Case 17

Eliminating Measles in Southern Africa

Geographic area: Seven countries in southern Africa: Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, and Zimbabwe

Health condition: In 1996, the seven countries of southern Africa reported a total of 60,000 measles cases and 166 measles deaths.

Global importance of the health condition today: Measles, one of the most contagious infections known in humans, ranks among the top four childhood killers worldwide. Despite the existence of a safe and effective vaccine, an estimated 30 million to 40 million cases of the disease and some 454,000 deaths occurred in 2004. Just under half of these deaths were in sub-Saharan Africa, where measles kills more children than HIV/AIDS.

Intervention or program: In 1996, the seven southern African countries agreed on a plan to eliminate measles. The strategy consisted of routine immunization for babies at 9 months, a nationwide catch-up campaign to provide a second opportunity for immunization to all children aged 9 months to 14 years, and follow-up campaigns in young children every three to four years. In addition, the countries organized surveillance for cases of measles and improved laboratory facilities so that suspect cases could be confirmed.

Cost and cost-effectiveness: The majority of the funding for the measles initiative came from national budgets. An estimate of the total cost of the program is $26.4 million, with the average cost per immunized child at $1.10. The cost of increasing routine coverage from 50 percent to 80 percent has been estimated at about $2.50 per year of healthy life gained, making measles immunization an extremely cost-effective intervention.

Impact: Between 1996 and 2000, the number of measles cases across southern Africa fell from 60,000 to 117. The number of reported measles deaths fell from 166 to zero.

Measles is one of the most contagious human infections. Along with acute respiratory infections, diarrheal disease, and malaria, it ranks among the top four childhood killers worldwide. Nearly nine out of 10 measles deaths claim the lives of children under the age of five. Malnutrition, especially vitamin A deficiency, strongly increases the risk of death from measles. Of an estimated 454,000 deaths from measles in 2004, more than 216,000 were in sub-Saharan Africa.[1] South Asia had the second largest number of measles deaths, with 202,000 in 2004.

With a pennies-per-dose vaccine, reducing child mortality from measles through high levels of vaccination should be affordable in the developing world, making measles as rare a disease in the poorest countries as it is in the richest. As the story of seven countries in southern Africa demonstrates, a concerted effort to immunize children against measles can work—as long as the organization, political leadership, and funding are there.

The first draft of this case was prepared by Phyllida Brown.

Impact on Child Health

The measles virus spreads through the air, attacking vulnerable surfaces in the body, such as the lungs, the lining of the intestines, and the cornea. The infection results in a wide range of symptoms including pneumonia and diarrhea. The most visible signs include fever, cough, runny nose, red lips, red rims to the eyes, rash, peeling skin, and difficulty breathing.

In developing countries, the chance that a child infected with the measles virus will die of the disease ranges from about 5 percent to 15 percent, but the proportion can be higher in overcrowded conditions or during outbreaks.[2] Among those who survive measles, a substantial number suffer serious complications, including blindness, loss of hearing, and nerve damage.

Since the vaccine was added to the Expanded Programme on Immunization in the 1980s, making it routine in most parts of the world, measles mortality worldwide has fallen by more than 80 percent compared with the prevaccine era.[3] In large areas of the world, including the Americas, Mongolia, and the Philippines, measles transmission has been interrupted or controlled at very low levels. Yet in most of Africa and parts of South Asia, the death toll from the disease has stayed stubbornly high. This is largely because vaccination has not reached as many children as it should. Overall in sub-Saharan Africa, coverage in the past decade stayed well below the levels of other basic children's vaccines such as diphtheria, tetanus, and pertussis. During the 1990s, coverage reached an average of 60 percent across the continent;[4] in 15 African countries, fewer than half of all 1-year-olds were immunized against the disease.[5]

High coverage matters for measles, more than for almost any other vaccine-preventable disease. Measles is so contagious that the proportion of the population vaccinated must be above 90 percent to stop the spread of the virus. At lower coverage levels, enough susceptible individuals will remain to create a pool within which the virus can spread. With coverage above 90 percent, the population achieves what epidemiologists call "herd immunity"—a condition created when immunization levels are so high that even the small minority not immune are still protected from the disease.

At just 26 cents per dose,[5] including the safe injection equipment, the cost of measles immunization is not the problem. Instead, practical issues have kept coverage low. First, the vaccine must be given after 9 months of age—about six months later than the other basic vaccines—because before that age an infant still carries the mother's antibodies. These antibodies "passively" protect the baby so the vaccine fails to trigger an active immune response. Unfortunately, though, it is much harder to reach 9-month-olds than newborns: Mothers may be working outside the home nine months after delivery, or pregnant again. If the clinic is many miles from home—as is often the case in sub-Saharan Africa—families may be unable to make the trip. Many babies simply miss their routine measles vaccination. Adding to the difficulty of reaching older babies is the fact that in about 15 percent of the children vaccinated at the recommended age, their immune systems fail to make protective antibodies unless they receive a second booster dose.[6]

Aggressive Policy to Cut Measles Mortality

In Latin America and the Caribbean in the 1990s, researchers and immunization teams showed that they could overcome most of the difficulties in reaching and effectively immunizing older babies by using a strategy known as "catch up, keep up, and follow up."[7] This strategy, designed by Dr. Ciro de Quadros and recommended by the Pan American Health Organization (PAHO), consists of the following three components:

- A single nationwide "catch-up" campaign in which mobile teams vaccinate all children in a particular age group, usually between 9 months and 14 years, within just a few days. This approach reaches children who missed their routine measles immunization and also provides a second dose for any child in whom the first dose failed. If coverage reaches 90 percent or above, the chances of the virus spreading anywhere within this age group are sharply reduced, and the health impact is dramatic and immediate.
- Sustained routine coverage ("keep up") at levels of at least 80 percent.
- Regular "follow-up" campaigns every three to four years to prevent the number of susceptible cases in

the population rising to the critical mass required for transmission.

Applying this strategy, the countries in Latin America and the Caribbean worked together to bring down the annual number of measles cases from around 250,000 in 1990 to 537 in 2001.[5]

Action in Southern Africa

While immunization teams across Latin America and the Caribbean were pursuing this approach, some health officials in southern Africa had also begun to act. One key player was Dr. Robin Biellik, an epidemiologist and team leader for the Expanded Programme on Immunization in southern Africa at the WHO Regional Office for Africa in Harare, Zimbabwe. Before arriving in southern Africa, Biellik had worked with de Quadros at PAHO in Brazil in the 1980s, focusing on polio eradication (see Case 5). When Biellik arrived in southern Africa, immunization teams there were also concentrating on polio eradication. In fact, the success of the polio campaigns, which significantly reduced the number of cases, led to an intensified interest in measles elimination. Measles cases and deaths also were declining, but the disease remained a much greater health threat than polio. "The decision makers were saying, 'What we're really interested in is the thing that is killing our kids,' " recalls Biellik.

Dr. Adelaide Shearley, former immunization program manager for Zimbabwe and then WHO immunization adviser for Namibia, explains that health officials had observed the success of measles elimination strategies in Latin America and the Caribbean and believed that the same success could be achieved in southern Africa. By 1996, seven nations—Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, and Zimbabwe—had agreed on plans to eliminate measles.

Political and Popular Support, and Favorable Starting Conditions

Before these countries embarked on the elimination strategy, many already had relatively strong and effective immunization services compared with many other African nations (see Box 17–1 for a description of how another country raised the coverage of immunization from a low level). Since the mid-1980s these other countries had achieved average routine coverage of about 80 percent against measles, although in some countries and in some years the figure was lower.[4,8] This helped lay the foundation for the initiative.

Despite the good starting conditions, however, politicians in some countries had to be convinced that the investment was worthwhile, says Shearley. Measles campaigns—intensive efforts outside of routine immunization services—cost up to $1.10 per vaccinated child, depending on transport costs. However, says Shearley, the decision makers understood the potential benefits to public health and the potential savings from greatly reducing the incidence of a disabling and often deadly disease. Parents, too, needed persuasion, particularly about the need for a second dose. But the appearance of measles cases in some older children helped health workers make the case that 15 percent of children need a booster dose. Because no one can tell who those children are second doses are recommended for all.

In Zimbabwe, where some parents refused to allow their children to be immunized on religious grounds, the immunization program hired a private-sector marketing company to use road shows to communicate the benefits of the measles vaccine. Three countries—Zimbabwe, Botswana, and South Africa—introduced public health statutes to discourage the religious refusal of vaccination.[8]

Catch Up, Keep Up, Follow Up

In each country, the ministry of health planned and implemented the strategy, with technical support from WHO in Harare. Reflecting distinct needs and resources, each of the seven countries followed slightly different pathways but used common principles. All countries began with a national catch-up campaign. South Africa used its ongoing series of polio national immunization days to deliver measles vaccine to all children aged between 9 months and 14 years during 1996–1997. Botswana divided the campaign into two geographic areas, one in 1996 and the other in 1997. Swaziland and Lesotho immunized children in two age groups, one in 1998–1999, the other in 1999–2000; Swaziland, like South Africa, combined measles immunization with polio national immunization days. Malawi, Namibia, and

Box 17–1

Against All Odds: DTP Immunizations in the Democratic Republic of Congo

A smaller immunization success story has emerged in the war-torn country of Democratic Republic of Congo (DRC), which has suffered 10 years of conflict. Despite ongoing violence, political instability, and economic hardship caused by the war, the DRC was able to garner support from the international community, national leaders, and local community members to triple DTP3[a] coverage within a period of six years.

In the early 1990s, DTP3 immunization coverage plummeted from what had been a stable 40 percent to about 20 percent, as a result not only of the severe national instability but also of an abrupt break of bilateral and multilateral cooperation.[9] Coverage rates remained at around 20 percent for nearly a decade until a new infusion of funds and external support led to an upward trend in coverage, which in 2004 was around 64 percent.[10]

This three-fold increase in coverage rates of DTP3 can be attributed to a better planning process, greater community involvement, multisector partnerships and coordination interventions, and social mobilization. Initially focused on polio eradication, an interagency coordinating committee was organized in 1995 to improve coordination among partners in their planning, technical, and financial activities. This partnership between the Ministry of Health, World Health Organization, UNICEF, bilateral aid agencies, nongovernmental organizations, and missionary groups proved successful in addressing the nation's severe polio outbreak and was soon expanded to include routine immunization services.

But improving immunization coverage within a conflict zone takes special efforts.[11] In 1999, UN Security Council Resolution 1234 documented "the commitment by the parties to the conflict in the Democratic Republic of the Congo to stop fighting in order to allow an immunization campaign."[12]

In following years, warring DRC factions observed a truce and supported national immunization days (NIDs) during which children received their annual dose of life-saving vaccinations. Financial and material support was provided at the national level to produce public information materials such as posters, radio and television programs, and megaphones. On a local level, commercial activities were suspended during NIDs to ensure that parents could take their children to be immunized. Community members went to church authorities to inform their congregations of the dates and locations of immunizations, and volunteers used alternative transportation such as bikes and motorboats to administer immunizations.

The dynamic and comprehensive strategy helped boost immunization coverage so that thousands of children are now receiving all three doses of the DTP vaccine.[13] Although the DRC still has a long way to go before reaching the goal of 80 percent DTP3 coverage set by the Global Alliance for Vaccines and Immunizations, the commitment of immunization program officials and partners to increasing immunization coverage over the last decade has resulted in remarkable progress.

[a] DTP3 signifies the three doses of diphtheria toxoid, tetanus toxoid, and pertussis vaccine needed for full protection from these diseases.

Zimbabwe did their catch-up campaigns in a single year. In Lesotho, Malawi, and Namibia, health workers gave children vitamin A supplements along with the measles vaccine.

Because of the importance of monitoring the impact of the campaigns, countries also increased their surveillance of measles cases. The WHO trained surveillance staff at national and provincial levels, who in turn developed guidelines tailored to their country's needs. Those guidelines were used to train national medical and public health staff at the provincial and district levels. To provide the laboratory structure to investigate all suspected measles cases by testing samples for antibodies to the measles virus, the WHO worked with national staff to train technicians and designated the National Institute of Virology in Johannesburg as a regional reference laboratory.

Between 1996 and 2000 the campaigns reached almost 24 million children, and the reported coverage of these campaigns averaged 91 percent across the seven countries. Some, such as Botswana and Malawi, reported universal coverage. Routine immunization continued throughout each country. All seven countries also did follow-up campaigns between 2001 and 2003, up to four years after completing their catch-up campaigns.[8]

Results: A 100 Percent Drop in Mortality

By 2000, six of the seven countries (all but Lesotho) had completed their catch-up campaigns. For these six, surveillance data could therefore be analyzed. In 1996, they had reported a total of 60,000 measles cases; by 2000, the number of confirmed cases was just 117, a reduction of close to 100 percent. The number of reported measles deaths had been 166 in 1996; in 2000, it was zero.[8] Lesotho's campaign was completed in 2001. There were no measles deaths there during that year.[4]

Other data also show how measles virtually disappeared from southern Africa over the five years. In two provinces in South Africa, hospitals compared the number of children admitted with measles before and after the catch-up campaign. They recorded a 96 percent reduction in cases and a 100 percent reduction in deaths. In Malawi, hospital wards were reportedly closed following a sharp fall in the number of admissions for measles.[14] Between the start of the southern African initiative in 1996 and 2002, an estimated 170,000 measles deaths were averted because of the actions of the governments of the seven countries, their international partners, and the health care workers who implemented the campaigns. (See Box 17–2 on extending this success further in Africa.)

National Governments Financed the Effort

The majority of funding for the measles initiative came from national government budgets. The South African government funded its own activities in full; other countries received modest external support from sources such as UNICEF, the US Centers for Disease Control and Prevention, and the UK Department for International Development. These funds supplemented the resources from each country's ministry of health budgets. The total expenditure for each country has not been published, but a very rough estimate of expenditure by all countries combined, based on a cost of $1.10 per immunized child and 24 million children vaccinated, is $26.4 million.

Governments were convinced to support the strategy, and to continue to support it, in part because measles vaccination is highly cost-effective. The cost of increasing routine coverage from 50 to 80 percent has been estimated at around $2.50 per year of healthy life gained.[15] To put this in context, interventions that cost less than gross national income (GNI) per capita for each year of healthy life gained are considered to be cost-effective.[16] The seven southern African nations involved in the elimination strategy have generally higher incomes than in much of Africa, although political instability and AIDS have seriously affected several of their economies. While Malawi is notably very poor, with GNI of just $160 per capita, Namibia, South Africa, and Swaziland all have GNIs in excess of $1,000 per capita. In stark contrast, the Democratic Republic of the Congo, to the north, has a GNI of $90 per capita.[17]

However, the added cost of the measles campaigns, on top of routine services, must also be taken into account.

Box 17–2

Extending Success in Africa: The Measles Initiative

The striking success of the southern African countries' strategy demonstrates that careful and sustained immunization can effectively control measles. The success leads to a question: Can the strategy also work in other African countries where the burden of measles has long been greater? For example, during those five years, the southern African initiative prevented the deaths of an estimated 170,000 children. But in the rest of sub-Saharan Africa, some 2.5 million children died of the disease during the same period.[4] Many of the countries with the highest burdens are dealing with conflict or its aftermath, extreme poverty, and multiple competing health problems, making nationwide vaccination coverage much more daunting.

To tackle this situation head-on, a major initiative was launched across sub-Saharan Africa in 2001. Governments of all measles-endemic countries in the region are working with the Measles Initiative, an alliance of the American Red Cross, the International Federation of Red Cross and Red Crescent Societies, the Centers for Disease Control and Prevention, the United Nations Foundation, the WHO, and UNICEF to implement accelerated disease control activities across the continent.

The basic model that has been successful elsewhere—"catch up, keep up, follow up"—is being applied. A particular emphasis has been placed on a WHO- and UNICEF-endorsed guideline of providing a second opportunity for vaccination, in addition to the first dose at 9 months, to ensure that those children who did not receive a first dose or who did not respond to their first dose are ultimately immunized.

To generate local demand for vaccinations, the initiative has employed community-based mobilization. Volunteers are recruited from the community and trained to educate caretakers—mostly mothers—about the importance of routine immunization. Volunteers are organized to reach families through door-to-door visits to document eligible children.

Children are mobilized as well: "measles songs" are taught in school, and children march through the streets in parades, brandishing posters and banners extolling the importance of immunization. To further improve primary health care services in the region, the initiative also delivers additional child survival interventions such as vitamin A supplementation, insecticide-treated bed nets for malaria prevention, integrated management of childhood diseases, polio vaccines, and deworming medication.

The initiative's success has been striking: between 2001 and the start of 2006, more than 213 million children have been immunized in 40 sub-Saharan African countries. Measles cases and deaths have been slashed 60 percent across the continent since 1999, saving an estimated 1.2 million lives.[1] The original objective of halving the death toll of measles by 2005 compared with 2000 levels has nearly been achieved. The program has now set even more ambitious goals of reducing global measles death by 90 percent by the year 2010, compared to 2000 levels. To achieve these targets, the initiative faces the challenge of extending their success in the large countries with the highest measles burdens, including Nigeria, India, and Pakistan. Efforts also must be sustained to strengthen case management and disease surveillance and to ensure that at least 90 percent of infants are vaccinated against measles before their first birthday.

In estimates from a set of African countries where catch-up campaigns have been pursued in 2001, Dr. Mark Grabowsky and colleagues suggest that the average cost per death prevented is $319 in the first year, and $104 over three years, figures they consider "extraordinarily cost-effective."[18] Dr. Nigel Gay of the UK's Communicable Disease Surveillance Centre of the Health Protection Agency has estimated the cost-effectiveness of the combined intervention of improving routine coverage to 80 percent and doing catch-up campaigns. Depending on the age group covered by the campaign, the incremental cost per death averted could range from $20 to around $800.[19]

Slipping Routine Coverage—and the First Deaths for Several Years

Overall, measles transmission and deaths have remained at extremely low levels in the group of seven southern African countries since 2000. However, as in Latin America, the elimination strategy has occasionally proved "leaky," allowing a few clusters of measles cases to break through. In most instances, those affected have not been vaccinated, including children whose parents refuse immunization on religious grounds and those from families whose private doctors had wrongly advised them that they did not need to participate in the catch-up campaign.

In Gauteng province in South Africa, three hospital-based outbreaks occurred in 1999 among infants younger than 9 months who were born to HIV-positive mothers. Two babies died. The hospitals began a policy of immunizing all infants aged 6 months or over who were admitted, and measles transmission was halted.[8]

However, in 2002 and 2003 more serious outbreaks occurred. Cases believed to have been imported across the border from neighboring Angola triggered one outbreak in Engela in northern Namibia and, it is thought, another outbreak in the capital, Windhoek. The outbreak in Namibia continued for 18 months between 2002 and 2003, resulting in 1,218 reported cases and 13 deaths.[20] Transmission was subsequently interrupted following a major vaccination campaign in June 2003. In Zimbabwe an outbreak started in September 2003, primarily among children whose parents refused vaccination on religious grounds, causing 80 cases and 20 reported deaths.[20] Another outbreak was detected in Johannesburg and was traced to an immigrant community.

If routine coverage were sufficiently high in these areas, imported infections could not have spread to others. But they did, suggesting that the main problem is inadequate routine coverage.[21] In Namibia, national coverage may have slipped to around 60 percent, and among those who refused vaccination in Mutare district in Zimbabwe, coverage was 75 percent.[22] As a result, the weighted average of routine measles coverage in the seven southern African countries fell from 87 percent in 2000 to 72 percent in 2001 and 73 percent in 2002. "If we want to maintain the elimination phase we have to raise our coverage to more than 80 percent and do follow-up campaigns," says Shearley. In 2003, this goal was accomplished with reported coverage stabilizing at 81 percent.[20]

Maintaining the Success

Tackling diseases such as measles is hardly a one-time effort. It requires steady, conscientious effort by public health workers, backed by committed governments in the seven countries. Virtually all the impressive gains could be eroded unless the routine immunization system keeps up, the surveillance system identifies suspected measles cases in a timely manner, and confirmed cases are thoroughly investigated to prevent secondary spread. Like other campaigns, the intense effort against measles succeeds only within a functioning public health architecture.

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