


Fall 12-1-2014

Evaluating Current Management of Drug-Resistant Tuberculosis in Mumbai, India

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Evaluating Current Management of Drug-Resistant Tuberculosis in Mumbai, India

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Fall 2014

TABLE OF CONTENTS

1.0 Abstract...	3
2.0 Introduction...	3
3.0 Methodology...	6
4.0 Private Sector...	6
4.1 Private Practitioners...	7
4.2 Private Drug Market...	8
4.3 Private Sector Suggestions...	12
5.0 NGO Involvement...	13
5.1 CRHP...	14
5.2 The Jamkhed Model...	15
5.3 Jamkhed Success Aspects...	17
5.4 LMM Program Setup...	18
5.5 LMM Defaulters and Default Prevention...	20
5.6 LMM Private Practitioners...	23
5.7 LMM Conclusions...	23
6.0 DR-TB/HIV Comorbidity...	24
7.0 Case Study...	25
8.0 Conclusion...	27
9.0 Acknowledgements...	29
10.0 Recommendations for Future Study...	29
Works Cited...	30

1.0 ABSTRACT

This research was aimed at analyzing the current state of drug resistant tuberculosis in Mumbai and how effectively different actors in the realm of public health are managing DR-TB. The methods for this project involved a variety of semi-structured interviews as well as field observation. Key findings show a very present and largely negative private sector influence, effective NGO models for disease control, a burden of DR-TB/HIV co-morbidity, and a rapid increase to transmission-based spread of DR-TB. Key implications of conclusions include the necessity of increasing the private sector's compliance with WHO standards, adaptation of community and education based NGO models for disease control, allocation of resources towards DR-TB/HIV patients, and focus on transmission-based disease prevention.

2.0 INTRODUCTION

Tuberculosis (TB) is a curable infectious disease caused by mycobacteria, generally affecting the lungs. According to the most recent WHO data, there are 2,600,000 cases of TB in India and 58% rate of case detection (India). More alarmingly, India is top three globally for prevalence of multiple drug-resistant TB (MDR-TB), or infection with TB strains that have developed antibiotic resistance (Tuberculosis). In India, 2.2% of new TB cases are reported with MDR-TB, along with 15% of retreatment cases (India). MDR-TB is commonly caused by mismanagement of drug-susceptible TB cases, which further emphasizes the importance of proper tuberculosis programs (Tuberculosis).

According to recent data, TB accounts for 15% of deaths in Mumbai, a major metropolitan setting in India. In a study undertaken by the Revised National Tuberculosis

Control Programme (RNTCP), 24% of previously untreated patients in Mumbai were found to be MDR as well as 41% of retreatment cases (D'souza). The prevalence and severity of MDR-TB in Mumbai are some of the highest in India: “since TB is a disease with strong socio-economic determinants, with demonstrated association between poverty, over-crowding and inadequate access to quality health care services, the marginalised populations from large Indian cities like Mumbai are highly vulnerable to infection and to MDR TB” (Pradhan). The question this research aims to answer is: how well is DR-TB being managed in Mumbai? What are the challenges facing the control of DR-TB in Mumbai and how are they being interacted with by different players in the realm of public health? What influence do different components of the private and public sectors have on DR-TB care in Mumbai, and how do patients navigate these spaces?

Since there is a high prevalence of drug resistant TB in the area and there has been ample research conducted on the topic of TB in Mumbai, it is an apt area to do research on this topic. Studies addressing the causes of high incidence rates of drug resistance have pointed to several common themes in Mumbai. When DOTS is used to treat drug susceptible strains of TB, it is generally effective. However, in India, 4% of the anti-TB drug market is private and unregulated by the government, not required to follow DOTS protocol (Ecks). Much research indicates lack of regulation within the private sector of TB treatment as a major factor in the prevalence of drug resistant TB, one 2010 study even finding that among 106 doctors in Mumbai, only 6 were able to prescribe an appropriate drug resistant TB regimen (Udwadia 2010). To aggravate the issue, patients with DR-TB are more likely to seek treatment with private practitioners (Udwadia 2011).

Next, susceptibility tests are not often used so drug resistant strains are ineffectively handled (Almeida). In Mumbai, people with drug resistant strains of TB are living among the general populace, in a densely populated area, which intensifies the spread of DR strains (e.g. initial resistance cases). Also related to the urban setting is the wide availability of treatment options; in the city of Mumbai, patients have access to a variety of private and public practitioners, and have opportunity to mix and match drugs, treatments regimens, and diagnoses from various medical sources (Almeida). In addition, some studies suggest that DOTS Plus may not be a viable option based on the extensive monitoring and testing infrastructure needed for its effective implementation (Almeida). Recent research has shown that by 2015, “42% of new MDR cases are transmission-generated and this proportion continues to rise over time” (Suen). This means as time passes, control of drug susceptible TB cases becomes less effective in curtailing the spread of MDR-TB.

A study on DR-TB suggested that major challenges facing MDR-TB control in India include “diagnosis of TB and defining cure, detecting drug resistant TB, multiple sources of health care in the private, public and informal sectors, co- infection with human immunodeficiency virus (HIV) and a concurrent epidemic of non-communicable diseases, suboptimal prescribing practices, and infection control” (Mistry). This research will attempt to analyze the current state of MDR-TB control in Mumbai.

3.0 METHODOLOGY

This research was completed through the use of semi-structured interviews as well as field observation. Respondents included 5 members of two different NGOs who had various responsibilities, including TB prevention program directors, NGO director,

record keeping, and administrative member. Other interviewees included a DR-TB patient and an associated doctor, a mobile health team (MHT) member and a village health worker (VHW) for a total of 9 respondents. The names of the respondents and organizations have been changed in some instances to protect the identity of participants.

4.0 PRIVATE SECTOR

In 2006, WHO called for an increase in Public–Private Mixes (PPMs) when dealing with DR-TB in India, saying PPMs were one of the “core components of the Stop TB strategy” because “a partnership between government and non-NTP sector could thus be useful for making best use of existing resources, to achieve scale, while maintaining quality and positive outcomes” (PPM Toolkit). Partnership between government and private care within the field of DR-TB could aid in standardizing care and more effectively combatting the spread of drug resistance.

4.1 Private Practitioners

The necessity of engaging private practitioners in Mumbai with WHO guidelines for DR-TB treatment is not a new call to action. In 1991, a study of private practitioners in the vicinity of the Dharavi slum in Mumbai found that among 100 doctors, 80 different treatment regimes were recommended for treatment of drug-susceptible TB (Uplekar). Unregulated and haphazard first line TB treatment as highlighted in the 1991 study has traditionally been one of the primary causes for the spread of DR-TB (WHO).

A more recent 2010 study in the same slum area in Mumbai has shown that similarly unregulated prescribing practices have persisted (Udwadia ZF). In this study,

106 private doctors were asked to write a first-line drug regimen for a TB patient, including type of drugs, doses, and duration. Of these 106 providers, only 6 produced an accurate TB treatment. In total, 63 different drug regimens for a first time TB patient were “prescribed.” Not only has mismanagement of drug-susceptible TB cases continued over the past two decades, this study also engaged private management of DR-TB cases, finding similar results. Of the same 106 practitioners from the private sector, only 5 correctly prescribed a drug regimen for a TB patient resistant to the first line drugs isoniazid and rifampicin. 12 percent of respondents suggested continuing exclusively first line drugs for DR-TB, while 23 percent were unable to produce any drug regimen whatsoever (Udwadia ZF).

Despite research indicating poor DR-TB treatment in the private sector, some reports have shown it is common for DR-TB patient in Mumbai to seek initial treatment with private practices because of “a negative perception of government-run health facilities, due to long waiting periods, rude treatment, and the stigma associated with tuberculosis” (Loewenberg, Udwadia 2011). In Mumbai alone, inappropriate management of MDR-TB patients has led to development of totally-drug resistant TB (TDR-TB) in 12 reported cases in 2012 (Loewenberg). These new developments in drug resistance have led to the suggestion of some researchers that DR-TB only be treated “within the confines of government- sanctioned DOTS-Plus programs to prevent the emergence and spread of this untreatable form of tuberculosis” (Loewenberg).

4.2 Private Drug Market

Outside of a large presence of private practices treating TB, India also has a large private market for anti-tubercular drugs, for both TB and DR-TB. This in itself is unusual, as many countries do not have a prevalent private market for TB drugs. In fact, in the United States, United Kingdom, France, Japan, and several other high-income countries, there is no private market at all for anti-tubercular drugs (Ecks). Lupin Ltd., establishing itself in the private anti-tubercular market in 1968, has dominated the field since the 1990s. Lupin markets both single drugs and combo packages of drug regimens adhering to WHO's treatment guidelines. 74 percent of India's TB drug market is private with a large portion of this being controlled by Lupin (Ecks). Therefore, the behaviors of this firm have huge implications on the control of DR-TB in India.

Lupin has a lot of power in the private sector of DR-TB, both from an economic pharmaceutical perspective, but also in the influence they have over physicians prescribing practices. In *Public-Private Mixes: The Market for Anti-Tubercular Drugs in India*, many of the interviews with Lupin employees, mainly medical representatives (MRs), demonstrated in that most felt there was a sense of social commitment associated with their position. One MR explained Lupin MRs were not just pharmaceutical sales representatives and that "his aspiration to fight tuberculosis transcended his day-to-day job" (Ecks). This sense of social pride seems to stem from Lupin's global leading position manufacturing rifampicin and ethambutol as well as the company's reputation for high quality products. This allows MRs the sense of advocating for the best public

health measures instead of simply using capitalist practices to market brand name pharmaceuticals for company profit.

Despite the integrity associated with the Lupin MR position, MRs reported using significant amounts of money to ensure that marketing quotas were met and that doctors were willing to prescribe Lupin pharmaceuticals, saying “newly recruited reps have to give up half their salaries to doctors and retailers to achieve their sales targets” (Ecks). Some even reported that Lupin employees in management positions resorting to questionable money exchanges to meet targets.

Other marketing behaviors of Lupin demonstrate why capitalism in the DR-TB realm may not produce the best results for public health at large. Lupin makes more profit supplying private practitioners than it would supplying for public DOTS programs, so the company’s efforts are focused on promoting their own products, and therefore the predominance of the private sector. Lupin markets their drugs to government practitioners to influence them to suggest non-DOTS drug regimens to government patients, as well as patients in their private practices. Lupin MRs have noted that private practices were more likely to experiment with drug regimens and stray from DOTS protocol. Individual drugs produced more profit for Lupin, as opposed to fixed drug combinations that adhered to WHO guidelines, so private experimentation, as harmful as it may be to public health, is encouraged by Lupin because of pharmaceutical sales (Ecks).

Lupin MRs see several reasons for private practices veering from WHO recommended TB regimens, both for drug susceptible and resistant cases (Ecks). In the experience of MRs, specialized private doctors were most likely to do so because of their

education level; they felt qualified for experimentation and choice in their treatment regimens. Other reasoning given included better ability to control anti-tubercular drug side effects by brainstorming different combinations of TB pharmaceuticals. Most importantly perhaps was that private practitioners and specialists have more time per patient than government doctors and so are able to try take a more individualized approach. A major complaint among private doctors is the lack of dosage flexibility within the DOTS system, not allowing for treatments personalized to the patients' specific needs. MRs found specialized private practitioners most receptive to their drug advice, and favored their business because of their willingness to deviate in prescribing practices (Ecks).

Despite compliance with WHO standards, ethnographic research on Lupin Ltd. has highlighted the company's poor opinions of the DOTS and DOTS-Plus programs. Part of this resistance could stem from the perceived threat of DOTS in terms of Lupin profit yield. MR critiques of the program ranged from implementation of the program to actual structure. The centers, in the MRs' opinions, were not functioning properly, and if they were, they were not advertised well enough so the people who need to take advantage of them were not aware of their presence. In addition, they viewed DOTS workers as under-performing and not in congruence with WHO protocol. In theory they believed observation treatment to be an effective method but commonly felt like this aspect of DOTS workers' duties was being shirked. Furthermore, they critiqued the perceived existence of quotas within in the DOTS system, that they felt encouraged workers to falsify data to produce more positive results (Ecks).

In terms of actual program set-up, there were many complaints as well (Ecks). Importantly, Lupin employees found the heavy use of sputum smear tests to be a poor choice of diagnostic test because of its inability to detect certain kinds of TB, such as bone and abdominal TB. The lack of flexibility that existed within the drug scheduling was incredibly limiting to a number of patients. Since patients need to attend a DOTS center to have medication administered to them three times a week, any sort of extended travel prohibited a patient from executing their drug regime effectively. However, the three times per week TB medicine dosage, called intermittent therapy, also received criticism compared to the more commonly private prescription of daily therapy. Three times a week was not deemed a regular enough schedule to be convenient for patients. In addition, missing one dose of intermittent therapy was the equivalent of missing several days of daily therapy, and therefore harmed the patients' health to a more serious extent. Finally DOTS mandated an unnecessary amount of paperwork to be filed per patient, which deterred private physicians from willingly opting for this protocol (Ecks).

In terms of DOTS Plus, which was recently implemented in Mumbai, MRs were critical that the centers were not capable of detecting, diagnosing or treating patients who displayed signs of drug resistance, that is was too difficult to get a center approved as DOTS Plus, but the approved ones were not functioning properly.

Grounded or not as some of the claims may be, this data primarily shows the lack of private corporate interest in the success of the DOTS/DOTS Plus programs. Given the large impact of Lupin behaviors on the public health realm of TB, the employees' apparent disdain for DOTS programs is particularly concerning.

4.3 Private Sector Suggestions

Because of the largely negative impact of the private sector in the management of DR-TB, the WHO call for an increase in PPMs in the DR-TB public health realm has been called “a desperate grip to get a hold on a sprawling private market” more than a teamwork exercise, in a 2010 study on India’s private TB pharmaceutical market (Ecks). For some DOTs promoting TB officials, the efforts for an increase in PPMs are only “aimed at gradually smoking out treatments by private practitioners” (Ecks). While minimizing current private treatment behaviors is certainly beneficial from a public health perspective, eliminating private involvement completely does not have to be the end goal.

Ecks and Harper, coauthors of *Public-Private Mixes*, argue that TB/DR-TB treatment could be much more effectively managed if the private sector was assimilated into DOTS aligned programs, instead of eliminated. Their research shows that although there has been an increase of WHO compliant prescribing among private practitioners in past years, it is not a result of public sector influence or an increase in PPM efforts. On the contrary, “increasing numbers of WHO-endorsed kits and fixed-dose combinations in the private market” had the largest influence on private doctor prescribing practices (Ecks). To take advantage of this important impact potential of the private sector, Ecks and Harper have some suggestions. Since the TB drug market is relatively stagnate as a result of few new drugs being introduced, partnership with DOTS programs could be offered to large companies such as Lupin Ltd. as a way to remain in a dominant position in the private market. Other solutions aimed at harnessing the power of the private sector include promising access to new TB drug developments for those companies who pledge

to adhere to DOTS guidelines in current treatments. Next, instead of having new MRs sacrifice large portions of their salaries to meet profit quotas for Lupin Ltd., Global Fund resources could be offered to MRs in exchange for advocating for DOTS/DOTS Plus regimens amongst private practitioners. Alternatively, MRs could be incentivized to advocate for DOTS center referrals for (DR)-TB patients from private doctors (Ecks).

Although the current reality is that the powerful actors within the private sector of DR-TB treatment have a largely negative impact on the realm of public health, methods for harnessing this influence potential in the name of WHO standardization can be implemented.

5.0 NGO INVOLVEMENT

5.1 CRHP

The Comprehensive Rural Health Project (CRHP) is an NGO located in Jamkhed, Maharashtra, a rural area in the same state as Mumbai. The previous data on TB prevalence cited within this work demonstrates the uniqueness of the CRHP's efficacy in nearly eradicating TB in the surrounding Jamkhed area. When CRHP, an NGO with a focus on bringing health to disadvantaged populations, began working in the Jamkhed area with TB in the early 1970's, communicable diseases were one of the largest health concerns for the local communities, with TB being one of the top three threats. But by 1995, CRHP was able to minimize involvement with the tuberculosis program because there were few enough TB cases and their treatment model was so sustainable, that patients were able to rely on government treatment if necessary (Control). CRHP's

model of treating tuberculosis is of great interest to future public health endeavors because it has some facets that can be projected to a larger scale to aid in national TB prevention programs. Specifically, viewing the problem of (DR) TB in Mumbai within the theoretical framework of the Jamkhed model produces some applicable solutions.

5.2 The Jamkhed Model

The Village Health Worker (VHW) program is an integral part to the success of CRHP's TB model. This program demystifies health provision and allows direct community involvement by appointing one woman per community to act as basic health care provider. Chosen by the community itself, the VHW is responsible for a variety of mostly preventative care, such as recording blood pressures, performing ante- and neo-natal check ups on women, assisting in home deliveries if necessary, performing urine glucose tests (Comprehensive). While these simple preventative tasks are incredibly beneficial to the community, the VHW's most important task may be community-based education. This is a critical aspect of creating a sustainable community health model. Providing education and empowerment so that the community understands its own health needs, is invested in bettering its public health, and understands how to access the necessary resources is indispensable for overall health. The role of the VHW in creating this phenomenon is disseminating the preventative health education she receives at CRHP training throughout the community.

CRHP's VHW program helped carry the success of the Jamkhed TB model. The first component was detection. VHWs were given specific training on detection and referral of TB patients. When the VHWs did house to house checks, they would note

patients with persistent coughs, coughing up blood and sputum, unusual fatigue and weight loss, and other symptoms of TB. If symptoms persist or were severe, sputum tests would be performed. For diagnoses confirmation, the VHWs would refer the patient to the hospital for chest x-rays. If confirmed, treatment for TB begins immediately (Village, CRHP).

The next component was consistent follow-up. The VHW everyday observes the TB patient taking their medicine, and assesses the patients' overall condition. Several members of CRHP noted that oftentimes, patients are tempted to default, or cease the treatment regimen when their symptoms start to lessen. (Village, CRHP) The VHWs observing medicine consumption throughout the entire regimen ensures the patient does not default, relapse, or create antibiotic resistance.

Finally, the VHW program emphasized community education when combatting TB. According to one of CRHP's VHWs who has been working with the program for 35 years, TB was initially a very stigmatized disease in the area, partially being to the viscerally striking symptoms, such as coughing up blood. Because of the stigma, patients were isolated and ashamed to seek treatment. She noted that when patients did opt for treatment, alternatives to allopathic medicine were often sought out because many people in her village understood the symptoms of TB to have been caused by the ill wishes of an enemy, not by a bacterial infection. This VHW has seen the social atmosphere surrounding TB alter greatly in her 35 years as a VHW, and she attributes this significantly to widespread health education. Through her work as a VHW, she educated her fellow villagers on covering one's cough, not spitting in public areas, and a simple biomedical model of the transmission of TB, how to recognize the symptoms of TB and

how to seek treatment. TB was regarded as a fatal disease in her area, so after a few patients were cured by CRHP's detection and treatment model, villagers started to become more convinced of the efficacy and authenticity of the VHW education. The VHW contended that after a while, patients were able to recognize their own symptoms and report themselves to the hospital for diagnosis (Village). Presently, the only cases of TB she sees in her village are people who have migrated from other areas. The education component of the TB model is one that ensures sustainability of prevention, detection, and effective treatment by enabling the individual to be one's own health advocate.

Other than various forms of VHW involvement, CRHP also provided the TB medication free of cost, and used funds and donations to ensure patients had adequate nutrition while on medication. Malnutrition makes one more susceptible to infections and aggravates preexisting conditions, so during periods of drought, CRHP would provide extra food to communities to compensate the seasonal lack of nutrition. Other forms of community advocacy groups, such as Mahila Mandal (MM), the women's self-help group; the Young Farmer's Club (YFC), the men's group; and the Mobile Health Team (MHT); who were all also formed of community members, helped to disseminate information regarding TB prevention, detection and treatment (Comprehensive).

5.3 Jamkhed Success Aspects

Based on in-person interviews with the VHW, a MHT member, and an administrative member of CRHP, the people involved with the TB program attribute the program's success to a few common aspects (Village, CRHP, Mobile). "Community-based" was indicated as a prominent aspect of success when describing both the TB

project and the Jamkhed model in general. Community aspects, such as the VHW program, provided personalized and dedicated care to the area. Secondly, education provided a means for people to take agency over their well being, and when people of the surrounding villages became trusting of CRHP and the VHWs, they were eager to take advantage of the education and health autonomy it brought. Education of the YFC, MM, MHT, VHWs and the general population was necessary to produce the success of the TB program. Education reduced stigma, increased knowledge of the biomedical model of TB, reduced the spread of the disease, decreased time to detection, and empowered patients to seek, receive and maintain treatment (Village). Finally, the encouragement of medical pluralism played a large role in decreasing the prevalence of TB in the area. People were much more likely to try taking allopathic medicine, which they were unfamiliar with, if they were still able to use forms of medical treatment that they were accustomed to using. So MHT members and VHWs would encourage people to continue treatment with their local healers, and to supplement these practices with the biomedical medication and preventative measures taught by CRHP (Mobile, Village, CRHP). This way, patients did not have to risk as much by partaking in the TB treatment regimen, and were not forced to choose one form of treatment over the other.

5.4 LMM Program Setup

Some aspects of the urban Mumbai setting render it an unfavorable environment for the Jamkhed model. However, many of the challenges facing DR-TB control could be positively affected by applying the Jamkhed model, as is demonstrated in some instances by the success of LMM. LMM is an NGO working with TB prevention in several low-

income wards in Mumbai. The information presented here on LMM was gathered through personal interviews and field observations (LMM). LMM has been successful at managing many of the challenges associated with DR-TB control in the city, so it is important to analyze relevant aspects of their program to derive what tactics are effective in Mumbai.

LMM adheres to WHO guidelines for TB treatment. A member of LMM trained for symptom detection goes door to door throughout the ward and analyzes residents for relevant symptoms. If a resident shows signs of TB, they are referred to the NGO's own lab for a sputum test. If the sputum test is positive, chest x-rays will be completed and analyzed by a doctor to diagnose the patient with TB. The patient must be registered with BMC, and one box of CAT I medicine per first-time TB patient is then sent to LMM. The patient is then started immediately on treatment, and must come to the LMM center located in their ward three times a week so they can be observed taking their respective medicines. CAT I treatment consists of 6 months of three per week alternate day medicine consumption.

After two months, patients on CAT I drugs perform another sputum test. At this point if they test positive for TB, they need to have a culture test and be evaluated by a doctor for DR-TB. DR-TB treatment immediately starts with the DOTS Plus treatment.

In addition, the NGO performs "contact service" or referral of family members and others in close living quarters with an individual displaying symptoms of TB for sputum testing. This allows immediate detection testing for high-risk individuals, ultimately shortening the time to detection and increasing the effectiveness of first line treatment. Another important aspect of treatment is the provision of nutrition for patients

while on medication. A member of LMM noted that he has seen treatment to be ineffective in cases where the patient is malnourished, even if the drug regime is followed correctly. Finally, LMM emphasizes community education as a way to encourage communities to engage in the appropriate treatment seeking behaviors after recognizing their own symptoms, as well as to enable them to be proactive about TB preventative behaviors (LMM).

5.5 LMM Defaulters and Default Prevention

Defaulters, or patients who fail to complete a prescribed drug regimen for TB, are more likely to develop DR-TB (WHO). These patients have had exposure to anti-tubercular drugs, but not enough to cure their bodies of TB, often leading to the development of a drug resistant strain of TB. When LMM first started working with TB in their respective wards in 2003, defaulting was high, but has now dropped to below five percent of patients. Although the rate of defaulters is improving in the area, it is necessary to further eliminate defaulting among patients to better control DR-TB. Therefore, understanding the reasons patients default can be a productive tool in eventually eliminating these factors.

Speaking with various members of LMM, several common themes arose as reasons for patient default (LMM). Migratory work was named as a factor associated with defaulting. Since the cost of living in Mumbai is so high, people looking to work in the city will often commute daily or seasonally from an area outside of Mumbai. In the case of seasonal workers, they often live in an LMM target area long enough to have their TB symptoms detected and started immediately on the appropriate treatment. However,

as their employment in Mumbai ends, migrant workers leave the city and default on treatment, which needs to be taken under observation at the LMM center in Mumbai. This is also the case with patients who may have had steady employment in Mumbai but lost their jobs, or can otherwise no longer afford the price of living in Mumbai. Oftentimes these patients will return to their villages, permanently or temporarily, defaulting on their TB regimen.

Patients who are new to the area are also more likely to default (LMM). Since LMM provides thorough training and education to their target wards, newcomers are often less educated on TB prevention than the locals. In this case, once the patient's symptoms have been detected and treatment has been initiated, the individual is likely to stop taking the medication when the symptoms start to alleviate. Without education about needing to completely finish a regimen to be cured of TB, patients often assume that they are no longer positive for TB after they feel recovered, only taking the medicine as long as the symptoms last. If a patient's symptoms are mild, some LMM members noted that patients would stop taking their medication because the drug side effects seem to outweigh the symptoms of TB, at least temporarily. Also patients suffering from substance abuse, such as alcoholism have been more likely to default.

Finally, initial treatment seeking to private practitioners has resulted in high default rate for patients (LMM). In the private sector, treatment is much more expensive and oftentimes less effective because of inappropriate regimens. Both the inability to afford treatment and lack of productive results can lead to patients forgoing treatment. Again, private-treatment seeking was primarily associated with patients who migrated to LMM wards and were not exposed to the NGOs educational outreaches about TB

prevention. In this case, LMM would come in contact with the patient after they had already defaulted at least once from private treatment (LMM).

The default rate for LMM patients was less than 5%, a great deal less than the city-wide average for Mumbai (D'souza, LMM). To keep the default rate low, LMM uses some preventative tactics when dealing with patients who fall into one of the high-risk defaulting categories laid out about. If a patient fails to appear at the LMM center for treatment, a member of the NGO will go to the patient's residence to determine the problem. For cases of patients defaulting because of side effects, being new to the area and unfamiliar with TB prevention, or substance abuse, patients must be convinced to continue treatment. However, this method is only effective if the resident still resides in the LMM ward; other measures must be taken for patients who have moved from the area. For example, information on a secondary living location, such as family village, is collected on patients as they begin treatment. This allows for a method of contact with patients who leave without notice as they lose the money or employment to stay in Mumbai. LMM offers nutrition to as incentives for patients to stay in an LMM ward until treatment has been completed. Since patients oftentimes leave Mumbai as a result of economic conditions, providing food can offset the financial burden of staying in the city, as well as increasing the effectiveness of the treatment (LMM).

5.6 LMM Private Practitioners

The role of private practitioners in the treatment of DR-TB and TB also factored in to the LMM TB control program (LMM). Oftentimes, patients who have not had exposure to LMM education initially seek private treatment for TB, especially if

symptoms are severe because treatment is expected to be of better quality privately. In fact, LMM experience and much research has shown the opposite to be true, that cases are more often mishandled in the private sector (Udwadia ZF). In their experience, the private sector did not follow regulated protocol when treating TB patients, often leading to ineffective treatment regimens. WHO cites mismanaged first line treatment as a common cause for the development of DR-TB, indicating that private practitioners as experienced by LMM could have a role in the development of DR-TB. To counteract the effects of the unregulated private sector, LMM offers education to private practitioners on the national TB program and advises following standardized treatment regimens if prescribing TB patients. In addition, LMM has requested that private practices in the area send patients displaying TB symptoms to an LMM lab for sputum testing, and that the patients remain in LMM care for treatment to ensure DOTS protocol is followed for these patients.

5.7 LMM Conclusions

Many of the aspects that made the Jamkhed model successful in nearly eradicating area TB and DR-TB can be seen at play within LMM operations. Specifically, approaching disease control on a small scale with wards instead of villages, providing prevention and treatment education for patients, providing some nutrition incentives, and being diligent about patient detection and follow up have proved effective in both Jamkhed and the target Mumbai wards. Further inclusion of CRHP style management of TB and DR-TB may prove successful in Mumbai if adopted by organizations like LMM. Mainly, a further emphasis on education and prevention of new residents to target wards,

increased provision of nutrients to patients, building a sense of community commitment to health, and expansion of similar programs to encompass a far larger portion of Mumbai, focusing on disadvantaged and high-risk areas will prove productive.

5.0 DR-TB/HIV COMORBIDITY

Another challenge Mumbai faces when dealing with DR-TB is DR-TB/HIV comorbidity. In 2005, WHO published a fact sheet citing that globally, TB was oftentimes a prominent cause of mortality for HIV/AIDS patients, and in India, TB accounted for 50% of deaths among HIV/AIDS patients (Key TB). Specifically in terms of drug resistant TB in Mumbai, a 2014 study found an alarmingly high correlation between people living with HIV (PLHIV) and DR-TB infection. Among new cases, 25% of surveyed HIV patients were positive for drug resistant TB. This percentage increased to 44% with retreatment cases. The severity of resistance was measured in the following percentages: 21% mono-resistant, 38% MDR, 21% pre-XDR, and 6% XDR (Isaakidis).

This data highlights the severity of TB/HIV infection, as well as the danger of these combined conditions. In WHO's call for increased PPMs in the India's TB public health realm, attention to TB/HIV patients was emphasized. WHO implemented a pilot program in Mumbai that followed the guidelines for TB/HIV care laid out in *Public Private Mix for TB Care and Control: A Toolkit*. The main goals of this Mumbai program were to increase HIV testing of TB patients by providing resources at DOTS centers, and "to increase access to DOTS for HIV/AIDS vulnerable groups" by working in conjunction with NGOs that are already established to cater to these demographics. In the 2010 report summarizing the 8 months of data gathered on the program, positive data

trends were apparent. Referral for HIV testing and access to these tests increased among current TB patients. In addition, HIV patients were shown to have increased access to TB care services (Public). The Mumbai TB/HIV pilot program offers a good starting point for increasing access to care for patients with co-morbidity and eventually slowing the mortality of this condition.

7.0 CASE STUDY

A case study of a DR-TB patient contextualizes several of these issues relevant to the control of DR-TB in Mumbai (Patient). This patient, a middle aged man, was experiencing symptoms he was unfamiliar with, and so sought treatment with a private practitioner because he hoped to ensure the best treatment possible. The doctor diagnosed the man with TB and prescribed first line drugs without use of drug susceptibility tests. After the first line treatment failed, the doctor ran tests to find the patient was sputum smear negative but chest x-rays showed a continued presence of TB. After the doctor told the patient the cost of second line drugs, the patient left private treatment because he was not able to afford the cost of treatment. This is a common occurrence; according to the book *Role of NGOs in Management of Drug Resistant Tuberculosis*, “default because of inability to buy second line treatment is documented in countries with high prevalence of MDR TB” (Pradhan). The man then sought treatment at the university health clinic at his employment, where the doctor directed he attend a government hospital in his area. Since he could not afford the price of living in Mumbai, he commuted daily from work. The government hospital in his area started him again on first-line treatment because his sputum smear tests were negative for TB despite chest x-rays showing the presence of TB

in his lungs after a course of first-line drugs (Patient). This example embodies many of the problems associated with drug-resistant TB in Mumbai, including lack of education leading to private-treatment seeking behavior for TB, lack of drug susceptibility testing, error associated with sputum tests, private practitioner TB case mismanagement, expense of the private sector and second line treatment, difficulty accessing treatment for the large commuter demographic, and mismanagement of DR-TB patients.

8.0 CONCLUSION

The data synthesized in this ISP indicates both the severity and prevalence of DR-TB in Mumbai as well as the importance of establishing effective future preventative and treatment tactics for disease management. It is important to take note that research has shown nearly half of future MDR-TB cases will be as a result of direct spread of drug resistant strains of TB as opposed to development through mismanagement of drug susceptible TB strains (Almeida, Suen). This being said, future efforts to control drug-resistance should strongly emphasize proper management of DR-TB cases: “Strategies that disrupt MDR transmission by shortening the time between MDR activation and treatment are projected to provide greater reductions in MDR prevalence compared with improving non-MDR treatment quality” (Suen). This motions to the importance of understanding and engaging in the key findings of this research. Based on the primary and secondary research, several conclusions can be drawn in terms of positive directions to take for future management of DR-TB in Mumbai. Primary data collected on the Jamkhed model and LMM disease management techniques suggest effective measures to be taken in the future of NGO involvement.

Approaching TB by villages or wards within Mumbai would be more apt to produce positive results as demonstrated by the small-scale, community emphasis in Jamkhed. Also, the need to commit to a single treatment regimen that is enforced via observation of a health worker, like the Jamkhed VHW, is an important factor to decreasing TB prevalence and preventing drug resistance. In Mumbai, this would essentially entail that everyone partake in DOTS (or similar) protocol, which further means regulating the private sector through standardization of practice and adherence to WHO standards. Another significant correlation is the importance of education in controlling TB. Appearance of new TB cases in Mumbai could be slowed through preventative education, such as cover one's cough and avoidance of other's bodily fluids, but more so through early self-detection. Rigorous education about TB symptoms and how to immediately access appropriate treatment could decrease transmission rates, as was the case in the CRHP approach. Lastly, an emphasis on providing extra nourishment to high-risk communities, since malnutrition puts one at a greater risk for TB infection and decreases the likelihood of successfully completing a drug regimen would effectively contribute in combatting TB and DR-TB prevalence in Mumbai.

The Jamkhed model's efficacy can be tailored and transferred in some respects to aid Mumbai in controlling TB prevalence rates and curtailing drug resistance, as LMM involvement in TB control has shown. Emphasis on patient involvement, education and empowerment, focus on disadvantaged communities, and operation within small-scale communities when possible are effective methods derived from CRHP and adopted by LMM in the Mumbai setting.

Other tactics include standardization of the private realm. Involving the private sector in the control of DR-TB in a positive and meaningful way is critical. Establishing incentives for both private practitioners and private pharmaceutical firms such as Lupin Ltd. to adhere to WHO compliant standards will greatly aid in the accomplishment of this goal. The private sector is able to impose a large impact on the current DR-TB public health in Mumbai and ensuring that this influence can be transferred to supporting the public sector and WHO standards will be a significant milestone. In addition, further development and monitoring of resources for DR-TB/HIV patients will have a positive effect on future drug resistant control by targeting a particularly high-risk community. Overall, data indicates these steps to be most effective in future management of DR-TB in Mumbai.

9.0 ACKNOWLEDGEMENTS

I would like to thank the plethora of individuals who were integral in the production of this ISP, including all the SIT staff and my academic advisor, especially Azim Ji and Abid Ji. Also a huge thank you for all the respondents who participated in the field interviews, as well as the two affiliated NGOs.

10.0 RECOMMENDATIONS FOR FUTURE STUDY

Recommendations for future study include investigating the most effective methods for involving the private DR-TB sector with WHO guidelines, efficacy of DR-TB/HIV patient resource programs as they further develop, and patient access and success rate of DOTS Plus in Mumbai.

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