- Conduct stakeholder workshops to finalise target behaviours with stakeholders

Understanding the reasons that encourage and discourage consistent use of ITNs will allow us to hone in on the specific target behaviours that we believe will have the largest impact on usage, as well as the barriers to those behaviours. This might include: user or provider behaviour to improve the last mile distribution of ITNs from local government stores to individual households; increasing rates of proper instalment and care within the home; or encouraging households to prioritise the

protection of members with the highest risk of severe disease. From the initial longlist uncovered during the research, we will shortlist the target behaviour for solutioning in collaboration with key stakeholders.

Phase two: Co-creation of prototype interventions using behavioural insights

In phase two, we will develop interventions focusing on the shortlisted target behaviour, aiming to address related barriers, and leverage the behavioural enablers. We will do this by combining findings from exploratory research in phase one, with insights from behavioural science – findings from sciences such as behavioural economics and social psychology telling us how to effectively influence human behaviour. We will leverage BIT's EAST framework (which comprises four principles of successful behavioural interventions: Making it Easy, Attractive, Social, and Timely,) [50] as well as their experience from running over 1,500 behaviour change projects across the world.

The exact nature of the intervention will depend on the findings from the exploratory research. Options may include: behaviourally-informed communications to households to streamline instalment and encourage ongoing usage,[51, 52, 53, 54, 55,] digital solutions to boost engagement and ensure usage over time (such as text reminders,[56] chatbots,[57] or edutainment[58]), small rewards and incentives[59] or community- or socially-oriented programmes[60, 61, 62] to encourage correct usage. We are keen to explore innovative solutions beyond the existing communication campaign tools currently deployed as part of distribution campaigns, to help identify the future go-to intervention(s) for increasing ITN usage. We will run a co-design solution workshop with key stakeholders to develop a longlist of potential solutions. These solutions will be prioritised using criteria such as impact and feasibility. The most promising 2-3 intervention ideas will then be prototyped and tested with communities to understand feasibility and acceptability. High-fidelity prototype(s) with then be tested by communities before selecting the final intervention(s) in collaboration with key stakeholders.

In this phase, we will:

- Conduct a solution co-design workshop with local stakeholders
- Rapidly develop low-fidelity prototypes of behaviourally informed intervention(s)

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- Gather a first round of user feedback on low-fidelity prototypes, through focus group discussions in 2-4 communities
- Leverage user feedback to develop high-fidelity prototypes
- Gather a second round of user feedback on high-fidelity prototypes, through focus group discussions and direct observations of user interaction with prototypes in a real-world setting
- Finalise design of intervention(s)

Phase three: cRCT evaluation and subsequent scale-up

To our knowledge, there is limited existing evidence on methods to improve use of ITNs in communities where access is high but use is low. The majority of existing studies focus on qualitative outcomes or self-reported quantitative outcomes measured through household surveys, but no robust study has yet been completed measuring health outcomes directly.[63,64]

To fill this key research gap, we propose conducting a cRCT in Nigeria and Uganda. The study sites and timing of the intervention will be determined by the existing schedule of ITN distributions in the study countries during round six and seven campaigns. The cRCT will be conducted as close to the distribution as possible with an acceptable window for the cRCT to start within six months of a distribution campaign. We will randomly assign selected wards in Nigeria[65] and parishes in Uganda[66] to receive the behaviourally-informed intervention(s), while other wards and parishes will continue to receive ITNs and existing uptake activities as usual.

We conducted statistical power calculations to determine the sample size necessary to detect a 10 percentage point increase in ITN usage with 80% power at 5% significance level. Assuming an intra-cluster correlation of 0.05 and that each parish or ward covers 25 households on average, we would need to include a total of 64 parishes or wards in the trial (32 in each arm), equivalent to 1,600 participants per country or around 3,200 in total for this trial.

Our primary outcome measure will be ITN use rates collected through household surveys, conducted at baseline and endline. Our secondary outcome measures will include: malaria prevalence collected through a malariometric component within the household surveys, incidence data collected at health facilities and through active case detection in a cohort of children, and entomological data collected using light traps. We will also collect process evaluation data during the trial as a supporting dataset. Enumerators will conduct data collection; for example digitising paper health records or going door-to-door to conduct household surveys and active case detection. We will develop further details of the trial design once we have more information on the nature of the intervention.[67]

Data collection

Essential

Household and Malariometric surveys

[63] Helinski, M.H., Namara, G., Koenker, H. et al. Impact of a behaviour change communication programme on net durability in eastern Uganda. *Malar J*. 2015 ;14, 366.
[64] Kilian, A., Lawford, H., Ujuju, C.N. et al. The impact of behaviour change communication on the use of insecticide treated nets: a secondary analysis of ten post-campaign surveys from Nigeria. *Malar J* 2016;15, 422.
[65] A ward in Nigeria is a local geographic area, following state and local government area. There are ~8,800 wards in Nigeria.
[66] A parish in Uganda is a local geographic area, following districts, counties and sub-counties. There are approximately ~10,700 parishes in Uganda
[67] For example, if the intervention(s) were implemented by community health workers who work across more than one community, we would need to pay additional attention to cross-community spillover effects. The trial design will be developed alongside the intervention design, and pre-registered in a trial protocol.

Household and Malariometric surveys will be used to collect information on ITN use, healthcare seeking behaviour and malaria prevalence among all children aged 0-15 years in the randomly selected households. To supplement self-reported net use the household surveys will collect data on the direct observation of an ITN hanging over a sleeping area in the household. The malariometric component of the survey will include the measurement of temperature and the collection of a finger-prick blood sample to measure for malaria prevalence and haemoglobin. Although surveys are simple to conduct, this data collection method only provides a snapshot in time. In addition, there is lag time between the change in use of ITNs and malaria prevalence, therefore, due to the short duration of the project, measuring malaria prevalence alone would not be optimal for demonstrating the public health impact of this intervention.

Routine health facility data

Collecting malaria case data from health facilities will enable us to understand the impact of the intervention over time. We will work with district biostatisticians and health workers to collect routine data from health facilities. However this type of data has a number of limitations. This data will only pick up symptomatic cases as people will only present at a health facility if they are experiencing symptoms. In moderate and high transmission setting there are likely to be a large number of asymptomatic cases that would not be detected collecting this type of data alone. In addition, this type of data relies on the population having good treatment seeking practices and the use of health facilities can be determined by the perceived or actual availability of diagnostics and treatment. Furthermore, where there is poor availability of diagnostics tests, diagnosis may be presumptive based on symptoms which can lead to incorrect diagnosis.[68]

Active case detection in a cohort of children

Collecting malaria case data through active case detection will enable us to understand the impact of our intervention on symptomatic and asymptomatic cases over time. Active case detection involves health workers taking a finger-prick blood sample for a thick blood smear and for an rapid diagnostic test from the same cohort of children every two weeks throughout the intervention. This method is more labour intensive than conducting surveys however this will give measure of incidence and give a robust indication of how the intervention is performing from a public health impact perspective. This type of data collection is essential for assessing the impact effectiveness of the intervention.

Using these datasets together provides a richness of understanding of the impact of our intervention and will also provide critical data to further understanding of the relationship between ITN use rates, prevalence and incidence. If this intervention is deployed at scale this information will be important for understanding the impact given that programmes would only be able to track the impact through routine data sources, for example health facility data and prevalence surveys. Our data will also help others to define the parameters when converting between prevalence to incidence, and the relationship between incidence collected at health facilities and incidence from active case detection.

Important

Entomological and resistance monitoring data

Collecting entomological data will enable us to understand the impact of our intervention on infection rates in the vector, which impacts transmission. In addition, we will be able to track any changes in vector dynamics (species biting and resting behaviours) that would affect the impact this intervention can have. For example, a change from indoor biting mosquitoes to outdoor biting or mosquitos changing the time of biting will limit the impact of the ITNs even if use is high. This

[68] World malaria report 2022. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.

dataset would also provide important information on the type of nets that should be deployed in the study regions, identify any areas that may be allocated the incorrect net type and provide critical information on insecticide resistance which will inform future national planning and can be submitted to the WHOs Malaria Threat's Map for use by the global community.

Process evaluation data

Conducting a process evaluation will enable us to measure and document the external factors that could impact the outcome measures for the intervention. Examples include stockouts at a health facility which affect treatment seeking rates and environmental factors which impact malaria transmission. This measure is helpful as it can explain why changes in the outcome measure are not as expected. This dataset is particularly beneficial when the impact achieved from an increase in use does not translate to a reduction in transmission. If the intervention was implemented without this measure, it would be difficult to explain which factors affected the intervention and which were the most important.

Expected impact

Projected impact on ITN usage

Given the available data on ITN access (Table 1)[69] and population size,[70] we estimate that across the 32 countries surveyed, a potential 130 million people would currently not use an ITN even if they had access to one. In reality, this figure could double, if ITNs recorded as 'used' are only used by one person rather than two.

Through our cRCT we expect to be able to detect a minimum increase in net use of 10 percentage points although depending on the intervention selected, at 80% power and 10% significance level. Note however that the effect size could be higher based on existing evidence (see studies cited in 'phase two', showing effects ranging from 12 percentage points for basic behavioural communications to approximately 60 percentage points for the most intense community-based programs).

Potential cost effectiveness improvement

We conducted preliminary cost-effectiveness calculations (attached as a part of this submission), looking at the breakeven point for our potential interventions. Starting with the lower bar, at the cost of $0.15 per household (similar to existing low-cost behavioural communication campaigns),[71] the intervention would be cost-effective using GiveWell's threshold if increasing ITN use by at least 4 percentage points in Uganda and 2 percentage points in Nigeria (assuming this would induce a proportionate reduction in malaria prevalence).[72] At the higher bar, interventions costing $3 per household, would need to increase ITN use by 25 and 19 percentage points in Uganda and Nigeria respectively, to meet the cost effectiveness threshold (a high but not potentially unreachable effect, given existing evidence outlined above).

If successful, this intervention will increase the cost-effectiveness of funding already committed to ITN distributions. Between 2019 and 2021 approximately 590 million ITNs were delivered to communities across this region with a potential to protect over 1 billion people (1 ITN for two

[69] ICF, 2015. The DHS Program STATcompiler. Funded by USAID. http://www.statcompiler.com. July 3 2023.
[70] World malaria report 2022 - Annex 4F. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
[71] Bowen, H. L. Impact of a mass media campaign on bed net use in Cameroon. *Malar j.* 2013;12(1), 1-18
[72] Some potential interventions could be even cheaper, if using cheaper technologies like SMS or chatbots. Lester, R. T., Ritvo, P., Mills, E. J., Kariri, A., Karanja, S., Chung, M. H., et al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *The Lancet.* 2010;376(9755), 1838-1845.

people)[73]. However, with an estimated use rate of 75%[74] approximately 147 million ITNs were distributed and not used, leaving a potential 295 million people unprotected. Moreover, these estimates are from self-reported usage rates – known to lead to over reporting – therefore in reality average use rate are likely to be lower. Since ITNs are the main vector control tool in most malaria endemic countries, any increases in use from our intervention could have a meaningful impact on progress toward malaria elimination.

Improving the cost-effectiveness of ITNs will be increasingly important as next generation nets, which are comparatively more expensive, are more widely introduced. Closing the gap between access and use could result in a cost-effectiveness of next generation nets comparable to existing ITNs, despite the increased cost of the nets themselves.

Organisational track record

Malaria Consortium have a strong track record of delivering projects on vector control and behaviour change including:

NetWorks Project: This project aimed to increase access and use of ITNs among vulnerable populations in sub-Saharan Africa. Through innovative approaches such as social and behaviour change communication (SBCC), community engagement, and capacity building, the project has successfully contributed to improving ITN ownership and usage rates in various countries.

Support to the National Malaria Programme in Uganda: Malaria Consortium provides technical assistance and support to the National Malaria Programme in Uganda. This collaboration includes efforts to increase ITN coverage and promote behaviour change related to ITN usage through SBCC campaigns, community mobilization, and training of health workers.

Support to the National Malaria Programme in Mozambique: Malaria Consortium provides technical assistance and support to the National Malaria Programme in Mozambique. This collaboration includes efforts to increase ITN coverage and promote behaviour change related to ITN usage through SBCC campaigns, community mobilization, and training of health workers.

Strengthening Community-based Malaria Prevention and Surveillance Interventions, Southern Nations, Nationalities and Peoples' Region (SNNPR): This project used the role model approach to improve malaria prevention and control. Over 12 months (2021–2022), we sought to improve understanding and uptake of malaria interventions by implementing the role model approach in selected kebele (wards) in the target districts. Collaborating with implementing partners including the SNNPR Health Bureau, Wolaita Zone health department, and the Boloso Sore and Damot Sore district health offices.

BIT has a strong track record of delivering projects on behaviour change, public health, and impact evaluation including:

Chatbot to increase COVID-19 vaccination in Argentina: BIT partnered with the Vaccine Confidence Fund, Unidad de Ciencias del Comportamiento y Politicas Públicas de Argentina and the Ministry of Health of Chaco to design, implement and evaluate a behaviourally-informed chatbot in the province of Chaco, Argentina. BIT carried out an extensive desk review and fieldwork to establish structural and behavioural barriers to uptake of COVID-19 vaccines in Chaco, designed a WhatsApp chatbot with personalised messages and reminders, practical information, and time-based prompts. To date, the chatbot has been sent to 8024,000 people and impact is currently being evaluated in an RCT using real vaccination data from the national vaccine database. Preliminary suggest that results are

[73] World malaria report 2022. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
[74] ICF, 2015. The DHS Program STATcompiler. Funded by USAID. http://www.statcompiler.com. July 3 2023.

expected by mid-year 2023. You can also say that preliminary results suggest the chatbot more than tripled vaccinations compared to a pure control group.

Behavioural interventions to encourage hygiene behaviours in Bangladesh: BIT and BRAC joined forces in 2020 to encourage hygiene behaviours, such as handwashing and mask-wearing, during COVID-19 pandemic. We designed and tested behavioural interventions ranging from simplifying large posters on public handwashing stations to local promoters who actively encouraged handwashing, incentivised use of the stations with free soap and facemasks, and updated community message boards to highlight emerging social norms. To test these interventions, we first designed an online experiment where we collected survey data using a social media chatbot, and followed by a field RCT where station caretakers were recruited to record detailed behavioural data automatically generated by tally counters rigged to the foot pedals of over 800 stations. We estimated that interventions increased handwashing station usage by roughly 15% over the three weeks they were implemented, resulting in an additional 100,000 additional handwashes with soap.

Designing SBC toolkit for UNICEF: We developed a toolkit for childhood overweight and obesity prevention in Lower and Middle Income Countries (LMICs), on commission from UNICEF HQ. To develop the toolkit, we first focused on answering the following key research questions:

- To what extent has SBC been used in relation to childhood overweight and obesity prevention?
- What implementation processes have been used for SBC campaigns in LMICs?
- To what extent and how have SBCC campaigns been monitored and evaluated in LMICs?
- What are best practices from other SBCC initiatives focused on health behaviours?

We answered these questions using a rapid evidence review, stakeholder interviews, and toolkit development. The toolkit utilised BIT's TESTS methodology and provided step-by-step guidance for designing, implementing, monitoring, and evaluating SBC initiatives.

The completed project resulted in the publication of a comprehensive SBC toolkit for UNICEF country teams. The toolkit offers practical, step-by-step methodologies for designing, implementing, monitoring, and evaluating SBC initiatives. It includes activities, accompanying worksheets, and examples throughout the toolkit and Worksheet pack.

In this partnership, BIT will lend its industry-leading capabilities in behavioural insights research, intervention design, and evaluation. Malaria Consortium will bring its comprehensive expertise in delivering cost-effective ITN programs, deep understanding of local communities, and broad partnerships with public health stakeholders. The combined expertise from BIT and Malaria Consortium makes this a compelling partnership for impact.

We envisage the following breakdown of roles and responsibilities between BIT and Malaria Consortium throughout the project.

Table 3 roles and responsibilities

	BIT	Malaria Consortium
Phase 1 Exploratory research	• Conduct desk review to identify barriers and gaps in existing evidence • Co-design research questions • Design exploratory research activities (e.g., survey questionnaires, interview guides) • Conduct direct observations during field visits	• Co-design research questions • Support BIT to design exploratory research activities • Conduct in-depth interviews and FGDs via enumerator staff
Phase 2 Intervention design and prototyping	• Co-design interventions for prototyping • Lead design of user testing questionnaires and interview guides • Analyse data from prototyping phase • Co-design final intervention	• Co-design interventions for prototyping • Organise practical design and implementation of interventions for prototyping phase • Conduct user testing via enumerators • Co-design final intervention
Phase 3 cRCT evaluation and scale-up	• Contribute to the trial design, including writing trial protocol • Conduct light-touch implementation monitoring • Contribute to the data analysis • Co-disseminate results	• Lead trial design, including writing trial protocol • Implement intervention in communities • Collect data during trial (e.g., collecting and digitising paper records from health facilities, conducting household surveys) • Lead the data analysis • Co-disseminate results

Timeline

We estimate the project will take 2.5 years to complete. Key project milestones and timeline are detailed in the tables below.

Table 4 project milestones

Milestone	Timeframe
Complete desk review on existing literature	Month 2
Finalise exploratory research	Month 6
Finalise solution design	Month 8
Begin baseline data collection	Month 9
Gather endline results	Month 27

Gantt chart

Activity	YEAR 1												YEAR 2												YEAR 3					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Outcome 1: Project initiation and start up																														
Conducting stakeholder mapping																														
Conducting a rapid assessment of which ITNs have been deployed where and when																														
Carrying out national and subnational level engagment and mobilisation of key stakeholderson policy uptake expectations																														
Developing a research uptake plan																														
Outcome 2: Availability of a new body evidence on factors affecting ITN use																														
Conducting a desk review of academic and grey literature																														
Analysing data from demographic and household and malaria indicator surveys																														
Conducting stakeholder workshops to review barriers and identify target behaviours																														
Conducting first-hand qualitative research, including semi-structured in-depth interviews and focus group discussions with members of the target communities to fill research gaps in the existing evidence on barriers																														
Conducting direct observations of the user journey that community members take to access, hang, and maintain bednets to identify points of friction in the process																														
Finalising barriers and target behaviours with stakeholders																														
Outcome 3: Availability of a new body of evidence regarding effectiveness of behaviourally informed intervention																														
Conducting national-level stakeholder workshops to co-create interventions																														
Designing interventions																														
Creating low-fidelity prototype interventions																														
Conducting focus group discussions to gather user feedback on the low-fidelity prototypes in 2-4 communities																														
Developing high-fidelity protoypes using the findings of the user feedback																														
Conducting focus group discussions to gather user feedback on high-fidelity prototypes																														
Conducting direct observations of user interaction with the high-fidelity protypes in a real-world setting																														
Finalising the design of the intervention																														
Conducting national stakeholder review meeting and disemination of findings																														
Developing trial protocol and tools																														
Implementing intervention in target communities																														
Collecting and digitising baseline data collection for health facility data																														
Conducting household and malariometric surveys for baseline data																														
Conducting routine monitoring of implementation																														
Conducting active case detection																														
Conducting entomological data collection																														
Conducting household and malariometric surveys for end line data																														
Collecting and digitising health facility endline data																														
Conducting data analysis																														
Writing up and disseminating findings to key stakeholders																														

Budget

TOTAL				
	Y1 (USD)	Y2 (USD)	Y3 (USD)	TOTAL (USD)
Staff Costs	181,886	202,660	154,291	**538,837**
Travel Costs	1,075	1,708	1,811	**4,594**
Activity Costs				
Outcome 1	14,137	-	-	**14,137**
Outcome 2	119,741	-	-	**119,741**
Outcome 3	492,462	578,293	464,229	**1,534,983**
Consultant Costs	329,468	284,458	184,644	**798,571**
Equipment and Supplies	5,143	-	-	**5,143**
Other Direct Costs	19,706	25,462	15,745	**60,913**
TOTAL DIRECT COSTS (USD)	**1,163,618**	**1,092,582**	**820,720**	**3,076,920**
Overheads	60,570	28,254	26,436	**115,260**
GRAND TOTAL (USD)	**1,224,188**	**1,120,836**	**847,156**	**3,192,180**