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Risk Factors of Treatment Outcomes for Multi-drug Resistant Tuberculosis in Shanghai, 2009-2012

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Abstract

Background: Multi-drug resistant tuberculosis (MDR-TB), defined as resistant to at least isoniazid and rifampicin, has imposed serious risks on public health globally. China has the largest number of MDR-TB patients, and a prevalence rate two times of the world average. The study investigated the association between MDR-TB treatment outcome and patient risk factors, including physical accessibility to TB hospitals.

Methods: We collected all the 336 MDR-TB cases reported in Shanghai between 2009 and 2012 from Shanghai CDC regarding information on age, gender, resident status, treatment history, and outcomes. Using the Geographical Information System (GIS), TB hospitals and study subjects' locations were geocoded on digital maps. To identify the statistically significant geographical clusters, kernel density estimation (KDE) and Average Nearest Neighbor (ANN) index were used. Logistic regression analysis was employed to determine the association of spatial and non-spatial variables on the occurrence of poor treatment outcomes.

Results: The spatial clusters of MDR-TB cases were concentrated in the most densely populated central urban areas. There was a tendency toward higher odds of poor treatment outcomes among aged>45 years old (aOR 3.251; 95%CI 1.527-7.21), residential (aOR 2.566; 95%CI 1.154-5.88), retreated (aOR 2.566; 95%CI 1.154-5.88) and sputum smear positive (aOR 3.286; 95%CI 1.154-11.66) MDR-TB cases. Both the straight-line distance and the road distance from a patient's home to the related TB hospital were significantly associated with poor treatment outcome with an odds ratio of 1.04 (95%CI 1.009-1.08) and 1.029 (95%CI 1.005-1.06) respectively.

Conclusion: This study highlights the effect of spatial and non-spatial determinants of MDR-TB treatment outcome, particularly with regard to physical accessibility to the TB hospitals. Accordingly, non-spatial factors in terms of previous treated status need

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for more attention by public health policy makers, and then more focus should be placed on the health delivery system, particularly in elderly patients. In addition, using the GIS application with a view to MDR-TB distribution and physical accessibility to hospitals is a novel method in Shanghai and it can be developed to reach other related public health disciplines.

1. Introduction

Tuberculosis (TB) is re-emerging as one of the top challenges in China. Multi-drug resistant tuberculosis (MDR-TB), defined as resistant to at least isoniazid and rifampicin, is a major barrier to TB control, especially in high burden countries such as China[1]. The World Health Organization (WHO) estimates that China has the second largest number of MDR-TB cases globally[2]. The national baseline TB survey in 2007–2009 found that 8.3 % of cases were MDR-TB, predicting approximately 120,000 new MDR-TB cases annually, and 5.7% of new cases and 25.6% of previously treated cases had MDR-TB[3].

The Chinese government started the programmatic management of MDR-TB in 2008, supported by the Global Fund to Fight AIDS, TB and Malaria (The Global Fund, Geneva, Switzerland). Laboratory and clinical capacity was strengthened in designated TB hospitals at the prefectural level to turn them into MDR-TB diagnosis and treatment centers[4]. MDR-TB requires prolonged treatment with costly second-line anti-TB drugs (SLD), leading to health system opportunity costs, adverse effects, and financial impacts for patients[5-7]. Patients with MDR-TB have a low treatment success rate: 48 % globally and 50 % in China[8]. Recurrence and treatment failure are more common for drug resistant than drug sensitive TB[9, 10], and the treatment outcomes of MDR TB patients have been less favorable than that of TB patients whose disease is caused by a susceptible strain of M. tuberculosis[11, 12].

In spite of the evidence indicating the contribution of non-spatial characteristics, including age, gender, low education achievement, domicile and social class to determine the outcomes of MDR-TB treatment[13, 14], the spatial factor in terms of physical accessibility to the related TB hospitals during the treatment course has been less considered. Moreover, reasons for poor treatment outcomes are multifaceted and involve a combination of spatial and non-spatial factors, along with how health policy was formulated to deliver health care services[15, 16].

Shanghai, an international metropolis, is the most populous city in China, with more than 23 million inhabitants in 2010[17]. The health needs and implications of this sizeable population are considerable and constitute a vast challenge to its public health. There are a few studies on spatial patterns of TB and their related treatment outcomes that have focused on non-spatial factors. These studies have shown a link between ethnicity, previous unsuccessful treatment, age and sex with anti-TB drug resistance[18-20]; however, information on the effect of spatial and non-spatial determinants on MDR-TB treatment outcomes is scare. Therefore, this retrospective study aimed to address whether or to what extent spatial and non-spatial factors with a focus on the healthcare delivery system would affect successful MDR-TB treatment outcomes in Shanghai.

2. Methods

2.1. Study area and population

Shanghai had a total of 16 sub-districts, and were further divided as central urban, peri-urban and rural areas according to the population density and economic functions[21]. We performed a retrospective cohort study using the existing data of all MDR-TB patients who were diagnosed and reported by the Shanghai TB Program at the Shanghai CDC from 01 Jan 2009 to 31 Dec 2012. In China, passive case finding was the major method to identify adult patients who are susceptive of having TB, i.e., those who have coughed over 2 weeks, having fever, weight loss, night sweats and abnormal chest radiography were referred or self-referred to the TB designated hospitals, where they were diagnosed of TB according to China national guidelines. All patients provided three sputum