

# innovations

TECHNOLOGY | GOVERNANCE | GLOBALIZATION

## Sharing the Health

### *Lead Essay*

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*commentaries by* Lawrence Summers; William Foege; Laurie Garrett; and  
Matthew Basilio & Connie Chen

### *Cases Authored by Innovators*

*The Aravind Eye Care System: Making Sight Affordable*  
V. Kasturi Rangan and R.D. Thulasiraj  
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*Institute for OneWorld Health: Seeking a Cure for Inequity  
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## Organization of the Journal

Each issue of *Innovations* consists of five sections:

1. **Invited essay.** An authoritative figure addresses an issue relating to innovation, emphasizing interactions between technology and governance in a global context.
2. **Cases authored by innovators.** Case narratives of innovations are authored either by, or in collaboration with, the innovators themselves. Each includes discussion of motivations, challenges, strategies, outcomes, and unintended consequences. Following each case narrative, we present commentary by an academic discussant. The discussant highlights the aspects of the innovation that are analytically most interesting, have the most significant implications for policy, and/or best illustrate reciprocal relationships between technology and governance.
3. **Analysis.** Accessible, policy-relevant research articles emphasize links between practice and policy—alternately, micro and macro scales of analysis. The development of meaningful indicators of the impact of innovations is an area of editorial emphasis.
4. **Perspectives on policy.** Analyses of innovations by large scale public actors—national governments and transnational organizations—address both success and failure of policy, informed by both empirical evidence and the experience of policy innovators. The development of improved modes of governance to facilitate and support innovations is an area of editorial focus.
5. **Letters.** Readers comment on essays and papers published in previous issues.

*Salmaan Keshavjee, Kwonjune Seung,  
Hind Satti, Jennifer Furin, Paul Farmer,  
Jim Yong Kim and Mercedes Becerra*

# Building Capacity for Multidrug-Resistant Tuberculosis Treatment Health Systems Strengthening in Lesotho

*The story of Teboho is typical of many tuberculosis (TB) patients in Lesotho. Teboho was first diagnosed with TB in 1981 when he was 18 years old. In those days, he had just started working in the mines in South Africa, a path followed by many of his compatriots. At that time, he was treated with medications for nine months; he had no recurrent symptoms until 1998. It was in that year that he began losing weight and developed a nagging cough that would not go away. Many of his friends—who also had worked in mines for most of their lives—*

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*coughed all the time, but they, like Teboho, thought it was because of the dust and the cold. Teboho's symptoms persisted and, when he finally could visit a doctor, Teboho was again told he had TB. Since his last bout with TB, the standard short-course regimens had been adopted and Teboho received this six-month treatment.*

*Teboho continued to work in the mines until 2004, when he developed a cough producing sputum streaked with blood. He went to his doctor who told him that he had TB yet again. Teboho undertook treatment for a third time. In early 2006, Teboho started to lose weight and experience fevers. He felt that he was sick but needed to keep working in order to send money home. When he went to see his doctor, he was diagnosed with TB for a fourth time and began yet another cycle of six months of treatment. This time, he was also told that he had HIV infection, and, this time, Teboho did not get better with the TB treatment. In late 2006, he went back to the doctors. The doctors gave him a second treatment for eight months (two months longer than his previous regimens), with one new drug: an injection for the first two months. They also sent him back to Lesotho. In mid-2007 Teboho was declared a treatment failure. He was unable to work and remained at home with his wife and son.*

*In October 2007, Teboho was diagnosed with multidrug-resistant tuberculosis (MDR-TB). In early November, he was admitted in critical condition to the TB hospital in Botsabelo (Maseru), with advanced AIDS and severe malnutrition. He soon fell into a coma from TB meningitis. After receiving aggressive therapy with second-line anti-TB medications and other antibiotics, intensive nutrition through a feeding tube, and round-the-clock nursing care, Teboho awoke after one week. His preliminary mycobacterial culture results eventually showed that he had the highly resistant form of MDR-TB, now known as XDR-TB.*

*If Teboho had presented to Botsabelo three months earlier, he would have died: there was no MDR-TB treatment facility there, there was no local laboratory capable of confirming his diagnosis, and the drugs required to treat his highly resistant TB were not available in the country.*

In 1978, the International Conference on Primary Health Care, meeting in Alma-Ata (Almaty, Kazakhstan) in the former USSR, issued a call to arms for governments, health and development workers, and the international community. It was a call to embrace the idea of health—defined by them as a state of complete physical, mental, and social well-being—as a fundamental human right, whose attainment would require the involvement of “many other social and economic sectors in addition to the health sector.”<sup>1</sup> This became known as the Alma-Ata Declaration, which recognized that “the existing gross inequality in the health status of people particularly between developed and developing countries as well as within countries is politically, socially and economically unacceptable and is, therefore, of common concern to all countries.” The document called for the “attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead

a socially and economically productive life.”

As we approach the end of the first decade of the new millennium, it is clear that while great strides have taken place since the laudable declaration in Alma-Ata, many of the world’s poor have continued to suffer and die from a host of preventable and treatable diseases, ranging from diarrheal and upper-respiratory infections, HIV infection, malaria, and tuberculosis (TB), to diabetes and heart disease. But delivering health care in some of the world’s poorest regions is not easy. Firstly, in many areas, the infrastructure required to support the delivery of patient services does not exist. Health care systems in developing countries are plagued by numerous challenges, which become roadblocks to successful delivery of care: overcrowding in existing clinics and hospitals; limited access to clean water; limited, if any, electricity; limited laboratory equipment; limited training for professionals; limited management and evaluation; and a weak drug and supply procurement system.<sup>2</sup> Secondly, even when infrastructural barriers can be overcome, disease, illness, and access to appropriate medical care are linked to large-scale social forces—structural factors—such as poverty, racism, gender inequality, political violence, and war, to name a few. For this reason, successful health care delivery requires that these factors too be sufficiently addressed.<sup>3,4,5,6,7,8</sup> Both infrastructural barriers and structural factors can be overcome by appropriate analyses—which allow discernment of how these factors limit access to care and how they become embodied at the level of the community, the individual, and even the microbe—and the implementation of programmatic solutions that ameliorate their effects.<sup>9,10,11,12,13,14,15,16</sup>

In recent years, there has been a marked increase in international and domestic funding and partnerships between non-governmental organizations (NGOs), global health initiatives (GHIs), governments, and communities directed towards addressing the health problems faced by poor countries. With the announcement of the Millennium Development Goals in 2000, there has been a push to reduce global poverty; to reduce infant, child, and maternal mortality; and to improve and scale-up access to treatment of specific diseases, including AIDS, TB and malaria.<sup>17,18</sup> GHI activities can range from financing institutions with specific programs to partnerships focused on resource mobilization and technical support. In order to maximize the full potential of GHIs, the World Health Organization (WHO) has called for them to invest in health systems in a manner that leads to health systems strengthening: “improving the capacity in critical components of health systems in order to get more equitable and sustained improvement across health services and outcomes.”<sup>19,20</sup> For this to happen, it means, “aligning with countries’ own plans and rules of engagement with partners,” and avoiding the creation of separate health system programs that lead to duplication and fragmentation.<sup>21</sup> It also means developing and building projects in a manner that can facilitate scale-up of successful interventions.<sup>22</sup> Many developing country governments themselves realize that in order to successfully deliver care for the myriad of diseases faced by their populations—both infectious and chronic—their health systems must be strengthened. Indeed, among 105 countries submitting Round 5 proposals to the

Global Fund to Fight AIDS, TB and Malaria (Global Fund) in 2005,<sup>23</sup> 30 countries requested assistance for health systems strengthening.<sup>24</sup>

In this discussion, we present the experience of a multi-drug resistant tuberculosis (MDR-TB) treatment program in Lesotho—a product of a GHI, international funding and international and local partnerships—as an example of a program whose aim is to :

(1) addresses a serious epidemic; (2) build capacity in the health sector through close integration with the national government; (3) address limitations in infrastructure and structural barriers to care; and (4) set the foundation for nationwide treatment expansion.

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Tuberculosis has been killing humans for millennia, and in many ways, is the quintessential disease of poverty, overcrowding and social marginalization; the association between TB and social structural factors has been well documented.

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Though targeting MDR-TB patients, including those co-infected with HIV, this experience can inform efforts to deliver other complex health interventions.

#### THE SPECTER OF DRUG-RESISTANT TB

Tuberculosis has been killing humans for millennia, and in many ways, is the quintessential disease of poverty, overcrowding and social marginalization; the association between TB and social structural factors has been well documented.<sup>25,26,27,28</sup>

The WHO estimates one third of the world's population is infected by *Mycobacterium tuberculosis*, the pathogen that causes TB: a treatable disease that kills more than 1.7 million persons every year.<sup>29,30</sup> In 1993, the WHO declared TB a global emergency, and adopted the DOTS strategy (directly observed therapy short-course) for TB treatment, which employed the supervised delivery of standard short-course regimens that could cure the great majority of TB patients.<sup>31</sup> Based on experience in Africa and Asia, DOTS was introduced as a global strategy with the aim of providing the best TB treatment available in the shortest possible time, and thereby preventing the development of drug-resistant TB and large numbers of “chronic cases.”<sup>32,33,34</sup>

Multi-drug resistant TB (MDR-TB) is defined as TB disease caused by strains resistant to isoniazid and rifampin, the two most powerful first-line drugs, which form the backbone of the short-course TB regimen. Although drug-resistant TB had been known for some time,<sup>35</sup> an epidemic of MDR-TB in New York City in the early 1990s, along with evaluations of TB treatment in a variety of settings, made it evident that in areas where resistance to first-line TB medications was high, some

patients had to be treated with regimens other than short-course regimens containing only first-line medications.<sup>36,37,38,39,40</sup> In fact, use of the standard regimens containing only first-line drugs was contributing to poor outcomes and unnecessary mortality.<sup>41,42,43,44</sup> Patients with MDR-TB required a more complex intervention, with 18 to 24 months of therapy using four to eight second-line medications, including daily injection for at least six months and aggressive management of adverse events.<sup>45,46,47,48,49,50,51</sup> This approach—tested in multiple pilot sites under the aegis of the WHO's Green Light Committee mechanism for MDR-TB<sup>52,53</sup>—along with programmatic interventions to overcome structural barriers to care, resulted in MDR-TB cure rates greater than 75 percent.<sup>54,55,56,57,58,59</sup>

Over the last decade, it has become clear that drug resistance poses a grave threat to global TB control,<sup>60,61,62</sup> with a total global burden of MDR-TB estimated at over 425,000 cases per year (4.3% of all TB cases).<sup>63</sup> Some strains of TB have acquired resistance beyond the 'simple' MDR-TB strains that were just resistant to isoniazid and rifampin, the backbone of the first-line TB regimen. These strains, referred to as extensively drug-resistant tuberculosis (XDR-TB),<sup>64</sup> are resistant to key first- and second-line anti-TB drugs. An outbreak of XDR-TB occurred in 2006 in the South African province of KwaZulu-Natal, resulting in a 98 percent case fatality rate among patients with HIV disease.<sup>65</sup>

This glimpse of the pre-antibiotic era was a reminder that, complex though MDR-TB may be to treat, if left unattended, it is a problem that will become worse.<sup>66</sup> In order to stem the tide of MDR-TB and XDR-TB, the WHO has called for the integration of the treatment of drug-resistant TB into national TB control strategies.<sup>67</sup> However, in order to be able to treat drug-resistant TB, programs need to have proper diagnostic tests, access to second-line anti-TB drugs, and a system of delivering care and managing adverse events over the two-year period of treatment that most patients will require.

In the area of diagnostics, this means access to mycobacteriology laboratories capable of performing cellular culture. In regions with high rates of TB drug resistance, the ideal laboratory would employ newer liquid-based culture techniques, capable of providing culture results in two to three weeks, rather than the eight to twelve weeks required by older solid-medium cell-culture methods. Additionally, in countries with high prevalence of both drug-resistant TB and HIV, programs would ideally employ rapid DNA-based techniques for the identification of MDR-TB (resistance to at least isoniazid and rifampin). This would permit clinicians to start patients on empiric therapy as early as possible, while waiting for results of sensitivity testing to other drugs. For access to second-line anti-TB medications, programs need sufficient technical assistance and programmatic organization in order to apply for quality-assured drugs provided at concessionary pricing through the MDR-TB Green Light Committee mechanism.<sup>68</sup> And lastly, programs need to be able to create and sustain a system of care delivery that can provide patients with medications given under direct observation, at least twice daily. This not only requires appropriate human resources and training of staff to identify and manage the sometimes life-threatening adverse events associated with MDR-TB



**ROLES AND RELATIONSHIPS**

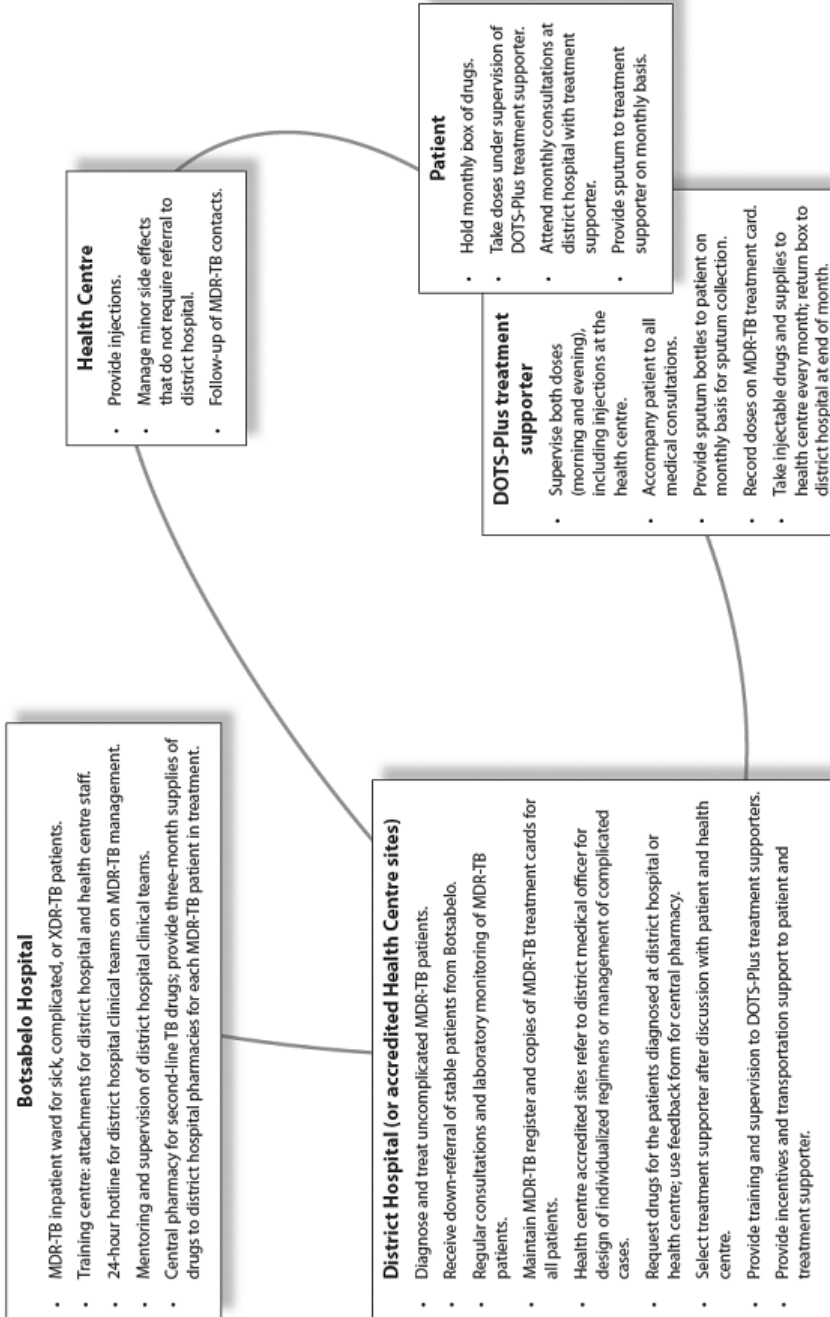


Figure 2. Components of the Lesotho Multidrug-Resistant Tuberculosis Treatment Program

gram would find programmatic solutions to structural barriers that limited the ability of patients to complete treatment. Below, we describe how each intervention strengthened a specific area of the health system.

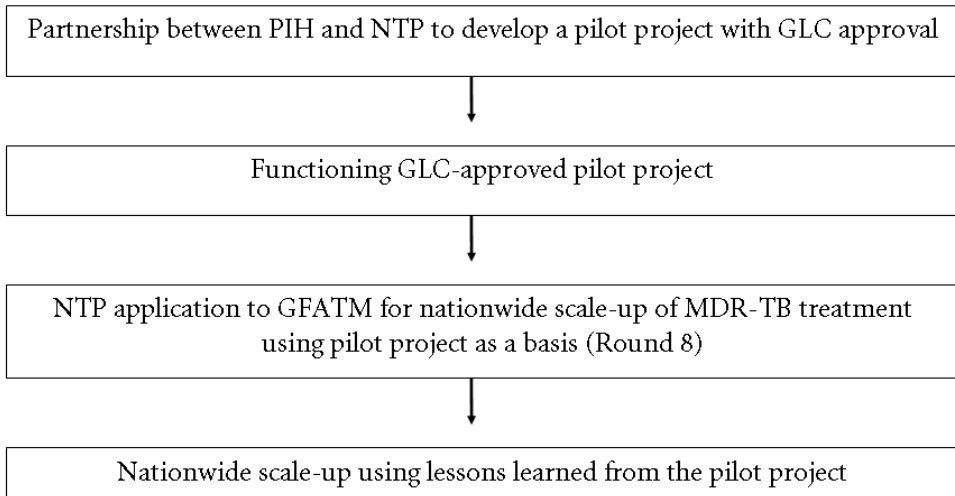
### **1. Health policy, regulatory, and strategic planning functions, including the development of institutions and organizational arrangements**

The MoHSW was eager to develop a country-level plan to treat MDR-TB, which included guidelines for the treatment of MDR-TB in the setting of high HIV prevalence. By September 2006, working with local NGOs including PIH, the MoHSW defined national protocols for the treatment of drug-resistant TB based on international guidelines.<sup>74</sup> Among the national plan's functions was to clarify the roles of the project partners:

- The National TB Program of the MoHSW provided policy leadership and political will to implement the new national guidelines, and willingness to refurbish or build the infrastructure for implementing these guidelines. The MoHSW was also responsible for linkages with other key ministries involved in the project.
- PIH provided seed funding, technical expertise on MDR-TB and HIV treatment, a full-time project director, consulting clinicians, and coordination and management of the project and grant funds.
- The Open Society Institute provided a three-year grant that would finance medicines, staff, and the refurbishment of the pharmacy, the hospital, the laboratory, the outpatient clinic, and the community-level program.
- FIND provided technical expertise (a full-time on-site laboratory specialist who will remain in Lesotho for 18 to 24 months) as well as liquid-medium cell culture equipment and necessary supplies for initial operations.
- The WHO provided political support through its international, country and regional representatives.

### **2. Mobilization and allocation of financial resources**

While PIH provided seed funding for initial coordination and operations, three key partnerships helped mobilize important financial resources. Firstly, PIH worked closely with the National TB Program to submit an application for treatment of an initial cohort of MDR-TB patients to the Green Light Committee of the STOP-TB Partnership. This application allowed the National TB Program to access technical assistance from the WHO, as well as concessionally priced quality-assured second-line anti-TB medications through the Global Drug Facility (GDF). Additionally, since Lesotho is one of the poorest countries in the world, the Green Light Committee application resulted in the activation of UNITAID funding for all the drugs needed to treat the first 100 patients.<sup>75</sup> Secondly, and in parallel to the Green Light Committee application, PIH successfully sought funding from the Open Society Institute to create a pilot program in Lesotho that would provide relevant policy and programmatic guidance for other parts of sub-Saharan Africa. The Open Society Institute's substantial commitment allowed the project to begin.



**Figure 3.** Plan for securing long-term funding for the tuberculosis treatment

This grant funded the refurbishment of the National TB Reference Laboratory, the pharmacy, the outpatient clinic, the Botsabelo MDR-TB Referral Hospital, and the national TB pharmacy. In addition, a number of staff positions are being funded by the Open Society Institute grant in the first two years of the project, with the Government of Lesotho slated to fund these positions subsequently. Thirdly, a partnership between the MoHSW and FIND secured funding for full-time on-site technical assistance for the National TB Reference Laboratory, as well as the provision of key equipment and reagents. This funding and partnership made the rapid building of laboratory capacity a reality in Lesotho.

With these funding streams and partnerships in place, the MoHSW was able to commit its own funds to the provision of ancillary support and medications for the program. It also set up the framework to use existing TB program funds allocated by the Global Fund. Plans are now underway for the MoHSW and the Government of Lesotho to apply for a Global Fund Round 8 grant to support ongoing drug-resistant TB treatment program activities (see Figure 3). This will build on an emerging country coordination mechanism which will include all partners involved in TB control, including the MOHSW, PIH, WHO, Médecins Sans Frontières, and the U.S. Centers for Disease Control and Prevention (CDC).

### **3. Mobilization and allocation of human resources**

Human resources for health care are scarce in Lesotho, with the country facing a shortage of physicians, nurses, and allied health professionals. Long-term staffing is required for all the MDR-TB facilities involved in the project. As part of human-resource development and capacity-building, the following locally based staff were

hired for the MDR-TB program to date: a community coordinator (1) treatment supporters (25), physicians (2) driver (1), pharmacist (1), laboratory technicians (3), data entry clerks (2), registered nurses (4), nursing assistants (4), ward attendants (5), and cleaners (2). In the near future, an accountant, logistician and second community coordinator will be hired. Although drawn from existing workers of the MoHSW, almost all of the MDR-TB program positions are new and will remain on the rosters of the MoHSW.

Because MDR-TB had not previously been an integrated component of TB care at the national level in Lesotho, all staff—both at the TB facilities and at key entry points in the general health care system (see Figure 2)—needed to be trained appropriately. Senior MoHSW staff, local health officers, nurses, and nursing assistants from central and district hospitals received intensive training in the identification and referral of MDR-TB patients, as well as the treatment and monitoring of patients. Training was conducted using the national guidelines, PIH training materials on MDR-TB including the PIH manuals,<sup>76,77</sup> and materials developed specifically for Lesotho.<sup>78</sup> All training is slated to be ongoing at regular intervals.

One of the most important elements of a successful community-based treatment program is the training of the treatment supporters. In other settings, the experience of PIH has been that patients with illnesses such as MDR-TB—requiring toxic and often noxious medications—fare better with daily support. Providing daily therapy given under direct observation has been PIH's standard approach for patients with MDR-TB and it can be applied to patients co-infected with HIV, especially those who experience circumstances which might adversely affect their ability to adhere to their medication regimens. The treatment supporter's role is focused on patients with active disease who are receiving therapy, and to complement the efforts of physicians and nurses, as an extension of the clinic in the community. These paid workers are initially trained on the basic treatment of MDR-TB, the early identification of potentially life-threatening adverse events, and the treatment of common adverse events. Because of the high rate of HIV co-infection among patients with MDR-TB, the treatment supporters also receive training in the delivery of HIV care and the identification of other illnesses. They receive monthly continuous education sessions from the community coordinators. The training of treatment supporters is perhaps the best example of how human-resource capacity is being expanded to provide high-quality care in the community.

For the National TB Reference Laboratory, in addition to the staff listed above, the MoHSW also hired two additional laboratory technicians using funding obtained through the U.S. CDC. All staff has received intensive training from the on-site laboratory specialist placed by FIND. The lab technicians have received on-the-job microscopy and culture training using the two laboratory training manuals (the Quality Assurance Training Manual and the Smear Microscopy Training Manual) created in early 2007 for this project and approved by the MOHSW for use throughout Lesotho. The FIND laboratory consultant has also used these manuals to train lab technicians at each district hospital in Lesotho, in order to

strengthen the system of mycobacterial smear microscopy needed for general TB surveillance. The availability of this full-time consultant on site has permitted ongoing interactions and staff development in a way that would not have been possible had the interactions been brief ones over the same period.

A major factor in human resources retention is to ensure that staff receive appropriate remuneration (e.g. hazard pay for those at risk) and are given the appropriate tools to do their work (e.g. training, transportation, respiratory protection masks to reduce the risk of infection). Our hope is that seeing the effects of their work will motivate staff to stay and develop their skills further.

#### **4. Disease diagnosis**

The diagnosis of MDR-TB and the subsequent delivery of MDR-TB care require a number of important components to work seamlessly together. The first component is the mycobacteriology laboratory capable of performing mycobacterial cell culture and TB drug-sensitivity testing, the linchpin of TB drug-resistance diagnosis. As mentioned previously, at the start of this initiative in late 2006, the national TB laboratory did not have the capacity to perform sputum culture or drug-sensitivity testing and so was essentially unable to diagnose MDR-TB or other drug-resistant TB. Mycobacterial culture is also required for follow-up during treatment,<sup>76,78</sup> especially for HIV co-infected patients for whom sputum smear microscopy is likely to be inadequate.<sup>79</sup>

In many low-income settings, mycobacteriology laboratory facilities have been viewed as beyond the financial and technical reach of the country. Instead, in the past, countries have been encouraged to send their sputum samples to supra-national reference laboratories for analysis, which is what Lesotho had been doing. While this system was able to work when MDR-TB was an insignificant problem, it became clear that if Lesotho was expecting close to 1000 cases of MDR-TB each year, the country would need its own mycobacterial culture and drug-sensitivity testing capabilities. With this in mind, the National TB Program, working with PIH and FIND, decided to embark on a program of renovation and retraining in the National TB Reference Laboratory. While the laboratory was being refurbished, the Medical Research Council in Pretoria, South Africa, which is Lesotho's supra-national reference laboratory, continued to perform cell culture on sputum samples from Lesotho.

The original laboratory had two work rooms, one office, and a single waiting area with no infection control measures in place. Based on guidance from the FIND consultants, a modular office space was rented (a trailer) to house the Principal Lab Technologist and the consultant from FIND. From the existing lab space, five rooms were created, including a separate microscopy room, a room for media preparation, a culture room with space for the MGIT 960 machine (automated rapid culture machine), and a room for autoclave sterilization. A state-of-the-art negative air pressure system was installed in the culture room to minimize the risk of transmission of pathogens to laboratory staff when handling specimens. The equipment inside the lab now includes three bio-safety cabinets (class II with

ducting to outside), a large autoclave with exhaust, a refrigerator, two incubators, one culture preparation machine, and one centrifuge. Additionally, air conditioning has been introduced where necessary, plumbing has been restructured to accommodate the water pressure required for extra work sinks and the autoclave, the electric supply has been upgraded, and work benches have been installed in all rooms. In short, the laboratory was transformed into an international-standard facility capable of meeting Lesotho's mycobacterial culture and drug-sensitivity testing needs for the foreseeable future. Lesotho's National TB Reference Laboratory is currently performing solid-media culture and first-line drug sensitivity testing, and has recently started performing parallel tests using more rapid liquid media culture techniques using equipment provided by FIND.

### **5. Management and delivery of health services**

The next major component of care delivery is to have appropriate facilities for patients with MDR-TB. The Botsabelo TB Clinic is the major TB referral clinic facility for the country (one third of the nation's more than 10,000 TB patients are seen here). In 2006, a lack of infection control measures at this clinic was identified as a major concern: the entire clinic was carpeted; there was insufficient ventilation; there was a single waiting area for new patients and those returning for follow-up visits, thereby creating opportunities for re-infection. Refurbishment included re-flooring of the clinic, the consultation rooms, and the pharmacy and the installation of appropriate ventilation. Administrative controls included the scheduling of new TB patients on different days than follow-up patients; MDR-TB suspects were also given a dedicated clinical time slot.

Although this new MDR-TB treatment program was envisioned as primarily an outpatient program, it became clear very early in the planning process that, given the high level of HIV co-infection, malnutrition, and advanced TB disease, some patients will require hospital level care. Once this need was identified, the MoHSW approved as part of this initiative the refurbishment of a leprosy hospital at Bostabelo, Maseru. Refurbishment of the Botsabelo MDR-TB Hospital was completed in September 2007, and the facility is now fully operational. Botsabelo Hospital was converted to a 20-bed facility for the treatment of critically ill MDR-TB and MDR-TB/HIV co-infected patients. This facility will also serve as the core facility for training in the management of MDR-TB/HIV co-infection. Prior to renovation, the hospital was in reasonable physical shape, but had no adequate infection control mechanisms in place. Additionally, it lacked appropriate toilet and shower facilities, family or visiting areas, and a functional nurses' station. A sophisticated ventilation system that meets international standards was installed at Botsabelo MDR-TB hospital to minimize the risk of infection transmission and cross-infection among the medical staff and patients. The refurbishment also included the creation of a family room for patients, separation of the TB Unit from a nearby HIV Unit on the same hospital grounds, updated toilet and shower facilities, and creation of a pleasant and humane environment, including an outdoor veranda and sitting area, for patients undergoing long-term treatment. Critically ill

patients with advanced disease and/or severe adverse events are now admitted to the Botsabelo MDR-TB Hospital, where they can receive care around the clock. The Botsabelo MDR-TB Hospital has essentially become the equivalent of a hospital step-down unit where critically ill patients can be stabilized and discharged to community-level care delivered by treatment supporters.

Although patients may require hospitalization at some point during their treatment, the majority of MDR-TB treatment is being provided at the community level. This care is delivered by paid and carefully trained treatment supporters who visit patients in their homes twice a day. Patients with very advanced disease and who are living long distances from health centers are provided with furnished temporary accommodations near a public health center. All patients receiving MDR-TB drugs also receive supplemental medicines and lab tests, food packages, and transportation vouchers; all treatment and supplemental services are provided free of charge to the patient and family. The program ensures that patients have enough food, cooking fuel, and clean water for themselves and their families. Since some of the second-line anti-TB medications can be toxic for infants, lactating mothers are provided with infant formula (in addition to the fuel and clean water that they are already receiving).

## **6. Management of drug supply**

Since MDR-TB patients receive combinations of three to five medications for two years, some of which have short expiry dates, programs need to have a pharmacy system that can properly store and distribute medications and an information system to control stock. The National TB Program approved the building of a Central TB Pharmacy on the Botsabelo clinic grounds. This pharmacy stores and distributes MDR-TB and supplemental drugs for all MDR-TB patients in the pilot program, and has the space and capacity to do so for the whole country. A software application has been purchased for the central pharmacy to manage information about patient medication use and stock levels.

## **7. Data and information management**

The improvement of the organization, management and quality of the services that MDR-TB patients are receiving is being ensured by the development and use of written protocols and patient forms. These detailed procedures and forms include those required to enroll and discharge patients, hospitalize those that require it, deliver daily doses at home or in hospital, and manage specific adverse events at home or in hospital. While based on standard procedures and forms developed and tested elsewhere,<sup>78,79</sup> forms used in Lesotho have been adapted to local requirements and have been approved by the MoHSW as standard forms for the national TB program. In addition to paper forms, a secure electronic database based on PIH's previous experience is being developed to capture essential clinical information.<sup>80</sup>

AIMING HIGH

The first patients began treatment under the MDR-TB pilot program on July 29, 2007, and the first patients were admitted to Botsabelo Hospital on September 30, 2007. As of the end of December 2007, 43 patients with MDR-TB have been initiated on treatment, three of whom had XDR-TB, and 65 percent of whom have HIV co-infection or disease. Eighty percent of the patients are alive and remain on treatment.

The MDR-TB treatment initiative in Lesotho to date is a modest one in the face of the overwhelming need in the region. Yet, it is a first step that provides a number of important lessons. Firstly, in order for a program to have any potential of

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[I]n order for a program to have any potential of achieving national expansion, it has to be fully integrated within the planning and implementation mechanisms of the government or other large care-providers.

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achieving national expansion, it has to be fully integrated within the planning and implementation mechanisms of the government or other large care-providers. This was also PIH's experience with MDR-TB treatment in Peru and Russia.<sup>11,54,55</sup> This approach requires close collaboration with the relevant ministries and close coordination between national and international partners. From the creation of national protocols to the hiring of staff, PIH has worked closely with the NTP to ensure that the use of existing resources (human and other) are optimized, and that

new facets of the interventions become a permanent part of the health system.

Secondly, we have seen that if approached properly, complex health interventions such as the treatment of MDR-TB can be used to strengthen health systems. Both diseases and health systems are the product of social, economic and political forces. As much as the presence of highly drug-resistant TB (MDR-TB and XDR-TB) speaks to the poverty and marginalization of populations who bear the greatest burden of TB disease, it is also emblematic of a weakened health system facing the extreme outcome of a poorly controlled TB epidemic.<sup>81</sup> The inadequate health care infrastructure—lack of laboratory capacity, lack of hospital facilities, lack of care delivery systems—and thus, a government's inability to respond alone to the epidemic effectively, is part of the same political economy that created the poverty, inequality and migration that ensures a pool of vulnerable individuals. As we have done elsewhere, this MDR-TB program has attempted to remediate the effects of these social forces by building both health system infrastructure and care delivery systems that help patients begin to overcome the many barriers limiting access to appropriate and effective care.<sup>55,82</sup>

Thirdly, this experience indicates that, if approached properly, complex health interventions such as the treatment of MDR-TB can bring important resources to bear on the health problems of a country, by bringing together different levels of government in partnership with bilateral agencies and institutions of global civil society. Because of the partnership that has grown around MDR-TB in Lesotho—and the resulting community-based pilot project with appropriate hospital, laboratory, and pharmacy back-up—the country will now be able to make a strong case to donors such as the Global Fund for nationwide expansion of MDR-TB treatment as part of an integrated TB-HIV control approach.

Fourth, the insights revealed by building capacity for MDR-TB care are not limited to one disease. In many ways, this experience can serve as a model for the delivery of care for other diseases.

The complexity of care required for its successful treatment—from appropriate diagnostic modalities to sophisticated community-based care-delivery systems—requires a functioning health system that can provide the required components of a treatment over a long time period. These components are also required for the treatment of HIV, asthma, diabetes, heart disease, mental illness, and other chronic illnesses. While some may caution that approaching a health system

through a single disease has limitations, it must be remembered that health system strengthening cannot happen overnight. Rather, it is a process for which complex health interventions such as MDR-TB can be an important entry point. The vast need for trained health workers at all levels of the health system will require major new investment and initiatives. But as an initial step, the system of treatment supporters delivering MDR-TB and HIV care—an extension of the clinic in the community—can be used as a platform for providing other health services for other illnesses.<sup>15,83</sup>

In sum, we conclude that with essential and appropriate technology—in this case, “appropriate” does not mean relegating communities and countries to their position in the global economy—complex health interventions can be delivered successfully, even in severely resource-limited settings, to respond to epidemics like drug-resistant TB. These technologies encompass state-of-the-art laboratory equipment and infection control, both of which have now set the bar high for similar interventions in Lesotho and elsewhere. They also encompass the information technologies and the project and partnership management skills required to strengthen infrastructure at various physical, human, and psychological levels. Building capacity for interventions like MDR-TB care can invigorate health sys-

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[T]he insights revealed by building capacity for MDR-TB care are not limited to one disease. In many ways, this experience can serve as a model for the delivery of care for other diseases.

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tems and allow them to leap beyond their current capabilities. When the challenge is to deliver life-saving medical care to poor populations, including those in the United States,<sup>84</sup> one way to make that leap is to remove the obstacles created by poverty and inequality through innovative programmatic solutions. The MDR-TB epidemic, like the HIV epidemic, is a reminder that we are long overdue to meet the goals outlined in Alma-Ata.<sup>85</sup>

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