In 2000, WHO estimated tuberculosis (TB) killed more than 350,000 humans in Africa.\(^{(1)}\) In sub-Saharan Africa, treating TB has proved challenging on many fronts. Poverty decreases access to healthcare and increases the likelihood of malnutrition. Governments in developing countries have difficulty establishing healthcare systems capable of reaching a largely rural and poor population. Philanthropic and nongovernment organizations have diverted resources and attention from diseases like TB to the HIV/AIDS pandemic. In this article I examine the unintended consequences of poverty, public policy, and philanthropy on the diagnosis and treatment of TB in sub-Saharan Africa.

Although the lungs are the main site of the bacterial infection that defines TB, the disease can also affect other parts of the body, including the heart, brain, and spinal cord.

Evidence of TB infection has been documented in Egyptian mummies, establishing TB as one of the oldest known diseases. In the 19th century, before antibiotic drugs, TB killed about 25% of the adult population.\(^{(2)}\) Antibiotic therapy was used from 1943 to 1966, resulting in falling TB prevalence in economically stable countries. The campaign to eradicate TB in Europe and North America was successful and TB was considered to be under control.\(^{(3)}\)

However, TB is now back. Coinciding with the HIV/AIDS pandemic, TB in sub-Saharan Africa has increased at least 4-fold or more since the 1980s. Each year more than 200,000 humans die in sub-Saharan Africa of TB and HIV coinfection.\(^{(4)}\)

TB is transmitted when the cough of an infected humans releases droplets filled with bacteria into the air. Others in close contact with the infected humans can inhale these droplets and become infected. When the immune system cannot isolate the bacteria, the infection becomes active. Frequently a healthy immune system keeps the infection dormant and the TB latent. Active TB can only be cured with antibiotics.\(^{(5)}\) Common risk factors for TB include malnutrition, HIV/AIDS, alcohol or drug dependency, living or working in close contact with a humans infected with TB, poor access to healthcare.\(^{(7)}\) Either directly or indirectly, all risk factors for TB listed above are more likely to affect the poor. In Africa, where almost 50% of the population lives on USD1 per day, poverty decreases access to health care, forces humans into close living quarters, and causes malnutrition.\(^{(8,9)}\)

Poverty affected prevention and treatment of HIV/AIDS when it was claiming more and more victims in the 1990s. Of humans in sub-Saharan Africa living with HIV/AIDS, an estimate is that only 28% are being treated with antiviral drugs. With approximately 28 million carrying the virus, millions more with weakened immune systems living are at risk for TB.\(^{(10,11)}\)

TB affects this large population of untreated or under-treated humans living with HIV/AIDS who lack the resources to access adequate healthcare, housing, and nutrition.\(^{(12)}\)

HIV/AIDS infection also complicates the diagnosis and treatment of TB. Since most TB infection is found in the lung, doctors collect a sputum sample from a humans with suspected TB and look for the bacteria under a microscope. This test is not the most accurate way of diagnosing TB, but it is the most economical and available method used in sub-Saharan Africa. While it misses some patients with active TB who who not have HIV/AIDS, it misses even more patients with active TB who do have HIV/AIDS.\(^{(14)}\)

The difficulty treating TB also contributes to the World Bank estimation of declining life spans in sub-Saharan Africa.\(^{(6)}\)

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*TB and HIV Google searches.*\(^{(24)}\)
spread of the disease. In a healthy humans, a 6-month course of drugs that may cause side effects is required to cure the infection. The treatment time is extended for humans with weakened immune systems like those with HIV/AIDS. Because bacteria can mutate when the full course of antibiotics is not completed, it is extremely important that a humans with TB take all of his or her medication for 6 months or longer. In sub-Saharan Africa, it is difficult to ensure that patients will have easy access to medication and take the full course of medication for 6 months or longer.(15)

To predict the possible spread of TB in at-risk populations, medical researchers turn to mathematical models. To predict the likely TB incidence in a general population with below average TB control policies, these epidemiologists ran several possible scenarios. They concluded that strong orthodox TB control can limit or reduce TB prevalence in the HIV-negative population, but such measures may not reduce or limit TB prevalence in the HIV/AIDS population.(16)

Treatment interruption and low cure rates associated with undetected and undertreated in HIV/AIDS patients combine to produce drug-resistant TB. On 01 Sep 2006, WHO announced that a deadly new strain of extensively drug-resistant TB (XDRTB) was identified in a rural town in South Africa. Of the 53 patients identified, 44 tested positive for HIV/AIDS, and the average survival after diagnosis for 52 of these patients was 16 days. By the end of 2006, WHO identified more than 300 patients with MDRTB in South Africa.(17)

JoAnn Carter from the non-government organization RESULTS was reported talking about drug-resistant TB. According to that publication, her comments included: "We know it's out there, but we don't know how much of it is out there. What you've seen in parts of the world with high rates of HIV is that that drives up TB rates enormously. So when you put together multidrug-resistant TB or extremely drug-resistant TB with HIV, it's really a potential explosion of a very deadly disease."(18)

Local government's response to TB has varied depending on its ability to respond economically and politically. Without the proper infrastructure like hospitals, clinics, and laboratories with equipment and supplies to treat the growing TB infected population, the ability to launch a full-scaled attack on TB is impossible. To draw attention to the TB epidemic and to steer resources to the countries needing help most, WHO developed direct observational therapy known as DOTS, the internationally recommended strategy for TB control. The cornerstone of this program is direct observation of therapy, making sure the full course of TB medicine is taken by the patient. DOTS also sets standards for identifying, tracking, and treating TB.(19)

Since DOTS started in 1995, country participation has increased steadily. In the last reporting year, 2005, more than 80% of humans in Africa lived within a DOTS coverage zone. Even with the program's theoretical coverage, the estimated number of deaths from TB have been reported to have increased from almost 200,000 in 1990 to over 500,000 in 2005.(19) These estimates are more than triple the benchmarks set by the 2015 Millennium Development Goals for TB control in the region.(2)

DOTS is not working as hoped in sub-Saharan Africa. With a reported 48% of humans with TB being treated and cured as the program's goal, adding the complication of HIV/AIDS to untreated humans will decrease lifespans considerably. Limiting DOTS therapy to smear-positive cases may have made sense in 1995 when HIV-related TB was limited to 4% of infected humans, but now HIV-related TB has more than tripled.(22)

Other program challenges face patients in many areas of sub-Saharan Africa. Only 10% of patients with TB are tested for HIV/AIDS, and routine testing for HIV/AIDS is not even offered in most TB clinics. This means patients have to go to 2 different locations to be tested and treated.(16) Additionally, too few healthcare workers are stretched thin by the burden of treating HIV/AIDS, and the cost of actually overseeing the DOTS program is more than the drugs needed to cure TB.(2) Many countries in this
region report no TB control education for physicians and nurses, no community based TB care, and no plan for HIV testing of TB patients.\(^{(19)}\)

Clearly, all of these programs require not only a plan, but also a way to pay for staff to administrate the programs, for equipment to diagnose illness, for buildings to house clinics, and for hospitals and drugs to treat the disease. Money for TB treatment and control comes from both public and private sources. Even though the total expenditure on healthcare has increased over the years, sub-Saharan Africa governments contribute on average about 50% of the funding while philanthropy and other forms of private money contribute the other 50%.\(^{(22)}\) While the way this money is spent are difficult to confirm, it is estimated that about two thirds of this money is earmarked for HIV/AIDS programs.

Global numbers reflect the increased attention of government and non-government agencies funneling more funding to TB control, but the gap in funding continues to grow.

With about 50% of all health care funding for sub-Saharan Africa coming from non-government funding sources, the role of philanthropy and private funding becomes an important underwriter of TB control and treatment in the region. Agencies are not anxious to discuss the impact HIV funding has had on TB and other "older" diseases, and data bases tracking sources of contributions are incomplete.

New drug development suffers a similar emphasis on HIV development compared with TB. Because of the proprietary nature of drug development, it is difficult to assess the complete picture. However, 2 independent sources illustrate the emphasis on HIV drug development compared with TB drug development as demonstrated in Table 2.

The global need for funding continues to grow. An assessment completed by The Global Fund estimates the amount of money needed to meet the Millennium Goals of 2015 for HIV/AIDS, TB, and malaria. The Global Fund contributes about 65% of the non-government global funding for TB and about 20% of the global non-government HIV/AIDS funding.

WHO estimates that more than 600 million humans will still be trapped in poverty in 2015. Many of these humans will be living in sub-Saharan Africa, where cramped living conditions, malnutrition, poor access to health care, and HIV/AIDS converge for an epidemic of TB. If funding continues at expected levels, insufficient resources will be available to fight this deadly disease. Added to the funding challenge is the questionable policy decisions of targeting only smear-positive TB through the DOTS program and government policies to keep HIV/AIDS treatment facilities separate from TB facilities.

Additional research is needed to target diagnosis and treatment options. An accurate and inexpensive method for detecting both smear-positive and smear-negative TB is urgently needed. Research into vaccines and newer, more effective drugs should be pursued. Second, government and policy makers should work together to remove artificial barriers to treatment by streamlining HIV/AIDS and TB treatment in one facility. Finally, global organizations should assess ways to transform the DOTS program into a model designed to succeed in areas with high HIV/AIDS infection rates.

TB killed in the days of the Pharos and continues to kill today. Certainly sub-Saharan Africa's future is dependent on taking steps now to stop the epidemic from spreading. But, given the ability of infectious diseases like TB to spread, it is in the world's interest to funnel resources into fighting this growing epidemic. If not, extremely XDR TB, will be a problem in every continent, every country.

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