

The married middle working class turned out to be the most financially fragile group when facing multidrug-resistant tuberculosis in China cities

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Research article

Keywords: MIDDLE WORKING CLASS, CHINA, TUBERCULOSIS

Posted Date: December 23rd, 2019

DOI: <https://doi.org/10.21203/rs.2.19439/v1>

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Abstract

INTRODUCTION With the emergence of multi-drug resistant tuberculosis and the threat it poses to public health, and the consequential cost involved in its treatment, constant effort has been put on evaluating and improving patient care to avoid treatment interference due to impoverishment of the household.

OBJECTIVE The aim of this study was to analyze socioeconomic burdens and other difficulties MDR-TB patients in cities are facing to identify major obstacles and which group of patients are most affected. **METHODS** Face-to-face and phone-call interviews were conducted in early 2018 to follow up with patients newly diagnosed with MDR-TB in 2017 in three tuberculosis clinics in China. Demographic data and information on their medical care, insurance coverage, medical expenses were collected and analyzed.

RESULTS A total of 144 newly-diagnosed MDR-TB cases were reviewed during the study period, among them 38 lost follow-up and 29 patients refused to participate. Eventually, 77 patients with MDR-TB were included in this study. 61 of these patients were hospitalized after MDR-TB diagnosis with an average hospital stay of 14.45 days, of them 57 were sputum positive on diagnosis. Ratio of home-discharged patients failing community care and returned to work were 48% and 8% for married and single persons ($p = 0.001$). In terms of insurance coverage, proportion of patients went back to work were 23% with no insurance and/or NRCMS and 45% with UEBMI / URBMI and commercial insurance. Significant difference was shown between these two insurance coverage groups ($\chi^2 = 5.059$, $p = 0.033$). Difficulties patients encountered were financial pressure (33%), psychological stress (26%), adverse drug reactions (23%), repulsive reaction to injections (17%). 48% of the patients spent over CNY2,000 (USD300) per month on TB treatment.

CONCLUSION The married “middle working class” were found to be the most vulnerable group being affected financially. They have the highest tendency to fail community care schedule despite treatment status. It is of utmost urgency to enhance the current medical policy to cater for this group and improve treatment adherence.

1. Introduction

Tuberculosis (TB) is a pressing public health problem affecting millions of people globally every year and China is one of the high caseload countries. Even worse, China is among the top burden countries of multidrug-resistant tuberculosis (MDR-TB)[1]. Provision of care and support for these patients and disease control has become more challenging and a top priority concern.

It has been proved long before that with infectious disease, poverty is a major obstacle to cure and impoverishment can lead to adverse effect to disease control[2]. The China government has introduced various measures to help combat poverty resulted from medical treatment. The three Government subsidized insurance programs were the result of a nation-wide health system reform[3-5]. The New Rural Co-operative Medical Care Scheme (NRCMS) targets at rural populations including farmers and the low-

income groups. Cost of insurance is CNY30 (USD4.5) / year which is minimal to make it affordable for the rural poor[6, 7]. The Urban Employee Basic Medical Insurance (UEBMI) covers the general working class and one thing worth to note is it is of a mandatory nature. Premium is 8% of an employees' wage of which 6% is contributed by employers and it provides a generally higher medical coverage. The Urban Residents Basic Medical Insurance (URBMI) is a household-level-voluntary medical insurance for those not covered by UEBMI, including children, students and other non-working residents[4, 5]. Despite the enormous effort, shortfalls still existed in certain aspects such as protection coverage and effectiveness.

In this study we aim to investigate real life problems encountered by MDR-TB patients in three generally mid- to high- income cities, identify major difficulties and suggest ways to tackle them via public health policy enhancement. The goal is to achieve higher cure rates and lower transmission rates through improving the overall wellbeing of these patients.

2. Methods

2.1 Study Population

A total of 144 newly diagnosed MDR-TB patients were recruited from three tuberculosis clinics from 3 China cities in 2017 in this study. 67 cases were excluded as 38 of them lost follow-up and 29 patients refused to participate, leaving 77 patients in this study. Face-to-face and phone-call interviews were conducted by their TB clinicians in early 2018. (Figure 1)

2.2 Questionnaire design

The questionnaire was designed to focus on the following aspects: 1/ sociodemographic characteristics, 2/ medical condition and care received, 3/ difficulties encountered, 4/ family financial situation and insurance coverage, 5/ amount spent on medical expenses and 6/ adherence to suggested community care (home isolation) schedule.

Sociodemographic characteristics included age, gender, marital status, occupation and education level. Medical conditions were presented in the form of length of hospitalization, result of sputum smear on diagnosis. Questions to measure the difficulties faced included financial hardship, fear of syringe injection, inconvenience in clinic visit trips, adverse reaction to prescribed drugs and psychological pressure. Patients were free to quote more than one problem. Questions to measure household economic conditions and medical expenses incurred included type of insurance and coverage, monthly self-pay amount on TB medications and adherence level of suggested community care schedule were reflected by questions on when these patients returned to work.

2.3 Statistics Analysis

Data analysis was conducted using Statistical Analysis System (SAS 9.2 version). Chi-square test was used to measure difference between high and low insurance coverage groups. *P*-values were reported to assess the statistical significance ($p < 0.05$) of the difference.

3. Results

3.1 Demographic characteristic (Table 1)

A total of 77 patients comprising 56 male and 21 females in the age group of 18-68 were interviewed in this study. Among them 70% were married. 70% were non-local patient. In terms of income, over 66% of them were from the no- and low-income group. Proportion of patients returning to work on hospital discharge were 48% and 9% in married and single persons ($p = 0.001$).

3.2 Medical Care received (Table 2)

79% (61) of the patients were hospitalized after MDR-TB diagnosis with an average hospital stay of 14.45 days. 74% (57) of patients were sputum positive on diagnosis.

3.3 Insurance Coverage (Table 3)

In our study, 26.0% (20) of the patients were covered by NRCMS, 53.2% (41) covered by UEBMI & URBMI, only 1.3% (1) covered by commercial insurance, 19.5% (15) had not bought any medical insurance for themselves. Proportion of patients went back to work were 23% with no insurance and/or NRCMS and 45% with UEBMI / URBMI and commercial insurance. Significant difference was shown between these two insurance coverage groups ($\chi^2 = 5.059$, $p = 0.033$).

3.4 Difficulties faced during treatment (Figure 2)

During MDR-TB treatment, patients encountered a range of difficulties including financial pressure (43%), psychological stress (34%), adverse drug reactions (30%), repulsiveness towards the use of syringe injections (23%). Patients in this study were free to choose more than one difficulty.

3.5 Financial burden (Figure 3)

On average, 48.1% (37) of the patients spent over USD300 per month on treatment. 28.6% (22) patients incurred costs of between USD150-300 per month. 23.4% (18) patients spent an additional of less than

USD150 per month.

4. Discussion

Multidrug-resistant tuberculosis (MDR-TB) poses a huge challenge to public health system in terms of treatment costs and disease control[8]. In 2012, the China government laid out a program for the treatment and care of MDR-TB, suggesting hospitalization and community care (home isolation) for patient management. It recommended patients to be hospitalized for about 2 months, followed by community care until treatment completion[9]. However, this was constrained by the variance of medical resources, infrastructure and their availability in different areas of China. Home isolation schedule adherence is also poor due to catastrophic cost associated with the disease[10]. We conducted a survey with enrollment from 3 mid- to high-income cities of China to review and identify potential factors and their impacts on city patients. Suggestions on improving and enhancing future policy design were then made based on the findings.

Beijing is the capital of China. Shenzhen is a special administrative region and enjoys a prime geographic location. Jiangmen is part of the Guangdong province and is benefitting from its fast development. These 3 cities are characterized by a relatively high GDP with a correspondingly high cost of living.

4.1 Risk of transmission from home-discharged “mid-income” patients

It has been reported that effective treatment of MDR-TB patients can quickly reduce its contagiousness[11, 12]. Some studies focusing on treatment outcome also claimed ambulatory-based MDR-TB management is more cost effective than hospital-based schemes[13-15]. Theoretically three weeks of effective treatment is enough to have the infectiousness of MDR-TB significantly controlled[11, 16].

However, treating MDR-TB is far more complicated. It has been reported that pooled treatment success was about 60% in MDR-TB patients[17, 18]. In the absence of new drugs such as bedaquiline, delamanid and linezolid, the success treatment outcome of MDR-TB with standardized second-line regimen in China before 2018 was only about 50%[19, 20]. We doubted that part of the MDR-TB patient with treatment failure were turned into XDR-TB in the end and undermined a large part of the efforts made in disease control. It has been reported that high rates of transmission from patients to exposed persons occurred when treatment regimens were ‘ineffective’[11]. Dheda, et al. reported that highly drug-resistant strains were spreading in the community from home-discharged patients and generating secondary cases with poor treatment outcomes[21].

Recent studies from China using genomic epidemiological approach have shown that new infection was the main cause of MDR-TB, and smear-negative tuberculosis patients are also part of the source of

transmission[22-25]. It is unclear how many of the patients still on treatment regimen were contributing to the spread of the disease.

Therefore, the risk of transmission is a challenge that needs to be addressed immediately. Our study showed that about 80% (61) MDR-TB patients were hospitalized and 74% (57) of them were smear positive at the time of admission. Average hospital stay for these patients were 2 weeks, which is below the suggested length of inpatient care. 36.4% (28) patients returned to work and participated in social activities immediately afterwards. This is especially true for those who were married and were the bread earner. Findings in our study showed a substantial difference in the ratio between the married (48%) and singles (9%) in returning to work during the suggested home isolation period. *"If I do not go to work, the family has not enough income, and I might be out of job and cannot pay the premium on my own. Without insurance coverage, I have to absorb all costs of medical treatment. This is the vicious outcome my family and I cannot afford."* A MDR-TB patient who worked as a taxi driver told us. This behavior, however, posed an alarming transmission threat to the community. Performance-linked incentives can be provided from care provider's level down to include patients to promote treatment adherence on a two-sided monitoring basis.

4.2 Financial hardship and catastrophic cost

The costs for treating MDR-TB were reported to range from US\$1,218 to US\$83,365 per case[8, 26]. This includes treatment cost, and other indirect costs such as transport cost and income loss. Potential loss of insurance coverage as a result of job lost could further aggravated these patients' financial burden. Despite constant efforts the China Government made in health care measures trying to ease financial difficulties, but many kinds of medicine are not provided free of charge, especially new effective medicines such as linezolid and cycloserine. Many MDR-TB patients reflected that one of the major problems from the illness was still financial hardship[27-29]

Many studies have proved total cost spent on treating MDR-TB to be catastrophic for patients from most low- and middle-income families[30, 31]. Surprisingly we found the middle working class were struck the hardest financially. Their relatively high cost of living, with an expensive-to-treat disease left them with a drained disposable household income. Their urge to return to work despite treatment status was the most alarming among all income groups.

Our study showed a direct relationship between the proportion of patients failing community care and the increase in foreseeable self-borne medical expenses. From the perspective of insurance coverage, 100% of patients obtaining self-paid commercial insurance and 46% of patients under UEBMI / URBMI returned to work before they were supposed to do so. Under UEBMI, employer has to pay 75% of premium for the employee. If one is out of job, they would have to bear full premium in keeping the insurance. Only 20% of patients without insurance coverage returned to work on hospital discharge, which is lower than the group covered by NRCMS (25%).

The same observation was reflected by out-of-pocket expenses. When monthly expenditure went above USD150, over 39% of patients chose to return to work despite the suggested home isolation care. This is true for patients under all kinds of insurance except NRCMS. The reason behind this could be the cost of keeping the insurance coverage. Premium for NRCMS is only USD4.5 / year which is way below any other insurance premium included in this study.

In combating this problem, the government could consider full medical coverage for MDR-TB patients, through special TB protection and registration programs, to enable expenses to be credited directly to the government, or an appointed agent. This can simplify the application and reimbursement process made on a per visit basis, and sooth patient's fundamental financial difficulty.

4.3 Problems faced during treatment and possible solutions

Although WHO had downregulated the importance of second-line injections in 2018, it was still widely used in many MDR-TB regimens in China in 2017[32, 33]. When new drugs are unavailable, clinicians will resort to injection to construct part of an effective regimen. The pain and uncomfortable experience with injection discouraged most patients from adhering to treatment. And deficient regimen and insufficient treatment are among the main causes which led to more drug resistance and treatment failure[34, 35].

Furthermore, most anti-MDR-TB drugs have obvious toxic side effects which cause treatment adherence failure. A 62-year-old female MDR-TB patient in our study has stopped treatment on her own several times. Her current drug sensitivity test turned out to be XDR-TB.

In addition, most MDR-TB patients suffer from severe psychological stress[36, 37]. Worrisome thoughts included their illness being difficult to cure and the fear of spreading the disease to their family and friends. At the same time, they also worried about being isolated and alienated by their friends and family.

Providing care providers with free TB drugs and patients with new and effective oral medications, counselling service, and organizing patient groups to share experience will help them get the emotional support they need to complete treatment. This in turn would reduce disease spreading and minimize drug-resistance TB to be further developed.

There were some limitations in our study. Firstly, the participants were only from 3 cities therefore are not representative of all MDR-TB patients. The lack of control groups hindered comparisons with other population groups. Secondly, some patients refused to be interviewed or lost contact, which may have contributed to a loss of important relevant information and caused selection bias leading to underestimation of the difficulties the overall MDR-TB patients are facing. Thirdly, the study had not measured the risk of disease transmission from these patients who were currently on TB treatment,

therefore no conclusions can be drawn on the relationship between airborne risk and infection risk spread by the said patients in the current study.

In summary, poverty and TB control has long been proved to have an inverse correlation. Tackling the problem must start from the root cause to alleviate caseload, all the way up to follow-up management of patients to minimize transmission and disease progression. Funding, free effective new oral medicine, providing patient-centred support and performance-linked incentives together could make a major step towards treatment success for TB.

Abbreviations

MDR-TB: Multidrug-resistant tuberculosis

XDR-TB: Extensively drug-resistant tuberculosis

TB: Tuberculosis

NRCMS: The New Rural Co-operative Medical Care Scheme

UEBMI: Urban Employee Basic Medical Insurance

URBMI: Urban Residents Basic Medical Scheme

CNY: Chinese Currency

USD: United States Dollars

Declarations

1. Acknowledgement

The authors are grateful for the continued academic support from The National Clinical Research Center for Infectious Disease in China and China Tuberculosis Clinical Trial Consortium (CTCTC).

2. Source of funding

This study was funded by the 13th Five-Year Major Science and Technology Project of China(2018ZX10715004-002-007) which is a government fund for the research of tuberculosis treatment and control.

3. Authors' contributions

Peize Zhang: Project coordination, training of data collectors, data analysis, manuscript preparation and drafting. Guanghui Xu, Yanhua Song, Jie Tan, Tao Chen: face-to-face and phone-call interview, manuscript review. Peize Zhang, Guofang Deng: Conception and design of work, manuscript review. All listed authors have read and approved this manuscript.

4. Availability of data and materials

The data sets used and / or analyzed in this study are available from the corresponding author on reasonable request.

5. Ethics approval and consent to participate

Ethical approval for the study was granted by the Research Ethics Committee at the 13th Five-Year Major Science and Technology Project of China. Participants were informed in the local language explaining the study purpose and design, confidentiality, risks and benefits and freedom to refuse. All participants provided dated signature in face-to-face interview or verbal consent in the phone call interview.

6. Consent for publication

No individual or identifiable persons' details are included in this manuscript.

7. Competing interest

The authors declare no competing interest.

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Tables

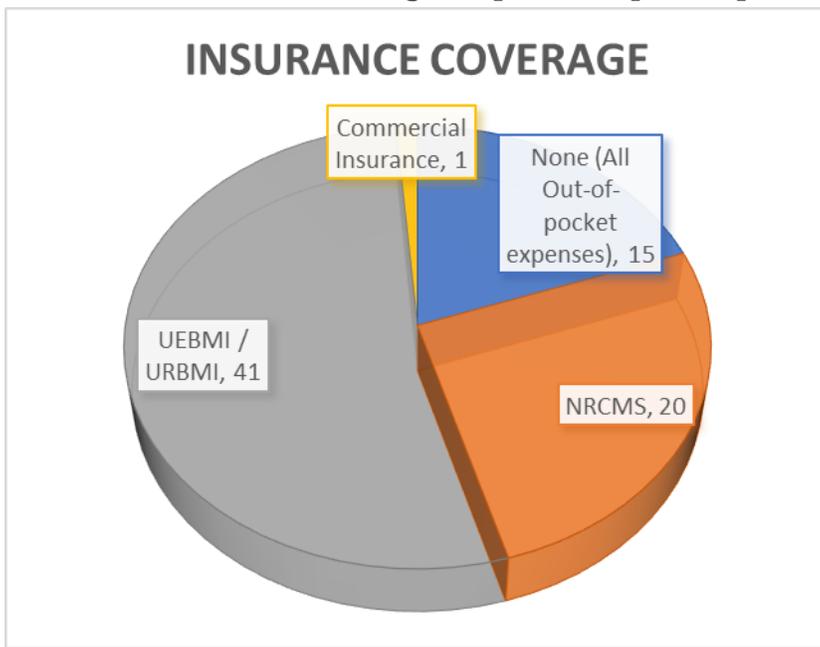
Table 1. Demographic characteristics of patients participated in this study

Characteristics	No. of patients	Proportion of total no. of patients (%)	No. of patients failed community care	Proportion of the group (%)	p-value
Gender					
Male	56	73%	18	32%	0.200
Female	21	27%	10	48%	
Age					
18-35	29	38%	6	21%	0.090
36-50	21	27%	10	48%	
>51	27	35%	12	44%	
Marital status					
Single / Divorced	23	27%	2	9%	0.001 ■
Widowed					
Married	54	70%	26	48%	
Residency					
Local	23	30%	10	43%	0.400
Non-local	54	70%	18	33%	
Occupation					
Student	8	10%	0	0%	0.090
Worker / Farmer	23	30%	6	26%	
White Collar / Officer / Specialist	18	23%	10	56%	
Others (temp jobs part-time jobs / unemployed)	28	36%	12	43%	
Education level					
Primary	9	12%	4	44%	0.500
Junior high school	25	32%	10	40%	
Senior high school	24	31%	10	42%	
College*	19	25%	4	21%	
*all students are in this group					
■ significant difference observed					

Table 2. Medical care for patients participated in this study

Characters	Total (n=77)	Proportion of total (%)	Patients failed community care	Proportion of the group (%)	p-value
putum smear					
-	20	26.0%	7	35.0%	0.9
+	31	40.3%	11	35.5%	
++	7	9.1%	3	42.9%	
+++	19	24.7%	7	36.8%	
hospitalized					
Yes	61	79.2%	20	32.8%	0.2
No	16	20.8%	8	50.0%	
average hospitalized period (Days)	14.45				

Table 3. Insurance coverage of patients participated in this study



Type of Insurance	Patients interviewed		Patients failed community care		Statistics
	No. of ppl	%	No. of ppl	%	
None (All Out-of-pocket expenses)	15	45.45%	8	22.86%	$\chi^2 = 5.059$ $p = 0.033$
NRCMS	20				
UEBMI / URBMI	41	54.55%	20	47.62%	
Commercial Insurance	1				
77					

Abbreviations:

NRCMS - New Rural Co-operative Medical Scheme _____

UEBMI - Urban Employee Basic Medical Insurance _____

URBMI - Urban Residents Basic Medical Insurance _____

Figures

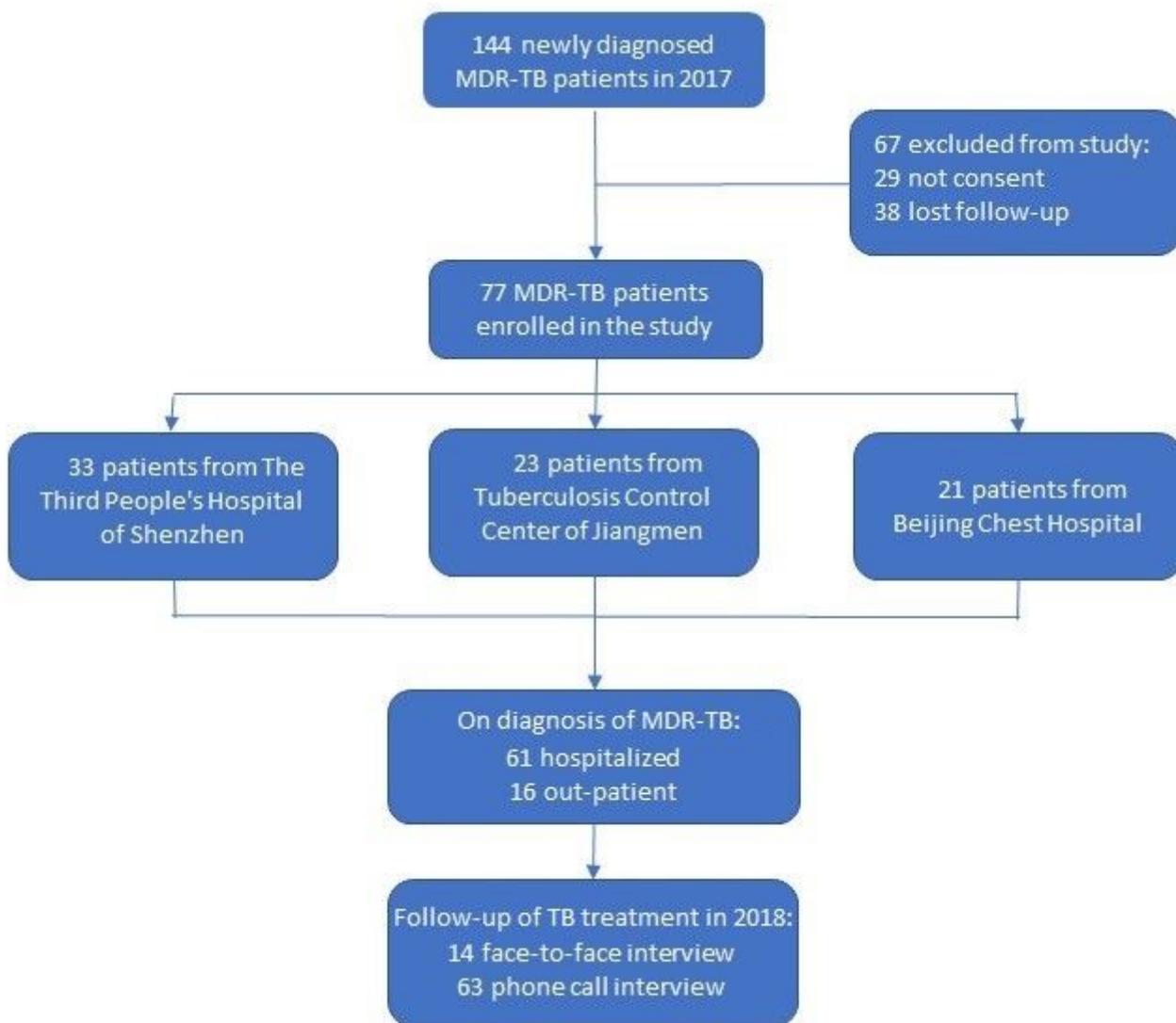


Figure 1

Flowchart of case recruitment in this study

Figure 1. Problems faced by patients with MDR-TB

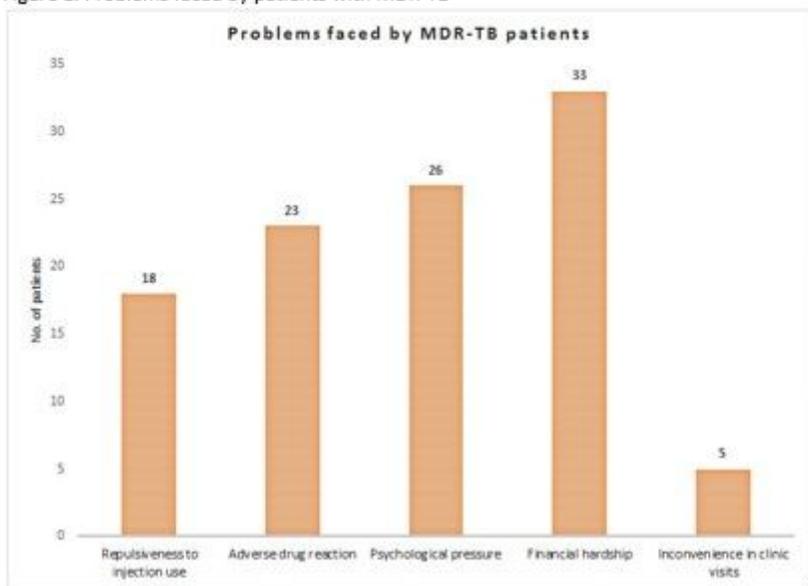


Figure 2

Problems faced by patients with MDR-TB

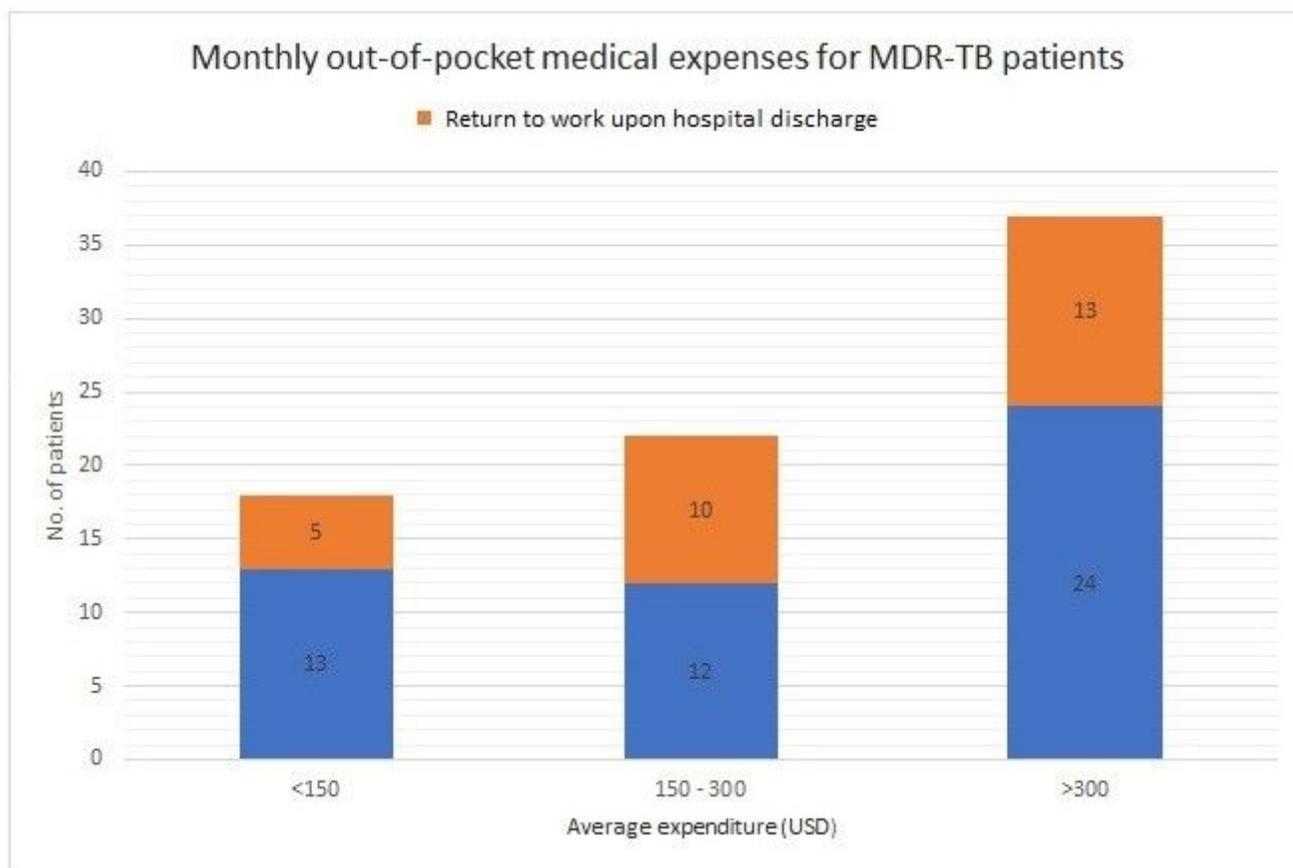


Figure 3

Monthly out-of-pocket medical cost for patients with MDR-TB