

MDR-TB in China

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ABSTRACT

China faces a critical epidemic of high incidence of multi-drug resistant Tuberculosis (MDR-TB) in a setting of insufficient control and prevention strategies. By systematically reviewing and analyzing the history of the Chinese medical system, this study focuses on analysing and exploring the problems and barriers of the current health care system, which impact TB and MDR-TB prevention and control programs. Special attention is paid to high risk populations.

Low TB and MDR-TB case detection rates among high- risk population groups, limited resources and work force in poor areas, low quality of health care services, and lack of co operation among health care facilities are the main barriers to the success of TB and MDR-TB control programs in China. These programs can be improved upon through public education and the strengthening of the national reporting, referral, and tracking system with government commitments and financial support. .

Key words: China MDR-TB TB Chinese Health Care System High risk population

Subject Terms: Qualitative Study

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TABLE OF CONTENTS

APPROVAL	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF ABBREVIATIONS	vi
INTRODUCTION	1
PURPOSE OF THE STUDY	3
BACKGROUND	5
Definition of MDR-TB	5
Treatment of MDR-TB	6
Prevention of Transmission of MDR-TB	9
TB control programs and strategies in China	9
METHODS	13
Protocol	13
Data Source	13
RESULTS	15
Situation of MDR-TB in China	15
How data are obtained in China	15
Epidemiology of MDR-TB in China	15
Differences among areas	16
Cause of MDR-TB (risk factors in China).....	17
Health care system reform and its impact on service of TB and MDR-TB	18
Brief Health care system recent reform history	18
Impact on service of TB and MDR-TB.....	22
Management of MDR-TB.....	25

DISCUSSION.....	26
Challenges for MDR-TB Prevention and Control Programs	26
1. Lack of data.....	26
2. Barriers in accessing health care (subjective, objective, for patients).....	27
3. Lack of effective TB control programs among the “Floating Population”	28
4. Lack of resource in poor areas.....	30
5. Health work force crisis in TB control	30
6. Low quality in TB health care	32
7. Financial problem (disease prevention has not been a “bigger” thing than treating disease)	33
8. Lack of co-operation and co-ordination between health facilities	35
Suggestions and recommendations	36
1. Increasing TB and MDR-TB case detection rate	36
2. Education and communication (Public awareness)	36
3. Good TB control and tracking system for the high risk population, especially, the “floating population”	37
4. Ensure the Quality of health care service	38
5. Financial Support	41
6. Co-operation among hospitals and CDCs	42
LIMITATIONS	44
CONCLUSION.....	46
REFERENCE LIST	48

LIST OF ABBREVIATIONS

TB	Tuberculosis
WHO	World Health Organization
MDR-TB	Multi-drug resistant Tuberculosis
XDR-TB	Extensively drug-resistant Tuberculosis
LTB	Latent Tuberculosis
DFID	Department for International Development
DOTS	Short-course Directly Observed Treatment
MHC	Ministry of Health of China
WB	The World Bank
CNHEI	China National Health Economics Institute.
PMDT	Programmatic Management of Drug-resistant Tuberculosis
CTCC	Chinese tuberculosis control collaboration
MDGs	Millennium Development Goals

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium Tuberculosis* (also called “Tubercle bacillus”). As the seventh leading cause of death worldwide, TB kills 1.5 million persons worldwide annually (WHO, 2010). TB is characterized mostly by the production of tubercles in the internal organs, especially in the lungs. Prior to the availability of streptomycin and other antibiotics, the treatment of TB was very difficult. Since 1940 the mortality rate of TB worldwide has decreased, this infection is no longer considered as a “terrorist” (WHO, 2009).

However, the TB bacteria’s structure was found to be changed in the 1980’s. This mutational bacterium was resistant to anti-tuberculosis drugs, and these drug-resistant strains became known as “Multi-drug Resistant Tuberculosis” (MDR-TB) and “Extensively drug-resistant Tuberculosis” (XDR-TB). According to the latest World Health Organization (WHO) report, it is estimated that in 2008 there were nearly half a million new cases of MDR-TB, about 5% of the nine million new TB cases. Globally, only 7% of estimated MDR-TB cases are diagnosed and reported and the treatment success rate among cases enrolled on treatment programmes is 60 % (WHO, 2010).

China is one of the world’s 22 TB high-burden countries, and has the highest burden of MDR-TB cases in the world. The WHO report estimated China’s cases in 2008 to be over 20 percent of the global burden of MDR-TB

(WHO, 2010). The Chinese Health Minister indicated at the Beijing Conference on M/XDR-TB in April 2009, that the proportion of MDR-TB cases among pulmonary tuberculosis patients was 8.32%, and estimated that there were 120,000 new cases of MDR-TB annually in China (Zhu, 2009). Among the estimated MDR-TB cases in China in 2008, the proportion of MDR-TB cases among new TB case was 5.7% and that among previous retreated TB cases was 25.6 % (WHO, 2010). This leads to a concern about the transmission of drug-resistant TB strains and points to an association between MDR-TB cases and previous treated TB cases.

Because of the laboratory capability requirement for MDR-TB diagnosis, the low treatment success rate (60% globally) among MDR-TB cases enrolled on treatment programs and the much higher drug costs for MDR-TB treatment compared with the treatment of regular TB, widespread MDR-TB has become a severe health burden and social issue (WHO,2008).

PURPOSE OF THE STUDY

An Assessment of MDR-TB Prevention and Control in China

In 2008, based on a survey data of 81 countries, WHO published “The Fourth Global Anti-drug resistant Tuberculosis Report”, reported that China had the highest number of MDR-TB patients (WHO, 2008). Based on those results, with the support from the Global Fund, some Chinese provinces started to carry out MDR-TB monitoring programs (He et al, 2008). However, because of limited provincial involvement and the fact that these programs were implemented at different times, those monitoring programs did not reflect the real situation regarding MDR-TB in China.

The data indicates that there is a high prevalence of MDR-TB in China and confirms the severity of the problem (WHO, 2008) (China CDC, 2007). Research has shown limited access to health care for TB patients (Squire&Tang, 2004), high MDR-TB prevalence in certain provinces in China (He et al, 2008), and the financial problem for TB patients in certain provinces (Liu et al, 2007). However, certain questions remain unanswered about the specific nature of the problem in China: its causes and the identity of the high risk populations. This study addresses these issues, guided by the following questions:

1. What is the current situation in regarding to MDR-TB in China?

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2. How has the health care system affected MDR-TB prevention and control?
 3. What are the possible recommendations to improve MDR-TB Control in China?

This paper builds on previous research and the author's own further investigation, with special reference to the Chinese health care system and high-risk population groups. The current study will provide valuable insight and recommendations helpful to further research for the Chinese health authorities.

BACKGROUND

Definition of MDR-TB

Multidrug resistant tuberculosis (MDR-TB) is a significant urgent problem in China as it is estimated that one third of the world's cases of MDR-TB are in China (Zigno et al, 2006). MDR-TB is defined as Tuberculosis (TB) that is resistant to at least isoniazid (INH) and rifampicin (RIF), the two most commonly used first-line anti-tuberculosis drugs (WHO, 2008).

MDR-TB infection can be divided into primary or acquired, with the latter being more common. Primary MDR-TB refers to patients infected with MDR-TB who have a TB-free history and who have not received anti-tuberculosis treatment. This mostly occurs in patients with HIV infection (WHO, 2006).

MDR-TB patients with at least one month previous anti-tuberculosis treatment are defined as acquired MDR-TB cases (Wang, 2009). Most MDR-TB cases are acquired through drug resistance. MDR-TB is common after re-treatment of cases with INH and RFP and after treatment failure in patients with chronic Mycobacterium.

XDR-TB is defined as MDR-TB that also has resistance to at least one of three injectable second-line anti-tuberculosis drugs (i.e. amikacin, kanamycin,

and capreomycin) (WHO, 2006). About 9.9% of all MDR-TB isolates in China meet the criteria for XDR-TB (Shah et al, 2007). While there is no official XDR-TB data worldwide, the WHO estimates there may be around new 25,000 cases per year. For these cases the treatment options are critically limited (WHO, 2008).

Treatment of MDR-TB

Fifteen percent of the nine million new cases of active tuberculosis worldwide occur in China each year (Consumer Health Complete, 2006). While the body can harbour TB with little adverse effect for some time, TB becomes an acute health risk when combined with other factors such as malnutrition or immunodeficiency. Also, TB is transmitted through the air making it easy to become infected and harder for people to avoid infection (Fabricant, 2009). Although TB is treatable and curable, the course of treatment for normal TB involves taking a combination of medications for 6 months. For the developing world, with the limited health care resources and some of the highest burdens of TB, completing this regimen is a real challenge. Not completing the regimen can lead to drug resistance contributing to the global MDR-TB epidemic.

For MDR-TB, the key is “prevention” rather than treatment. As the most commonly used first-line anti-tuberculosis drugs, Isoniazid is the best bactericidal drug and Rifampicin is the best sterilizing drug (Ormerod, 1997). Mono-

resistance to either of the two drugs requires extended treatments of 9 to 18 months. The loss of response to both Isoniazid and Rifampicin necessitates treatment with second-line drugs for at least 12 and in some cases more than 24 months, and means that patients remain infectious for much longer (Ormerod, 2005).

The second-line anti-tuberculosis drugs include para-aminosalicylic acid (PAS), ethionamide, cycloserine, amikacin and capreomycin. These drugs are more toxic, clinically less effective and elicit severe reactions much more frequently than first-line agents (Shi et al, 2007).

Studies have suggested that an MDR-TB treatment regimen should always include four to seven drugs (Iseman & Michael, 1993). These are generally poorly tolerated and more toxic than traditional regimens (Tabars, 2008). Re-treatment of patients with MDR-TB should be carried out in programs with a microbiologic, pharmacokinetic, psychosocial, and nutritional support system.

In 1998, the National MDR-TB Treatment Committee was established in China. After years of clinical research and data collection, a standard therapy of MDR-TB was initiated; “3CDThZ/xDOTh”, 3 months of standard chemotherapy of CDThZ (Capreomycin, Dipasic, Ofloxacin, Theraplix, and Zinamide) followed by “X” months of Direct Observed Therapy (DOTh), with “X” not fixed. Treatment

cannot be stopped until the patient's sputum culture becomes negative for six months, meaning that sputum specimens should be obtained for semi-quantitative smear and culture monthly during the treatment. Based on China's Center for Disease Control data, the cure rate of MDR-TB by this therapy can reach 70%, or even 75% (China CDC, 2001). The standard therapy should be initiated in the hospital, and therapeutic drug monitoring (TDM) is recommended (Li et al, 2004). Observation of toxicity and intolerance must be done by the clinicians, in order to be able to change a regimen before patients become intolerant to the medications (Iseman & Michael1993). Successful treatment of TB can prevent the occurrence of MDR-TB. The patient's previous treatment records have a significant effect on the treatment of MDR-TB, so it is important that "follow the patient" when he/she goes to another site for treatment (Goble, 1993). Since the discontinuation of treatment before completion of the schedule increases the risk of reactivation, the duration of treatment needs to be monitored by the clinicians (Goble, 1993).

Surgery is another strategy for patients with localized TB lesions and good cardio respiratory reserve. It can play a role in curing patients with severe disease (Mahmoudi & Iseman, 1992) (Josep & Gimferrer, 2005). For those with MDR-TB who are good surgical candidates, the cure rate can be over 90% with continued postoperative antibiotics for the appropriate period of time (Rizzi, 1995) (Iseman, 1990). Because of the high prevalence of positive smears in the resected lungs of patients with MDR-TB and to ensure long-term cure in patients,

postoperative individualized chemotherapy after removal of the lesions is crucial (Iseman ,1990).

Prevention of Transmission of MDR-TB

Because infection with drug-resistant tuberculosis is especially hazardous, special precautions should be taken to minimize the risk of transmission. This is made more challenging because there is no prophylaxis that has proved efficacious, and that is recommended for the prevention of tuberculosis for contacts of those thought to be infected with tubercle bacilli resistant to Isoniazid and Rifampin (Ferebee, 1970) (WHO Bulletin, 1982). However, the guidelines for preventing the transmission of TB in health care facilities were recommended by WHO in 2003(WHO, 2003).

Since ultraviolet irradiation systems have proved to be more effective than mask or ventilation (Nardell, 1991), they should be used to protect health care personnel and other patients in TB and MDR-TB high-risk environments.

TB control programs and strategies in China

Public Health has the overall mandate to prevent and control TB in China. This includes surveillance (collection and analysis of data), provision of treatment through TB dispensaries and the acquisition, distribution and quality assurance of medications. The curative services, including hospitals, primary care, and

other facilities are responsible for diagnosing TB cases and referring them to the TB dispensaries. These curative services are in a different Ministry department from the prevention and control program (MHC, 2002).

The Directly Observed Therapy Strategy (DOTS) was first introduced by the Chinese government as a TB control project in 1991 (MHC, 1992). The WHO recommended a five-point strategy entitled “The 10-year Infectious and Endemic Disease Control” (IEDC) project, which covered about half of the Chinese population in 1991 and was implemented in 12 provinces with the assistance of a World Bank loan. At the same time, the Ministry of Health provided limited funding to subsidize treatment for TB patients, which counted another 10-15% of the Chinese population (Wang et al, 2007). Under this project, by the end of 1994, with the coverage of 80% of the target population and a 90% new TB case detection rate, over 80% of previously treated cases were cured (Lancet, 1996).

Based on the 2000 national tuberculosis prevalence survey, in these 12 provinces, there was a 36% reduction in disease prevalence between 1999 and 2000 (WHO, 2002). By the end of 2002, the DOTS coverage was 78% in China, while the cases detection rate was still very low at 33% (WHO, 2009). After the Ministerial Conference on Tuberculosis and Sustainable Development in Amsterdam in 2000, the second 10-years plan (2001-2010) to control TB was issued in October 2001 (State Council of China, 2001). The Chinese

government increased the funding up to US \$4.8 million per year. Also, in 2002, a US\$48 million grant was received from the Global Fund to fight AIDS, Tuberculosis and Malaria, and a 7-year US\$104million loan with the World Bank(WB) was signed by the Chinese government. With increased political commitment and international support, DOTS expanded to cover the country by late 2002. For some smear-negative cases in some areas, treatment was also free of charge in China in 2005. 6.42 million Pulmonary tuberculosis cases were detected and treated from 2001 to 2008 (Sara, 2006) (China TB Org, 2008).

The World Bank-supported China Tuberculosis Control Project covered 668 million Chinese in 16 provinces, among which were poor provinces (WB, 2010). According to World Health Organization, by the end of 2005, the DOTS coverage of the Chinese population reached 100% and TB new case detection rate was 71% (WHO, 2009). By March 2010, the project had prevented an estimated 770,000 TB-associated deaths and prevented 20 million people from falling ill (The World Bank, 2010).

DOTS has brought remarkable improvements in tuberculosis control in China and been proven to be cost-effective at reducing the incidence of TB in high-burden settings (WHO, 2008). Additionally, the strategy of DOTS has strengthened public health-care capacity by improving cooperation across all levels of health care facilities and creating well-defined sector strategies or plans. It also helped to build system wide responses and information sharing. A study

conducted in 2004 indicated that the public health of provinces covered by DOTS were better resourced or organized, and this has contributed to strengthening the basic infrastructure of a public health system in China (Squire, 2004)(Chen et al, 2002).

It is noteworthy that free or subsidized TB diagnosis and treatment is available only at the special TB dispensaries, and only confirmed smear-positive and some severe smear-negative patients receive free drugs. As a result, the TB cases diagnosed elsewhere must be referred to these dispensaries in order to get the free standard 6 month treatment (MHC, 2002). Patients still have to pay a substantial proportion of their annual income for TB related services, between 12-40% (Liu et al, 2007). Repeated outpatient visits before diagnosis, over-prescription of drugs and prolonged treatments are common. Neither subsidies nor free diagnosis is provided in general curative health facilities, village health stations, or township and county hospitals (Wang et al, 2007).

METHODS

Protocol

This study was based on a systematic literature review focused on two areas: Health care system effects on MDR-TB and high risk populations for MDR-TB.

Data Source

A variety of sources were used in this study including the national survey, academic and grey literature search, followed by a systematic literature review on published articles and unpublished related reports and journal articles in Chinese and English.

By using the mesh term "MDR-TB and China" to scan the Pub Med database, 61 published articles were identified. Of these 17 were excluded because they were about other countries instead of China. The other 44 studies were divided by: Diagnosis (1), Treatment (15), Case study (4), Genetic types (6), Medication(6) and surveillance(12), which included 2 national surveys (one for TB and one for MDR-TB),9 certain areas' surveys, and one literature review.

To ensure that all the possible articles were captured in the above mentioned search, a cross check was completed using the phrase: "TB and China", which resulted in 1075 articles being found in Pub Med; The more

specific phrase: “TB prevention and control and China” yielded 148 results and “Multi-drug resistant Tuberculosis and China” yielded 167 results. The previously mentioned 44 articles appeared in the search. By reviewing the abstracts of all these studies, no additional information relevant to this study was found. Therefore, the 44 studies were considered as the main focus of this study.

The Chinese database CHKI, CBM was also searched using all above mentioned keywords and was screened by the subject headings in Chinese. The studies in the Chinese version that were found earlier either by Pub Med or Google Scholar were excluded, resulting in 21 different studies and reports in Chinese. There were 10 studies and 11 reports, encompassing 4 national TB surveillance reports.

In total, 65 (44 in English and 21 in Chinese) articles and reports were identified and screened by the author and the main points were extracted for this study. When additional information of specific issues in these articles was needed, the references cited in the article were reviewed.

RESULTS

Situation of MDR-TB in China

How data are obtained in China

A nationwide baseline survey for tuberculosis drug resistance with strict quality control was carefully organized and carried out in China from 2007 to 2008. This survey covered an estimated 47 million people from the 70 counties randomly selected in 31 provinces, autonomous regions, and municipalities directly under the Central Government. This survey screened 30,000 persons with suspected symptoms of pulmonary tuberculosis. Sputum culture, bacterial characterization for mycobacterium tuberculosis, and anti-tuberculosis drug susceptibility tests were given to 4,734 patients (3,384 male and 1,350 female with an average age of 46.4 years) who were detected to be smear-positive (National TB Epi survey, 2008).

Epidemiology of MDR-TB in China

China has the largest population in the world. The incidence of tuberculosis (per 100 000 population per year) was 98 and the prevalence of tuberculosis (per 100 000 population) was 194.0 in 2007 (WHO, 2009). Preliminary findings of the survey showed that 8.3% of pulmonary tuberculosis patients in China suffer from MDR-TB, which is much higher than the global

average of 3.6% (National TB Epi survey, 2008) (WHO, 2010). Based on this data, it is estimated that there are 120,000 new cases of MDR-TB in China each year. As one of the highest incidence MDR-TB countries, China has the highest absolute number of MDR-TB cases, and faces a big challenge in treating and controlling MDR-TB (WHO, 2009). The assessment and analysis of the information of the drug resistance survey is still ongoing at this moment. The following characteristics of MDR-TB patients were found in this survey: 80% of the patients were in rural areas; there were a high proportion of young and middle-aged patients; and there was no gender difference in MDR-TB prevalence (National TB Epi survey, 2008) (China CDC, 2009).

Differences among areas

According to a survey of ten provinces conducted from 1996 to 2004, the TB prevalence in economically underdeveloped provinces was 1.8 times that of more developed provinces (He et al, 2008). Among these ten provinces, Henan, Zhejiang, Inner Mongolia, and Heilongjiang reported MDR-TB prevalence of over 20% in previously treated cases. Those provinces were defined as MDR-TB hotspots (WHO, 2006). This study also indicated the differences in resistance to the individual drugs among the surveyed provinces. On average, the highest proportion of resistance in new cases was for streptomycin (16.4%) and isoniazid (14.0%), and the lowest proportion was for ethambutol (3.3%). In previously treated cases, average resistance proportions were highest for isoniazid

(39.2%), and intermediate for streptomycin (31.1%) and rifampicin (31.5%) (He et al, 2008).

Cause of MDR-TB (risk factors in China)

Studies showed that previous inadequate TB treatment, which included incomplete treatment (stopped too early), discontinuous treatment, and inappropriate therapies (e.g. single dose or too much drug use), or prolonged treatment, were the strongest determinants of MDR-TB in China (China CDC, 2008). Increased poverty in some regions, immigration from an area with high incidence of drug-resistance, and the impact of HIV are some of the main reasons for the persisting global tuberculosis burden. The belief that tuberculosis was a problem of the past contributed to the lack of resources devoted to TB, and the subsequent public health infrastructure breakdown had further contributed to the MDR-TB problem(WHO, 2006).

MDR-TB usually results from poor patient adherence and other causes of failure in the implementation of an effectively functioning TB control program (Yew, 1999). In China, the reasons range from characteristics of individual patients to the societal and economic environment, and include: absence of infection control; lack of supervision of treatment; low quality and short supply of anti-TB drugs; and availability of anti-TB drugs without a prescription in some areas of China (Xu et al,2007) (He et al,2008).

Delayed diagnosis and treatment is another reason for the high prevalence of MDR-TB in China, especially for rural TB patients, who often delay seeking help for continued coughing (Wei et al, 2008). MDR-TB diagnosis is time consuming and costly so that many patients in rural areas fail to complete the treatment (EATG, 2009). Moreover, rural TB patients may not believe they need treatment with the impression that TB is the problem of the past, and they may continue to risk infecting others. Those patients put themselves and their family members at risk of obtaining TB or MDR-TB (He et al, 2008). As well, the continuing transmutation of the established drug-resistant strains is also a significant source of new drug-resistant cases (WHO, 2006).

It has also been noted that cigarette smoking is contributing to the high prevalence of TB in China (Wang & Shen, 2009). The proportion of TB cases among cigarette smokers is higher than that of non-smoking population. TB relapse is earlier in smokers than in non-smokers (6-9 months vs.12-15 months) (Wang & Shen, 2009).

Health care system reform and its impact on service of TB and MDR-TB

Brief Health care system recent reform history

1950- 1980s

All hospitals and specialized facilities from urban areas to small clinics in the countryside were owned, funded and run by the government. Physicians

were employees of the country. Communes, the critical institution in rural life, were the cornerstone of the health care system in rural areas (Hesketh & Wei, 1997). The practitioners, who had limited health care training, so-called “barefoot doctors”, played a big role in meeting the needs of the rural population (Casella, 2009). By the beginning of 1980s, China was undergoing the epidemiological transition, the shift from infectious and deficiency diseases to chronic non-communicable diseases (EMHL, 1996).

Early 1980s-2003

In early 1980s, the privatization of China’s economy with a general effort to reduce the role of central government in regional and local affairs, created transformative changes to the health care system (Casella, 2009).

(A) The financing of health care system

The central government’s share in health care services fell from 32 percent to 15 percent over the period from 1978 to 1998 (Liu et al, 1998). Much of the responsibility of funding was transferred to provincial and local authorities who mainly provided fiscal support through local taxation (Hesketh & Zhu, 2004). Financial decentralization put a burden on local governments, resulting in reduced funding for public health programs in many locales. Local public health authorities concentrated on revenue-generating activities and neglected other chief roles they need to play, such as health education, maternal and child health care, and control of epidemics (Liu, 2004).

(B) The financing of health care providers

By imposing a system of price control only on routine services and routine pharmaceuticals, the government gave health providers permission to earn profits from new drugs, new tests and technology. The profit margins were 15 percent or more (Hesketh & Zhu, 2004). Additionally, the government modified the salary-based system of hospital physicians to include bonuses determined according to the revenue the physicians generated for their hospitals (Liu, 2004). Public hospitals became more like for-profit entities and there was an explosion in the sale of expensive pharmaceuticals and high-tech services (Hesketh & Zhu, 2004).

(C) Increased fiscal burden on rural residents

Without the cooperative medical system, most of rural China had no way to pool resources for health care expenses. This made it more likely for rural citizens who required health care to face financial difficulties (Wagstaff et al, 2007).

Another side effect was that barefoot doctors abandoned their previous emphasis on public health services since they were no longer compensated by the government (Lim et al, 2004). They found that selling drugs was one of the best ways to earn profit, leading to an explosion in the number of barefoot doctors selling drugs in rural areas (Bloom & Xingyuan, 1997). In addition, with

the barefoot doctors' limited training, their quality as clinicians was highly questionable (Martineau et al, 2004). As a result, residents with serious illnesses often sought care in the outpatient units of urban hospitals as they were aware of the poor quality health care in rural areas. This led to underuse of rural local facilities and overuse of urban hospitals (Martineau et al, 2004) (MHC, 2008).

Because of financial constraints, health care management, and the short supply of effective health care workers, the efficiency of the health care system declined sharply even though the number of Chinese health care facilities and personnel have increased since 1980 (Hsiao,2004). During the SARS epidemic in 2002, the Chinese government's slow response was a reflection of these inefficiencies. The central government was then more removed to the operational aspects of health service delivery and knowledge of the situation in the field (Liu et al, 2008).

Since 2003

Recognizing the huge health care problems that it created, the government introduced a new medical-insurance scheme in the countryside in 2003 (Hu et al, 2008). The scheme involves contributions from the central government, local government and rural residents. The number of people taking part was 80 million in 2003 and rose to more than 730 million in 2008 (The Economist, 2008). In 2007, the government introduced an urban insurance

scheme aimed at non-working residents, including children and university students (The Economist, 2007).

In the beginning of 2009, an investment plan of 850 billion Chinese Yuan (USD 124 billion) for the national healthcare system reform was announced by the State Council (Frog healthcare group, 2009). This investment will be implemented with a more detailed plan for the next three years. The aim of the plan is “solving pressing problems that have caused strong complaints from the public”. According to the Ministry of Finance, this investment will be divided into two parts: 2/3 will go to the end-user by improving the healthcare insurance coverage and the other 1/3 will be invested on improving the capabilities and service level of healthcare providers (Frog Healthcare group, 2009) (MHC,2008).

Impact on service of TB and MDR-TB

Following the national economic reform in the 1980s, China’s healthcare system had some challenges, which had negative effects on TB and MDR-TB control services. Since the central government reduced the funds for public health (CNHEI, 2005), patients in China paid much more out-of-pocket for medical services compared with the 1980s (Harvard School of Public Health, 2008). In 2006, out-of-pocket payments accounted for 50% of health spending, and at the end of 2008, they were over 60% (Zhao et al, 2008) (Hu et al, 2008). Also, insurance coverage disparities between urban areas and the country sides and increasing costs of medicine surfaced (Tang et al, 2008).

Reductions in government support for health care had made the public hospitals more profit-driven (Blumenthal & Hsiao, 2005). More than 90% of the incomes of health care providers were from fee for drugs prescription and medical services, especially the tests involving high-tech equipment (Martineau et al, 2004). The revenue-generating hospitals and clinics contributed to the misuse and mismanagement of antibiotics (Zhao et al, 2007). Together with the poor quality of antibiotics, this largely resulted in growing drug resistance TB (CTCC, 2004).

When the average cost for a single hospital admission reached China's annual income per person, health care became the number one concern for the Chinese population (Hu et al, 2008). Because of the need for strict observation and the long timeline for treating MDR-TB, and the more expensive drugs used treatment costs can be 100 times of that of treating common tuberculosis strains (Cobelens et al, 2008). It was found that the availability of medical insurance was associated with a shorter patient delay (Xu et al, 2007). However, although some insurance was available, there were over one third of urban households who had difficulty affording health care (Liu et al, 2002). Moreover, a massive migration to cities and millions of layoffs from companies going bankrupt or restructuring put a heavy financial burden on local governments and state-owned enterprises in terms of subsidising those people's health care (Weller & Li, 2000).

It was even worse for rural residents after the universal rural health-insurance collapsed in the 1990s, and there were no corresponding insurance schemes to replace it (Sleigh, 2007). Even though there was a rural cooperative medical system began in 2003, and 720 million rural households were covered by the end of 2007, over half of the funds were used for less than 5% of the population (Hu et al, 2008).

Hospital and clinic treatment is offered on a fee-for-service basis in China (Tang et al, 2008) which places a barrier to referral for treatment under the national tuberculosis programs. Furthermore, since public health is under a different department from curative services in China, the national tuberculosis program has difficulties controlling what is happening in hospitals (Liu et al, 2008). As a result, most patients seek care and are treated in the general hospitals and clinics rather than in the special TB dispensaries (Wei, 2008).

Compared with hospital sector, the primary health and preventive or promotional facilities, such as the Disease Control and Prevention Centers (CDCs) are really priorities in local health care. Secondary and tertiary hospitals have an advantage in bidding for government funding (China's health statistics yearbook, 2007), since the benefits of funding are seen by the government or the public much faster in hospital settings in terms of curing cases. In China, the government provides very limited fiscal support for preventive health facilities,

and almost no funds are available for village health stations (Zhao et al, 2007), which means the funds or resources may not been put where they are most needed (Wang et al,2007). Therefore, public health facilities in some ways have had to rely heavily on user charges to cover the operational costs. Ironically, because they receive less government funding, the managers of the preventive health facilities have greater autonomy than hospitals in deciding the kind of health services they offer and the allocation of financial resources (Meng et al, 2002). The uneven health care system has created a barrier to the success of TB and MDR-TB control and prevention in China.

Management of MDR-TB

There was no national TB reporting system in China until 2005. The CDC created a web-based system that provided nationwide information about TB case reporting, treatment and follow up. It helps to obtain the reliable data on TB prevalence, which benefits national and local TB prevention and control programs. In order to secure the reliability of the data, all members of the institutes who have access to the data and the reporting system have to follow strict rules (China CDC, 2005).

Under the 2009 WHO new policy guidelines on preventing transmission of TB, the Chinese government established the national and sub-national guidelines on how to reduce the risk of TB transmission in health-care facilities and how to conduct training on infection control (China CDC, 2009).

DISCUSSION

Challenges for MDR-TB Prevention and Control Programs

1. Lack of data

Studies indicate that data on drug resistance in China as reported to WHO is incomplete (He et al, 2008). The recent WHO country profile on China showed there were no data on MDR-TB treatment outcomes, and no data on treatment outcomes of previously treated MDR-TB cases. The quality of MDR-TB surveillance data of China was not even on the class B lists among the table of “Continuous drug resistance surveillance data quality indicators” (WHO, 2010).

The main TB case detection strategy is symptomatic patients who either voluntarily attend or are referred to preventive health institutions. A high proportion of symptomatic cases never present themselves at any health facilities, make repeat visits (Dunn, 2005), or hide previous treatment history in order to get free re-treatment in some provinces, created a gap between the current case detection rate and the target rate (Dunn, 2005). Furthermore, the missing data also occurs during the long process of getting diagnoses of MDR-TB, and in patients failing to submit all the specimens and getting lost in the health care system (Tang & Squire,2005).

In addition to the lack of data on drug resistance, there is little readily available data on health care human resources for TB control (Zhao, 2003).

2. Barriers in accessing health care (subjective, objective, for patients)

Based on a study conducted in two different counties in different provinces either covered or not covered by DOTS, in general the overall TB care approach was found efficient and economical (Tang & Squire , 2005). However, the patients covered by DOTS still faced numerous barriers to regular attendance which included travel costs, time expense, and stigma when pursuing their occupation (Xu et al, 2006). Poor attitudes from providers were also found in this study. Compared with cynical and uncaring views of health facility workers, especially physicians, community health workers were more positive, but they arranged direct observation to suit their, rather than patients' schedules (Khan &Walley, 2005).

Although the national coverage of DOTS brought a substantially higher proportion of smear-positive TB patients to diagnosis and treatment, poverty, level of education, availability of medical insurance and the system of TB control had the big influence on patients' access to TB and MDR-TB care in China (Xu et al., 2005).

Gender, age and education status affect women' and men's access to health care. Men are generally prioritized for health care since they are

considered to be the 'backbone' of the family, while women take longer to seek care. Older people, especially females, tend not to seek care in order to not burden their families financially. Also low education status contributes to the delay of seeking health care among TB patients (Dunn, 2005). Poor and vulnerable people are often missed by health promotion campaigns because of their very limited knowledge about TB as a disease and the lack of awareness of the availability of free diagnosis and treatment (Fei et al, 2006).

The social stigma for TB patients also plays a role in delaying treatment. For example, young people will find it difficult to get married, or migrants from rural to urban areas will find it difficult to find a job if it is known that they have or have had TB (Jiang et al, 2008).

3. Lack of effective TB control programs among the "Floating Population"

Significant social-economic reform has resulted in a special population in China, called the "floating population". The term "floating population" refers to people who have not in fact migrated, and will not become a permanently settled group. They usually move back and forth from different areas with the seasons. The general floating direction is from the countryside to cities, from underdeveloped regions to developed regions, and from central and western areas to eastern coastal areas (People's Daily, 2005).

The “floating population” is largely composed of young to middle-aged people, with those between 15 and 35 making up over 80 percent of the total. China’s “floating population” was about 120 million in 2005. This comprises 9.3% of its total population of 1.3 billion people, and includes 88.4 million rural villagers, with the remainder coming from townships and small cities (China national statistical Bureau, 2006). The lack of effective TB control programs among “floating populations” is another contributor to the high prevalence of MDR-TB (Dai et al, 2004).

Attracted by better job opportunities and more income in cities, intra-province (west to east coast province) and inter-province (poor to rich areas) migration has been increasing each year due to urbanization in China. The health care burden is another major reason that rural populations migrate to cities seeking proximity to better health care facilities and higher wages to pay for health care (Jackson et al, 2006). To date there are no complete surveys or reliable data of TB or MDR-TB cases among internal migrants in China (Tang and Squire, 2004). The surveillance system is still lacking a tracking arrangement for patients who start treatment in one city and then continue in another city (China TB org, 2005).

In the big cities in China, such as Beijing and Shanghai, the number of new TB cases among internal migrants is much higher than that of registered permanent residents (Dai, 2004)(Tian, 2001). To get their TB diagnosis and

treatment subsidized, those suspected TB patients have to return to their home villages where they were registered at birth (Kelly & Luo, 2006). Given the sheer size and broad movement of this population, the “floating population” will become one of the most significant sources of new MDR-TB infections in China in the coming years.

4. Lack of resource in poor areas

Aware of the limitations of small clinics and community hospitals, people prefer to see a doctor in large hospitals no matter how serious the illness is (Frog health care group, 2009). Therefore, the small clinics and community hospitals lose funding and talented health care staff while the urban hospitals have to allocate more resources to serve more outpatients (MHC, 2008). It is also difficult for the clinicians to manage hospital outpatients, to track a patient’s medical history and to make effective referrals to TB dispensaries. Therefore, additional resources for TB programs in poor areas may be indispensable for improving MDR-TB control program implementation (The World Bank, 2007).

5. Health work force crisis in TB control

Research has shown a great variation in staff numbers and pay levels in the health work force (Zhao, 2003). In 2002, the China National TB Control

Center started to establish a comprehensive TB control work force strategy involving short-term and long-term development plans (Liu et al, 2005). In this strategy there are two different human resource systems in the TB control programs. One is for different levels of TB Control Dispensaries from the National Centre to Village Centres, and the other one is for health care facilities, and especially refers to general hospitals and clinics.

For TB Prevention and Control Centres, there are specific staffs or specialists to take the responsibility for each level TB control job. The number of the staff is specified by the National TB Control Centre, which is directly supervised by the Health Ministry of China. For instance, there are at least 20 staffs or qualified health specialists in charge of the TB control programs at the provincial level, and at least 15 people are responsible for the city or district level TB control programs. For the county and village level, it is required that at least one health care worker is involved either full-time or part-time National TB Prevention and Control Manual, 2008).

For health care facilities, especially hospitals at various levels, the National TB Control Center requires a special health worker to be in charge of reporting, registering, and referring TB cases or suspected TB patients to the local TB Prevention and Control Centre, to take care of the TB education programs in the hospital and to cooperate with the inspection of the local TB control center (National TB Prevention and Control Manual, 2008).

6. *Low quality in TB health care*

Attitude to TB patients of health care providers

The attitude of health care providers towards members of the “floating population” suspected of having TB contributes to the low quality service and low detection rate. From 2003 to 2008 in China 150 million people relocated from poor rural areas to urban areas. With less access to health care services and less information about TB, these people did not receive much attention from urban TB control programs. Local policies did not require urban TB control programs for this population. Consequently, many health care providers or staff considered services for them as “extra” work and had the impression that TB service for the “floating population” was not important (Jiang et al, 2008).

Delays

Also, it was shown that over 60% of TB patients experienced a delay between first seeking care and receiving a diagnosis. Most patients had to make repeated visits to health care facilities before receiving a diagnosis, and 23% of TB patients made over six visits (Dunn, 2005).

Barriers to reach Lab services

Getting tested can be a complicated process, even after the patients have reached the health care system. According to the WHO recommendations, patients should submit three samples of sputum on consecutive days and at

different times of the day (WHO, 2005). It sometimes takes weeks to get the results, as local level health care services do not have the costly equipment needed to carry out effective testing for diagnosis (Liu et al, 2002). Either the patients themselves or village TB control centre staffs have to travel a long distance to submit specimens to central testing laboratories. It is a time consuming and expensive procedure. Many patients got lost in the health care system because they failed to submit all the specimens, did not collect the results afterwards or failed to get registered for the treatment (China CDC, 2008).

7. Financial problem (disease prevention has not been a “bigger” thing than treating disease)

According to the WHO, the budgets for MDR-TB care and control in 2010 are insufficient in China, there is a two-million gap between the estimated one and the real one (WHO, 2010). Also, making the funding sustainable for the future is a key challenge for the TB and MDR-TB control programs since one third of the funding comes from external loans and grants (Wang et al, 2007).

In rural areas, fewer than 20% of patients have health insurance and 80-90% of patients pay their medical expense out-of-pocket (Wang et al, 2007). Out-of-pocket expenses accounted for 58% of health care spending in China in 2002, as compared with 20% in 1978 (Liu et al, 2003). Although the coverage of

DOTS has reached 100%, the patients' cost for over-treatment is significant (Yao et al, 2008). As some people need to make repeat visits to health care providers before being referred to the TB dispensaries, there are hidden costs of unnecessary medical check-ups and the medications suggested countering the side effects of TB treatment. Thus, the overall cost of TB care including the travel expenses is higher than that is usually considered (Wang et al, 1996).

Over 80 percent of TB cases are in rural areas, where more health resources are needed (WHO, 2009). In China, the health units in rural areas are divided into three levels: county, township, and the village. Counties have several hospitals; townships have a small hospital or a clinic, while villages have only simple clinics staffed by doctors (Blumenthal & Hsiao, 2005). Compared with big hospitals in urban areas, there are only limited health facilities available in rural areas (The World Bank, 2007). This limits the health care services for TB or MDR-TB patients in rural areas.

Since early detection of TB cases is important in preventing MDR-TB, strengthening the current TB reporting and referral system is essential. However, TB control programs do not have sufficient funds to offer attractive financial incentives for village and township level health care providers to detect and refer TB cases (Cai et al, 2003). Funds are also needed for effective health education and promotion of TB and MDR-TB control services (Xu et al, 2007). For the health care system in poor counties, the government budget covered only 40-

60% of the salary of health care workers. User charges are the major source of finance to support operations (Wang et al, 2007). As a result, there is an incentive for the providers to offer unnecessary care such as overuse of drugs or high technology tests for patients in order to create income from user fees (Yao et al, 2008). It has been shown that both the type and quantity of prescribed antibiotics are influenced by the health care financing system and related incentives in China (Dong et al, 2006).

8. Lack of co-operation and co-ordination between health facilities

Low referral rate

According to the World Health Organization, patients suspected of having TB should be referred to TB dispensaries for further diagnosis and treatment. However, the majority of TB suspects go to the TB dispensaries by themselves without a doctor's referral. This occurs because of the lack of knowledge and awareness of TB symptoms by general health care providers and the loss of future private fees for referring doctors (Guang et al, 2008). Studies have indicated that the referral rate is not defined by the level of the hospital or the test equipment involved, but rather by the communication or cooperation between health care facilities and local TB dispensaries (Xie et al, 2009). Consequently, strengthening the coordination and cooperation between different healthcare and TB service providers will contribute to improving referral rates to TB dispensaries.

Suggestions and recommendations

In China, the emergence and spread of MDR-TB has hampered the progress of the TB prevention and control, created a severe public health and social issue (Yang et al, 2006).

1. Increasing TB and MDR-TB case detection rate

To increase the TB and MDR-TB cases detection rate and obtain more complete and reliable data, besides the successful DOTS implementation to the whole country, a nation-wide health seeking awareness is needed. Moreover, there is an urgent need to complete and strengthen the current reporting, referral and tracking system for TB and MDR-TB patients nationally (Xu et al, 2006).

Although, according to the Ministry of Health of China, the coverage of DOTS has reached 100 percent of the target population (MHC, 2009), it is still uncertain that the TB programs have reached all the poor and the high risk populations.

2. Education and communication (Public awareness)

By developing and implementing a practical strategy, especially for poor areas in China, the information related to TB and MDR-TB should be widely available to the public and the leadership at all the levels of government. The curability of TB and the fact that delayed or inappropriate treatment of TB may lead to MDR-TB should be made the central part of these campaigns, in order to improve coverage and eliminate stigma. In addition, the public needs to be well-

informed through all media about the government policies on fighting TB and MDR-TB, such as the fact that TB patients can get free diagnosis and treatment at any TB dispensaries nationwide.

3. Good TB control and tracking system for the high risk population, especially, the “floating population”

To have an effective implementation of the TB surveillance system, especially for the poor areas where there is usually a higher prevalence rate, getting support from the local governments and politicians is essential. A community-based TB surveillance system can be set up together with the national reporting system with the special attention and financial support of the government (Tang, 2005).

Tuberculosis control measures should also reach the “floating population”. As a high risk population, the “floating population” needs special attention from the government, due to the huge number of people affected in the vast territory of China, and their “floating” character. The reduced management of confirmed TB cases and the uncompleted treatment among the “floating population” is a priority for MDR-TB control in China (Jia et al, 2007). A pilot study of “floating population” TB control was conducted in 7 eastern provinces of China between 2006 and 2008 (Li et al, 2010). This study showed that improvements of TB

detection and treatment among the “floating population” were possible by strengthening the management of TB.

One possible approach could be establishing a TB treatment booklet for active TB cases in the “floating population”, which patients are required to present at their next visit either to the hospitals or TB dispensaries. The booklet would have all the TB related information recorded by the health care professionals on each visit to hospitals or local TB dispensaries. They would then be registered as a “floating population” TB case when they receive their booklets. The booklet would be free of charge, and the patients who present them on their next visit would have the priority of test and treatment. When the entire treatment course is completed, all the information would be fed back to the TB dispensary where they were first registered. This would help to ensure that all the TB or MDR-TB cases are tracked or followed wherever the patient is.

4. Ensure the Quality of health care service

Besides the healthcare-seeking awareness from the public, the other important part is ensuring the good quality of health care service when the TB or MDR-TB patients present themselves at local health care facilities, especially in rural areas. The establishment of a high-quality continuous system for TB and MDR-TB management is urgently needed (Chen, 2009).

Since the epidemiology of tuberculosis is affected by multiple social and biological factors, it is difficult to assess the specific effect of DOTS. Nevertheless, it is important to implement DOTS carefully and with critical appraisal of what can be done to make DOTS work well. The implementation of the DOTS program should consider the patients' needs more and be more flexible and convenient (Khan, 2005). Education channels and treatment support should also be emphasized, especially in rural areas with poor health infrastructures and a shortage of human resources.

Strategies to strengthen the implementation of standard clinical guidelines for MDR-TB diagnosis and treatment are urgently needed for TB dispensaries and general hospitals. The network of TB laboratories needs to be completed and the strategies on how to enhance lab capacity building for MDR-TB diagnosis is also needed (WHO, 2008).

Each level of TB control dispensary or centre should have the infection control manual ready for staff, and the National TB Control Center should reinforce infection control strategies and measures under strict regular supervision. Regulations and laws need to be set up regarding MDR-TB clinical guidelines as well as a strict referral system for health care providers at each health care level. The corresponding bonus and penalty should apply to the health care providers who either follow the guidelines or obey the rules. A corresponding supervision system is also needed to be set up.

For MDR-TB, early detection and treatment is crucial. It is recommended that an appropriate treatment regimen with strict principles be followed while treating MDR-TB patients (Mukherjee, 2004) (WHO, 2008). Given the lower potency of second-line anti-tuberculosis drugs, the quality of anti-tuberculosis drugs needs to be ensured for each health care facility, and the use of anti-tuberculosis drugs, especially the second-line anti-tuberculosis drugs, needs to be regulated (China CDC,2008). Moreover, further clinical research is needed to make sure the best remedy is used as the treatment of MDR-TB becomes available even in resource-limited areas in China (He et al, 2010).

For re-treated TB cases, the high acquired resistance rates point to suboptimal initial treatments and insufficient case management of new TB patients, which raises a challenge for the National TB Control Programs in China (WHO, 2010). Another strategy to help improve the quality of health care services for TB and MDR-TB cases is continuous education of physicians or primary care providers. Poor clinician compliance with WHO TB treatment guidelines, in particular with TB regimens, has been documented, which contributes to the high incidence of MDR-TB (Uplekar, 1998) (Arif et al, 1998). There is also a need to strengthen the regulations according to the “National TB Prevention and Control Manual” and to speed the progress in addressing the crisis of TB health care and the TB control workforce in China (MOH, 2008). Considering that hospital clinicians play the key roles in identifying suspected

MDR-TB cases and referring them for TB dispensaries, it should be understood by the clinicians that all the previous treatment needs to be taken into account when a patient is re-evaluated. Clinicians also need to become familiar with the national guidelines of TB and MDR-TB patients' management, and should know when and how to seek expert consultation. Thus, further education of clinicians or health care workers on the proper referral and treatment of TB and MDR-TB patients is essential.

China still has inadequate human resources to ensure the quality of basic TB control services. Research indicated that insufficient numbers, inadequate distribution, lack of adequately qualified or trained staff at different service levels, and low motivation were commonly described with regard to the health work force (Figueroa-Munoz et al, 2005). Expanding services into new interventions, such as the diagnosis and management of MDR-TB, will be a big challenge for China's National TB control programs.

5. Financial Support

To improve the equity and accessibility of health services for TB and MDR-TB cases, increasing the coverage of medical insurance or financial support for rural residents, low-income people, the "floating population" and other vulnerable groups is necessary (Chen et al, 2002). As for rural residents with TB, although they are being provided with free diagnosis and treatment, the indirect cost related to TB or MDR-TB treatment is still a heavy financial burden.

Therefore, additional resources for TB program in poor areas may be indispensable for improving MDR-TB control program implementation (The World Bank, 2007).

Furthermore, a fiscal system needs to be established by the central government to ensure the funding transfer to rural areas and programs for vulnerable populations. It is also suggested that the government establish a multi-source financing arrangement with the major funding coming from the government in combination with funds from the international community (Wang et al, 2007). To ensure the earmarked budget goes directly to the areas needed mostly, the local government needs to establish reliable strategies on making effective use of the funding.

In addition, to improve the direct referral of TB or MDR-TB cases from general health care providers to local TB dispensaries, an alternative financial incentive mechanism is recommended, especially for village and township health care physicians. This would significantly shorten the delays in TB diagnosis and treatment in China (Meng, 2003).

6. Co-operation among hospitals and CDCs

There is a lack of cooperation between central and district or village level health facilities, and a lack of cooperation between hospitals and TB dispensaries. The disincentives for physicians working in hospitals to refer TB or

MDR-TB patients to local TB dispensaries should be addressed administratively (MOH, 2005). According to the most recent national surveillance, the highest incidence MDR-TB areas are those with poor socioeconomic conditions and in which people have limited access to tertiary care (China CDC, 2008). It would be hard to restrict the treatment of cases of MDR-TB only to specialized centers for those areas. Hence, the collaboration among health care facilities in different socioeconomic areas is needed as well. A cooperative network of TB care agencies including general hospitals, TB dispensaries and community health centers needs to be set up for the implementation of MDR-TB programs in China.

LIMITATIONS

Several limitations should be borne in mind. This study assessed MDR-TB prevention and control in China, but much of the data related to MDR-TB were mixed with TB control data in China, and it was very difficult to separate the two. Also, the latest national survey showed that the prevalence of acquired drug resistance was much higher than that of primary drug resistance in China (Yang et al, 2010). This further proves that good TB prevention and control is the base of successful MDR-TB control. Thus, the data and trends of TB are relevant to MDR-TB in China.

The validity of the data has limitations. To date China doesn't have published national MDR-TB data except for a few pilot studies in some provinces. It is difficult to generate the findings from individual studies because of the variations in study settings. Because of the huge size of the country, the diverse population density, and the uneven economic development in China, the magnitude and pattern of drug resistance TB may vary by region, it is difficult to get the precise estimates of MDR-TB facts nationwide. Also, given the prevalence of TB in China, the numbers of TB cases are relatively small when the national TB surveillance data are stratified by age, sex and provinces (National TB Epic survey, 2008). As well 70 percent of the samples are males in the national TB survey in 2008, which may bias the results.

Also, since only authorized governmental or specific research institutions can get access to some information system, this limited the availability of some information and data for this study. Instead of detailed data and facts of MDR-TB, this study is relatively high-level and the points raised are giving a general view of MDR-TB in China. Therefore, in spite of the limitations mentioned, this study provides a valuable look at the status of MDR-TB program interventions and implementation.

CONCLUSION

Although the Chinese government has made impressive improvements in program implementation to address TB and MDR-TB control nationwide, the MDR-TB epidemic is still very serious in China. Given the huge population of the country, the high prevalence rate of MDR-TB is significant. Low TB case detection rates, poor TB or MDR-TB control among the “floating population”, inappropriate treatment and poor compliance of patients for various reasons, such as financial or limited health resources are the main barriers to MDR-TB control success in China. With detailed analysis of these barriers, recommendations and suggestions were brought out for the consideration of the government and related health care authorities.

It should be noted that in the survey of 2000, among all the collected specimens, the analysis rate for drug resistance was only 0.1 percent (392/365,097) (Chinese Antituberc Assoc, 2002). And the central government started paying special attention to MDR-TB only five years ago (China CDC, 2006) right after the national TB reporting system was set up in 2005. This may explain why many gaps still remain to be addressed.

China is a big country with a special culture and a health care system different from western countries. Achieving the goals and objectives of *The Global Plan to Stop TB: 2006-2015 and Millennium Development Goals (MDGs)*

will be difficult without detailed further examination of the whole health care system, and its reform history (WHO, 2010). Since the SARS outbreak in 2003, infectious disease control and prevention has drawn much more attention from both the government and the public. A series of reform measures and policies have been executed since then.

At the recent 'Ministerial Meeting of High M/XDR-TB Burden Countries' in Beijing in April 2009, the Ministry of Health of China and the Chinese CDC announced a national target for MDR-TB prevention and control. The related policies and financial support were updated to help integrate TB and MDR-TB control services (China CDC, 2009).

As one of the top priorities of government in infectious disease control in China, MDR-TB prevention and control has both challenges and opportunities. By establishing and improving the TB and MDR-TB monitoring and evaluation system with government financial and health resources support, effective control of TB and MDR-TB in China is possible.

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