

Front Lines

Africa faces unique challenges in the fight against infectious diseases

Despite profound medical advances over the last century, infectious diseases still present a serious threat to world health. And though many regions are hard-hit, perhaps no part of the world faces as extreme challenges as Africa does. Ongoing fights against HIV, tuberculosis, and malaria, coupled with changing demographics, modernizing cities, and bloody conflicts, present a difficult road ahead for African nations to keep people healthy.

Infectious diseases are responsible for half of all deaths in African; by comparison, in Europe only 2% of deaths are triggered by infectious disease. The high incidence of infectious diseases shows in life expectancy. Although life expectancy is increasing in Africa, the climb lags behind that of other world regions. A resident of sub-Saharan Africa can expect to live only to age 46, on average. And although life expectancy is predicted to rise by more than 10-20% by 2030, it is the lowest for any region in the world, 14 years less than in Asia, the next shortest-lived region.

Poverty and poor health care exacerbate health problems. Of African nations, 32% of the population is undernourished, and 9 of the 10 worst countries for mortality of children under 5 are in Africa, according to the WHO. And African countries rank among the lowest in per capita spending on health and availability of physicians. In 2001, Africa averaged \$36 per person spent on health care, according to the Worldwatch Institute. Niger spent \$6, Sierra Leone \$7, and Nigeria \$15; for comparison, spending in the United States topped \$4800 per person.

The Big Three

AIDS, malaria, and tuberculosis remain the most significant killers in Africa. The African continent holds only 15% of the world's population, but 60% of the people worldwide infected with HIV—38.6 million people are infected worldwide, and 25 million are in Africa. And of the estimated 2.1 million who died worldwide of AIDS in 2007, 1.6 million of those lived in Africa. The percentage of the population newly infected with HIV in a given year peaked in the late 1990s, but, due to population growth and increased survival, the number of people living with HIV continues to rise. And now, more than 50% of those infected with HIV in Africa are women. Moreover, 10-20% of pregnant women are infected with HIV in some countries in sub-Saharan Africa, whereas no more than 5% of pregnant women are infected in other regions of the world.

HIV patterns vary across Africa. Sub-Saharan Africa bears the brunt of the HIV burden, with Southern Africa the hardest hit. HIV's prevalence—the number of infections per capita—has stabilized in many African countries, but continues to increase in South Africa, where more than 5 million people live with HIV. And the 19 countries with the highest prevalence are in sub-Saharan Africa, including 19% in South Africa, 24% in Botswana, and 33.4 % in Swaziland.

Not all parts of Africa are equally hard hit. Less than 1% of the population of Senegal carries HIV, and in general West Africa has relatively low prevalence. In countries such as Ghana and Senegal, HIV tends to affect those at highest risk, such as sex workers, rather than pervading the general population. Anti-viral therapy has been incredibly successful in allowing those with AIDS to live with the disease. Efforts to supply drugs to those affected in Africa have seen some success and treatment is becoming more available, but coverage is still limited.

Between 2003 and 2005, the numbers of people in sub-Saharan Africa with access to anti-viral therapy went from 100,000 to 810,000. 190,000 receive treatment in South Africa, a substantial percentage of the total number across Africa getting drugs, yet still less than 20% of the South African population with HIV. Only a few countries—Botswana, Namibia, and Uganda—have

succeeded in treating half of HIV-infected people. And although Northern Africa boasts a relatively low prevalence of HIV, less than 5% of those individuals have access to therapy.

Aside from the challenges of getting expensive therapies to infected individuals and getting patients to adhere to the regimen, public health efforts also face challenges in preventing the spread of HIV. Condom use is still limited, encouraging the transmission of the disease, and HIV positive people are still stigmatized, discouraging people from getting tested. An HIV vaccine would be a boon to stemming the spread of the virus, but vaccine efforts have thus far not proven successful. And even if a successful vaccine emerged, mass vaccination efforts would be economically and logistically challenging. HIV will likely remain a significant, if not the most significant, infectious disease threat in Africa.

Tuberculosis is on the rise

Not far behind HIV is tuberculosis. Tuberculosis takes 500,000 lives each year in Africa, out of approximately 2 million globally (two billion of the world's inhabitants are infected with tuberculosis). Worldwide, 22 countries bear 80% of the tuberculosis burden, and of these, 9 are in Africa. Moreover, 12 of the 15 countries with the highest incidence of tuberculosis are in Africa. And the incidence of tuberculosis in Africa is on the rise, increasing more than two-fold since 1990, according to the World Health Organization. For the most part, tuberculosis can be treated, and the major hurdle is getting treatment to the people who need it.

Treatment costs have dropped substantially through deals in which drug companies provide drugs to public health efforts for reduced prices. Still, according to the Global Fight Against AIDS, Tuberculosis, and Malaria, spending on tuberculosis treatment adds up to 8-20% of household incomes in the poorest areas.

Availability of treatment has spread through the expansion of the so-called DOTS program, or Direct Observed Therapy, Short Course. This international WHO effort to curb tuberculosis started in 1991, and now covers 89% of the world's population, in 187 of 193 WHO-affiliated countries. DOTS aims to expand identification of tuberculosis cases by screening patients in clinics, providing managed drug treatment of TB, ensuring a robust drug supply, and tracking the success of treatment. According to a recent study by Obermeyer and colleagues published in PlosOne, the program has improved the success of treatment by 18%. However, they found that many cases of tuberculosis still escaped detection despite the program's efforts. Thus, significant improvements are still necessary to improve the fight against tuberculosis.

Of significant concern is the intimate linkage between HIV and tuberculosis (Chaisson et al., 2008). Nearly 50% of people infected with HIV are infected with the tuberculosis-causing organism, and in some parts of Africa, more than 70% of tuberculosis patients also carry HIV. Tuberculosis kills as many as 40% of people with HIV. And the weakened immunity spurred by HIV increases the likelihood that an infected individual will develop the disease.

Multi-drug resistance worsens the situation

Coupled with the striking connection between HIV and tuberculosis is a growing concern about multi-drug resistant tuberculosis. Tuberculosis is largely treatable, provided drugs are accessible, but drug resistant strains means that treatment is more challenging and expensive, and the disease is deadlier. And an outbreak of a drug-resistant strain in 2006 spread in South Africa, particularly in health care settings, and killed the majority of those infected.

Important future goals include making existing treatments more widely available, devising programs that prevent tuberculosis cases from going unidentified, and developing new treatments, including new vaccines. Although considerable dollars are being invested into vaccine development, once again vaccination will require substantial logistic and financial backing to be successful.

Malaria hits Africa hardest

Malaria runs neck and neck with tuberculosis in terms of deaths: depending on estimates, anywhere from 1 to 3 million people die of malaria each year, and as many as 90% of those deaths are in Africa. Malaria is particularly deadly in Africa because of the type of malaria that occurs there. The organism that causes the most severe form of malaria, *Plasmodium falciparum*, is the dominant form in Africa, and is more prevalent there than anywhere else in the world (Guerra et al., 2008).

Children are particularly hard hit by malaria. Around the world, malaria is responsible for 10% of deaths of children younger than 5, but in Africa it causes 18% of deaths in this group. And the impact on children has worsened: during the 1990s, malaria deaths in young children doubled in southern and eastern Africa. Moreover, the poorest communities are the hardest hit, according to the Global Fund to Fight AIDS, Tuberculosis, and Malaria. Nearly 60% of malaria deaths occur in the poorest 20% of the world's population.

Like tuberculosis, malaria has connections with HIV, although these connections are just beginning to be understood. Virus levels rise dramatically in pregnant women with HIV when they also contract malaria. And suppressed immune systems could prevent HIV-positive individuals from responding to malaria treatment.

Current malaria treatments can be successful, provided people have immediate access to medicine and complete their treatment. However, in part from uncompleted treatments, malaria strains that resist existing drugs are expanding. That means new drugs are constantly needed. But as with other diseases, the expense of drugs hampers their widespread use.

Prevention is an important element in malaria control. As the malaria parasite is carried by mosquitoes, insect abatement is an important element, but coordinated government efforts are required to eradicate mosquitoes. Bed nets impregnated with insecticides represent an effective and relatively low cost—approximately \$1 US per year of use—way to prevent malaria in individuals, and stem the spread in communities. However, Teklehaimanot and colleagues (2007) argue that bed nets need to be distributed more widely to the population at large, not just to groups at highest risk. And the Global Fund to Fight AIDS, Tuberculosis, and Malaria estimates that 30 million nets will be required just to protect one portion of the African population—young children and pregnant women—in the next three years.

More widespread use of bed nets might be particularly important as the geography of malaria spreads. Malaria has become more prominent in higher altitude regions of Africa where it was once rare, spurred in part by warming temperatures which make the highlands more hospitable to mosquitoes (Pascual et al., 2006; Patz and Olson, 2006). In addition, changes such as deforestation and more mobile populations encourage mosquitoes to inhabit new environments, and infect new communities.

Other Threats

HIV, tuberculosis, and malaria might be the biggest killers, but they also draw attention away from other important infectious health threats. Cholera remains a significant threat in sub-Saharan

African, where poor water conditions, sanitation, and hygiene exacerbate the spread of this water-borne disease. Numerous cholera epidemics have broken out in recent years, including a significant epidemic in the late 1990s spurred by an El Nino climate event that brought unusually amounts of rainfall to parts of Africa.

In addition, public health officials must be on the look out for new diseases that hop from animals to humans. Outbreaks of rift valley fever, bird flu, and Ebola provide examples of some of the unexpected diseases that can emerge. Research and public health must not only seek out new, improved treatments and preventions for diseases such as malaria, tuberculosis, and HIV, but also predict and prepare for new, unexpected diseases.

Plant diseases are also an issue. Subsistence farming remains an important element of the food supply in Africa and plant diseases can cripple this important piece of the equation. Cassava, for instance, is one of the most important subsistence crops in southern africa. In the 1990s, an epidemic of cassava mosaic disease, caused by a virus carried by whiteflies, spread throughout Uganda, obliterated cassava crops, and triggered a devastating food shortage. Concerted efforts to identify and distribute disease-resistant strains enjoyed some success in helping the cassava crops to reinvigorate, however the diseases remains a threat in much of the region. Efforts to devise new resistant plant strains through biotechnology and to understand the factors that trigger epidemics of the disease continue.

Changing Times

As Africa continues to battle the substantial threat of infectious diseases, the population is also fighting an increasing battle against diseases once thought to be restricted to the developed world. Non-communicable diseases such as heart disease and diabetes have skyrocketed in sub-Saharan Africa over the last decade, increasing by 10 times (Amuna and Zotor, 2008). And the overall burden will gradually shift, making infectious disease a less dominant cause of mortality.

Other changes will alter the health landscape. Many of Africa's health challenges stem from the hurdles in delivering health care to remote, rural populations. Yet, African nations will increasingly face the different set of challenges that face urban dwellers. The United Nations Population Division predicts that in two decades, half of the population in developing nations will reside in cities. Although the bulk of urban population growth will occur in Asia, the population of Africa and Asia will shift at a similar rate: from approximately 35% urban currently to more than 60% urban in the year 2050 (Montgomery et al., 2008).

Although an increased population density could be a benefit by making health care more accessible and distribution of treatments or preventions more efficient, urbanization could also exacerbate health problems. Urban poor could face increased problems of poor water quality and sanitation, and larger cities would create environments in which infectious diseases could spread quickly among a large population. Other problems, such as increased abuse of injected drugs could catalyze HIV to spread even more.

Finally, the large number of armed conflicts in Africa severely impedes health, and changing political landscapes mean different regions might be affected. And the bulk of deaths under these conditions come from disease, rather than resulting directly violence. Conflicts hamper public health networks, destroy infrastructure, hinder accessibility of foreign aid efforts, and displace populations.

African nations will continue to face a spectrum of infectious health threats. Numerous factors complicate tackling the situation—political, cultural, climatic, and economic. Substantial

investments have been made in improving health in Africa, but substantial coordinated efforts will be necessary before infectious disease threats can be stemmed.

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