AN EPIDEMIOLOGICAL STUDY OF MULTI DRUG-RESISTANT TUBERCULOSIS CASES REGISTERED UNDER REVISED NATIONAL TUBERCULOSIS CONTROL PROGRAMME OF AHMEDABAD CITY

Gneyaa Bhatti*, Sheetal Vyas† and Kartik Trivedi‡

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Summary
Background: The emergence of resistance to anti-tuberculosis drugs in general and Multi Drug Resistance Tuberculosis (MDR-TB) in particular, has become a significant public health problem and an obstacle to effective TB control. Baseline and adequate information on epidemiological factors and their interaction are prerequisites for its effective control.

Objectives: To study socio-demographic profile, housing environment, health-seeking behaviour, present and past history regarding treatment of tuberculosis, drug resistance pattern and the preventive practice adopted by the patients.

Methodology: A cross-sectional study was carried out on 81 MDR-TB patients registered under RNTCP of Ahmedabad City during July 2007-June 2008. To accomplish the objectives, information was collected by personal interviews using pre-designed, pre-tested proforma. Data, so collected, was analyzed and tabulated using appropriate statistical software.

Results: More than 2/3rd were males and majority were in age group 16-45 years, educated up to primary level, living in overcrowded and ill-ventilated houses. Initially almost all had pulmonary TB. At the start of category II, maximum number of patients were defaulters, the prime cause being financial crunch. The mean number of Anti Tubercular Treatment (ATT) taken before start of category IV was 2.85. More than 90% experienced side-effects of drugs. Although indiscriminate skipping was less, other methods of sputum disposal were also unsafe. Resistance to all four drugs (H, R, S & E) was found in more than 2/3rd of cases. Smear and culture conversion rate at three month follow up was 62.0% and 58.7% respectively. Only one patient (1.2%) was reactive for HIV in the study. Most of the patients perceived some degree of improvement in their condition following treatment.

Conclusion: Most of the MDR cases were living in poor environmental conditions, had previous history of TB and defaulter of treatment regimen prescribed. Motivation of private practitioners for increasing referrals, use of incentives and enablers, enhancing contact tracing and increasing awareness regarding sputum disposal practices and measures to prevent the spread are necessary for effective control of tuberculosis. [Indian J Tuberc 2012; 59: 18 - 27]

Key words: Multi drug resistant, Tuberculosis, Epidemiology.

INTRODUCTION

Tuberculosis (TB) is a major cause of illness and death worldwide, especially Asia and Africa.1 There are 22 high burden countries which account for 80% of all estimated incident cases worldwide. Among such countries, India ranks first with two million estimated TB cases as against estimated global annual incidence of 9.4 million accounting for 21% of world’s new TB cases.2

The emergence of resistance to anti-tuberculosis drugs in general and MDR-TB, in particular, has become a public health problem of prime concern in a number of countries and a major bottleneck in effective TB control.3 As per the estimation of WHO, there are nearly half a million MDR-TB hit new cases every year, which is about 5% of nine million new TB cases of all types.4 Management of MDR-TB is a challenge which requires prolonged use of expensive second-line drugs with a significant potential for toxicity.4 Mismanagement of MDR-TB may lead to development of the Extensively Drug-Resistant Tuberculosis (XDR-TB), a virtually untreatable form of TB, which has been recorded in 45 countries.5 Patients with XDR-TB would have to be managed like TB patients in pre-antibiotic era. The economic, social and health security of countries and communities with a high prevalence of TB would be threatened by virtually untreatable TB among the broad-

1. Assistant Professor 2. Professor & Head
* Department of Community Medicine, AMC MET Medical College, Ahmedabad
** Department of Community Medicine, Gautam Adani Institute of Medical Sciences, Bhuj (Gujarat)
Correspondence: Dr. Gneyaa Bhatti, 4, Rajkamal Flats, Jagabhai Park, Maninagar, Ahmedabad – 380008 (Gujarat). Phone (R): (079)25430202, (M): 09427960378; E-mail: gneyaa@yahoo.co.in
winners, parents and economically productive age
groups.

In India, prevalence of MDR-TB is found
to be 2.8% in new cases and 17.2% in previously
treated cases. For the appropriate management
of MDR-TB patients, Revised National
Tuberculosis Control Programme (RNTCP) has
initiated DOTS-Plus activities from August,
2007 in Ahmedabad, a premier city of Gujarat
State. RNTCP has developed national guidelines
based on the WHO recommended international
DOTS-Plus guidelines.

The disease is not only a medical problem
or a public health problem but is also a critical
social problem of great magnitude. Baseline and
adequate information on epidemiological, social,
economic and cultural factors and their
interaction is required for its control and
effective treatment.

With this background, the present study was
conducted among MDR-TB patients registered for
DOTS Plus therapy under RNTCP of Ahmedabad city
with a view to get the information regarding socio-
demographic profile, housing environment, health-
seeking behaviour, present and past history regarding
treatment of tuberculosis, social and other problems
faced during treatment, drug resistance pattern and the
preventive practice adopted by the patients for
preventing its spread.

METHODOLOGY

Study setting

The present study was conducted in
Ahmedabad, a premier city of Gujarat State in western
part of India. The city is divided into six Municipal
zones and there are 10 Tuberculosis Units (TUs) in
the city. It was a cross-sectional descriptive study
carried out during August 2007 to October 2009.

Study population

Study Population consisted of MDR-TB
cases registered under DOTS Plus of RNTCP of the
city from third quarter 2007 to second quarter, 2008
excluding those patients who died or migrated before
the home visit by the interviewers. Total 92 patients
were registered under DOTS Plus register, of which
11 patients were excluded. Therefore, 81 patients
were included for complete analysis. However, a
few of socio-demographic information i.e. age and
sex and results of sputum smear and culture could
be obtained of all 92 cases from the DOTS Plus
register.

Study method

A list of MDR-TB patients registered
during the study quarters under DOTS Plus was
obtained from State TB Training and
Demonstration Centre (STDC) after obtaining
permission from the concerned authority. With
the help of Senior Treatment Supervisors (STS)
and TB Health Visitors (TBHV) of each of the
10 TUs, home visits of all the patients were
conducted after completion of at least 10
months treatment, average being 15 months. All
information to accomplish objectives was
obtained by personal interview of each of the
study subjects for 30 to 45 minutes at the time
of home visit by one of the investigators using
pre-designed and pre-tested proforma. The
proforma contained structured questionnaire
comprising questions for socio-demographic
profile, housing environment, health-seeking
behaviour, present history including symptoms,
treatment and its side effects, problems faced
during treatment, past history regarding
treatment of tuberculosis, contact history, drug
resistance pattern and the preventive practice
adopted by the patients. Subjective perception of
improvement in the condition of the patients
undergoing DOTS Plus treatment, excluding
defaulters, was assessed by asking percentage
improvement in their condition. General
impression regarding DOTS Plus was also
assessed, by inquiring about the difficulties
faced by them in approaching health care provider
at DOTS Plus site or other health facility,
behaviour of DOT provider or other health
personnel and about their overall feeling about
the efficacy or otherwise of the treatment. The
results for HIV reactivity, sputum smear and culture and drug susceptibility testing (DST) were obtained from the records of the patients available at respective TUs. At the RNTCP accredited laboratory, solid egg-based Lowenstein-Jensen (LJ) media was used for culture and DST was performed for Streptomycin (S), Isoniazid (H), Rifampicin (R) and Ethambutol (E) using economic variant of proportion method on LJ media as per the national guidelines.

Definitions used in study

- MDR-TB Suspect: A Category II patient who is smear positive at the end of the fourth month of treatment or later.
- Literate: Person who can read and write with understanding in any one language.
- Overcrowding: Said to be present if floor space area per person is less than 50 square feet.
- Ill ventilation: Said to be present if door and window area combined is less than 2/5th of floor space area.
- Contact/ contact person: The person with confirmed pulmonary TB disease with whom patient might have shared the air environment. Exposure may be close or casual.
- Treatment outcome of contact person: Treatment outcome of a TB case with whom patient might have shared the air environment.
- Secondary case: Person developing the disease following contact to index case.
- Addict: Includes tobacco chewer, smokers or alcohol takers who are regularly taking the same for ≥6 months.
- Ex addict: Includes Ex-tobacco chewers, Ex-smokers or Ex-alcohol takers; those who had formerly smoked or taken alcohol regularly for ≥6 months but got rid of the habit for ≥1 year since the time of interview.

Data analysis

Data so collected was then analyzed and tabulated using Microsoft Excel and SPSS 11.5. Analysis was done by finding out means and proportions and by applying tests of significance i.e. z test, standard error of difference between two proportions and chi-square test.

RESULTS

Socio demographic profile (Table 1)

Age and Sex details were available for all 92 patients while other details were available for 81 patients. In the study population, 83.7% of patients were in the reproductive age group of 16-45 years with mean age of 33.64 ± 11.03 years. Sixty three (68.5%) were males and 29 (31.5%) were females. Literacy rate was 86.4%, of which 61.4% had primary education. Majority of the patients belonged to Hindu religion (70, 76.1%) followed by Muslim and Christian. There were 53 (65.4%) patients belonging to nuclear family and rest to the joint family. Most of the patients 55 (67.9%) were married. Majority of patients belonged to the upper lower class (class IV) of Modified Prasad’s and Kuppuswamy’s Classification. At the time of interview, 45 (55.6%) patients were either unemployed or occasionally going for work. While before start of Category IV, only 13 (16.0%) such patients, which indicates that around 40% of the patients became incapacitated for work after starting Category IV treatment and the difference is statistically significant. (z = 5.77, p < 0.01)

Housing environment

Overcrowding in the house was found in 47 (58.0%) patients. In the houses of 70 (86.4%) patients, ventilation was inadequate.

Health-seeking behaviour and habits

For minor illnesses, about 80% were visiting the private practitioners while rests were attending either Municipal hospitals or Government hospital. However, for major illnesses, most patients gave their preference for municipal hospitals. Scar of BCG vaccine was absent in more than 80% of patients. There were 35 (43.2%) patients who never had tobacco or alcohol, 26 (32.1%) patients were ex-addicts and 20 (24.7%) patients were addicted at the time of interview.
Table 1: Socio Demographic Profile of Study Subjects

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Demographic Variable</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age (n=92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-25</td>
<td>28</td>
<td>30.4%</td>
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<tr>
<td></td>
<td>26-35</td>
<td>25</td>
<td>27.2%</td>
</tr>
<tr>
<td></td>
<td>36-45</td>
<td>24</td>
<td>26.1%</td>
</tr>
<tr>
<td></td>
<td>46-55</td>
<td>14</td>
<td>15.2%</td>
</tr>
<tr>
<td></td>
<td>56-65</td>
<td>1</td>
<td>1.1%</td>
</tr>
<tr>
<td>2</td>
<td>Sex (n=92)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>63</td>
<td>68.5%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>29</td>
<td>31.5%</td>
</tr>
<tr>
<td>3</td>
<td>Education (n=81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Illiterate</td>
<td>12</td>
<td>14.8%</td>
</tr>
<tr>
<td></td>
<td>Primary (Std. 1-7)</td>
<td>43</td>
<td>53.1%</td>
</tr>
<tr>
<td></td>
<td>Secondary (Std. 8-10)</td>
<td>21</td>
<td>25.9%</td>
</tr>
<tr>
<td></td>
<td>Higher Secondary (Std. 11-12)</td>
<td>2</td>
<td>2.5%</td>
</tr>
<tr>
<td></td>
<td>Graduate</td>
<td>3</td>
<td>3.7%</td>
</tr>
<tr>
<td>4</td>
<td>Religion (n=92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hindu</td>
<td>70</td>
<td>76.1%</td>
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<tr>
<td></td>
<td>Muslim</td>
<td>21</td>
<td>22.8%</td>
</tr>
<tr>
<td></td>
<td>Christian</td>
<td>1</td>
<td>1.1%</td>
</tr>
<tr>
<td>5</td>
<td>Type of Family (n=81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nuclear</td>
<td>55</td>
<td>65.4%</td>
</tr>
<tr>
<td></td>
<td>Joint</td>
<td>28</td>
<td>34.6%</td>
</tr>
<tr>
<td>6</td>
<td>Marital Status (n=81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>55</td>
<td>67.9%</td>
</tr>
<tr>
<td></td>
<td>Unmarried</td>
<td>19</td>
<td>23.5%</td>
</tr>
<tr>
<td></td>
<td>Widower</td>
<td>4</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Separated / Divorced</td>
<td>3</td>
<td>3.7%</td>
</tr>
<tr>
<td>7</td>
<td>Present Employment status (n=81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employed</td>
<td>36</td>
<td>44.4%</td>
</tr>
<tr>
<td></td>
<td>Unemployed/ occasionally going for work</td>
<td>45</td>
<td>55.6%</td>
</tr>
<tr>
<td></td>
<td>Past Employment status (n=81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employed</td>
<td>68</td>
<td>84.0%</td>
</tr>
<tr>
<td></td>
<td>Unemployed/ occasionally going for work</td>
<td>13</td>
<td>16.0%</td>
</tr>
</tbody>
</table>
In the present addicts, in 85%, type of addiction was of tobacco in any form, of which tobacco chewing was the most common. In ex-addicts also, the most common type of addiction was of tobacco, of which smoking was the most common.

**Presence of BCG Scar**

Scar of BCG vaccine was absent in more than 80% of patients.

**History of study subjects as regards contact with TB cases**

Thirty nine (48.2%) patients gave history of contact with a confirmed case of TB before they themselves got affected by TB. Average number of cases to whom the study subjects were exposed was 1.43 per patient. In about 85%, such case was a family member followed by neighbour, colleague at workplace and from occupation (DOT) provider. When treatment outcome of such cases was asked, in 23 (59%) patients, the outcome was death followed by cure in 10 (25.6%) patients, not known in five (12.8%) patients and still on treatment in one (2.6%) patient.

**Past and present history of TB**

Forty three (53.1%) patients visited at least one doctor/health care provider before coming to RNTCP. Forty nine (60.5%) patients started ATT from RNTCP while 25 (39.5%) started from private health facility. In 63% patients, referral to RNTCP was by Government/Corporation Doctor. Only 12% of referrals were by private practitioners.

At the beginning, almost all patients, 80 (98.8%) had pulmonary tuberculosis and only 1 (1.2%) patient had extra-pulmonary tuberculosis. At the start of category II, the reason was default in 25 (30.9%) patients followed by relapse in 23 (28.4%) patients, failure in 22 (27.2%) patients and others in 11 (13.5%) patients. The most common reason for default was financial problem. (in 48.0%) followed by no improvement in symptoms (in 32.0%). Other reasons for defaulting were side-effects of drugs, migration, alcohol and improvement in condition.

There were nine (10.8%) patients who used other systems of medicine at any point of time during TB treatment.

**Mean number of ATT and regularity of treatment**

The mean number of ATT taken before start of category IV was 2.85. Most patients (87.7%) were regular during their last ATT. The reasons for irregularity found were side-effects, migration, alcohol, riots, patient’s non-cooperation and type of occupation. Female sex was found to be significantly regular during last ATT. However, no significant difference was found between education of the patient and regularity of treatment.

**Symptoms**

Regarding symptoms at start of category IV treatment, cough with expectoration (79.97.5%) was the most common. Other symptoms were fever (95.1%), anorexia and weight loss (91.4%), breathlessness (38.3%), hemoptysis (23.5%), chest pain (22.2%), weakness (9.9%) and abdominal pain (1.2%). Six (7.4%) patients had co-morbidity with TB, of whom five had Diabetes Mellitus while one patient was suffering from valvar heart disease.

**Resistance pattern and HIV**

DST results showed that in about 70% of the patients, resistance to all four drugs (H, R, S and E) was present followed by H, R and S (16.3%) resistance, H, R and E (6.5%) resistance and H and R resistance (7.6%) (Fig. 1). Only one (1.2%) patient was found HIV positive.

![Figure 1: Result of drug sensitivity testing](image-url)
Status of patient in Category IV

At the time of interview, 75 (92.6%) patients were on treatment while six (7.4%) patients were defaulters, of whom in five (83.3%), the reason was side effects and non-cooperation in one (16.7%) patient.

Adverse drug reactions

Seventy-six (93.8%) patients experienced one or the other side effect of drugs. Gastrointestinal symptoms were the most common. However, serious side effects like psychiatric problems, ringing in ear, deafness, thyroid enlargement and convulsion though in lower proportion were also seen. (Fig. 2)

Problems during treatment

Most patients faced problems during initial months of treatment. Most of them, 39 (48.1%) had loss of wages followed by inability to do household work in 26 (32.1%) patients. However, 18 (22.2%) patients didn't face any social problem so far.

Culture conversion

The trend of sputum culture result during follow up period up to 12 months was studied. The culture conversion rate in available results was 62.8%, 62.2%, 67.5%, 67.2%, 65.7%, 64% and 81.5% at 3rd, 4th, 5th, 6th, 7th, 9th and 12th month of follow up respectively. No significant (p>0.05)

* More than one side effect was present per patient.

Figure 2: Side effects experienced by patients
gender difference was found. (Table 2 and Fig. 3)

**Perception of improvement following DOTS plus treatment**

Thirty nine (52%) patients perceived 50% or more improvement in their condition. However, seven (9.3%) perceived no improvement. When asked about DOTS Plus, majority were found to be satisfied. But around 30% found that treatment makes person incapacitated for any work.

**Secondary cases**

Twelve (14.8%) patients gave history of secondary case of tuberculosis. Total 17 secondary cases were found. In all patients, the secondary cases

**Table 2: Result of culture examination during follow up months**

<table>
<thead>
<tr>
<th>Culture Result</th>
<th>3 (n=86)</th>
<th>4 (n=82)</th>
<th>5 (n=77)</th>
<th>6 (n=67)</th>
<th>7 (n=67)</th>
<th>9 (n=50)</th>
<th>12 (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>32 (37.2%)</td>
<td>31 (37.8%)</td>
<td>25 (32.5%)</td>
<td>22 (32.8%)</td>
<td>23 (34.3%)</td>
<td>18 (36%)</td>
<td>5 (18.5%)</td>
</tr>
<tr>
<td>Negative</td>
<td>54 (62.8%)</td>
<td>51 (62.2%)</td>
<td>52 (67.5%)</td>
<td>45 (67.2%)</td>
<td>44 (65.7%)</td>
<td>32 (64%)</td>
<td>22 (81.5%)</td>
</tr>
<tr>
<td>Not available*</td>
<td>6</td>
<td>10</td>
<td>15</td>
<td>26</td>
<td>25</td>
<td>42</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
</tbody>
</table>

* n= shows no. of patients whose culture results were available at TU at time of visit

* Not available results were either because patient had expired or defaulted or at the time of visit patient was not eligible for particular month of follow up or result was pending.

**Figure 3: Culture conversion rate in follow up months in available results**
were the contacts living in the same premises as that of the patient. No significant difference was found between presence of Secondary case in the family and presence of overcrowding and of adequate ventilation.

**Sputum disposal practices**

Sixty five (80.2%) patients were used to spit in bathroom or basin and wash it off with water. Use of spit box either plain or containing ash or sand was seen in five (6.2%) and spitting in open ground away from home and covering it with sand was seen in four (4.9%) patients. Seven (8.7%) patients were spitting indiscriminately.

**Precautions taken by patients to prevent spread**

Most commonly found, though not recommended, was keeping separate utensils for patients in 45 (59.2%) cases either by self or by family member. Practice of covering mouth while coughing/sneezing was found in 37 (45.7%) and keeping children away from self in four (4.9%) patients. No significant difference was found between education of the patient and practice of covering mouth.

**DISCUSSION**

Present study was conducted with a view to analyze various epidemiological factors and aspects related to DOTS Plus treatment amongst MDR-TB patients put on Category IV during the first year of implementation of DOTS Plus project in city of Ahmedabad. Of the study subjects, more than 2/3rd of cases were males and mean age was about 34 years. Similar finding was found in other studies. Employment had significantly increased after undergoing Category IV treatment. This seemed to be because of side effects of drugs which made the patients incapacitated for work.

Around 57% of patients were addicted to tobacco and/or alcohol any time during their disease state. Studies in Russia showed alcohol abuse/dependence and smoking were associated with drug resistance.

About 50% patients gave history of contact with TB case and most of them were family members showing the fact that TB usually spread with close contacts. One striking finding was that in 60% of TB cases, to whom the study subjects were exposed, treatment outcome was death, the reason for the same may be that these persons might have suffered from drug resistant TB which remained undiagnosed. So, contact tracing can be one effective strategy for early detection of cases resulting in favourable outcome.

At the start of Category II, maximum number of patients were defaulters (30.9%) followed by relapse (28.4%), failure (27.2%) and others (13.5%). Afranio L. Kritski et al. found multi drug resistance in 6% of relapse patients and 33% of failure patients. The main reason for default in this study, found was financial problem.

It was seen that on one hand, referral to RNTCP by private practitioners was hardly 12% and on the other hand most patients preferred private practitioners for illnesses and financial crunch is a major factor for default. These findings suggest that private practitioners must be motivated to refer the patients of lower class to RNTCP so as to prevent default and further wandering of for treatment and consequent development of resistance. Mean number of treatment courses prior to commencement of Category IV was 2.85 times per patient. Similar finding was found in Philippines study.

There were 7.41% patients who defaulted from Category IV, at the time of interview and in 80% the reason being side effects of drugs. Studies conducted in Philippines and Tuberculosis Research Centre showed 14% and 24% default rate and in 69% and in 25%, the reason was adverse events due to drugs respectively.

The symptoms of MDR-TB and drug susceptible TB were found to be the same. Only six (7.4%) patients were having co-morbidity with TB. Of them, 81% had Diabetes Mellitus while 16.7% had valvular heart disease. In the Philippines study, around 23% had co-morbidity, of which
around 63% had Diabetes and 7.4% had heart disease.

As compared to other studies [13, 20], present study showed higher proportion of four drug resistance (H, R, S and E) which was about 70%. Only one (1.2%) patient was reactive for HIV as against the finding of Faustini A et al [18] which showed that MDR-TB cases were more likely to be HIV positive. However, study by Ruddy M et al [20] showed that HIV was not associated with resistance in all patients.

More than 90% (76) of patients experienced side effects, of whom, in 12% (nine) of patients, treatment needed to be modified by stopping the offending drug with/without replacing it with PAS (P- amino salicylic acid) while other patients could continue with the same treatment. The offending drugs in descending order were Cycloserin, Kanamycin, Ofloxacin, Pyrazinamide and Ethionamide. Similar finding was found in the Philippines [14] study and in study by Nathanson et al [22].

The culture conversion rate in available results on follow up at the end of third month was 62.8%. In the study of Philippines [14], 90% had converted to sputum culture negative status after three months of treatment. The study by Tuberculosis Research Centre [23] showed 90% culture conversion rate for cured patients by four months.

Majority were found to be satisfied with DOTS Plus treatment.

In 15.0%, secondary cases of tuberculosis were found in household contacts. Study in Uganda [21] found similar finding. However, no significant difference was found between presence of secondary case in the family and presence of overcrowding and of adequate ventilation which may be because of most number of patients living in overcrowded and ill ventilated houses.

Sputum disposal practices showed that indiscriminate spitting was less (8.6%) but other methods were also not safe. A study done by Krishnadas Bhattacharya et al [25] found safe sputum disposal practices in 20% and indiscriminate spitting (50.8%). Patients were practising one or the other method/s to prevent spread. The practice of covering mouth during coughing/sneezing was seen in less than 50%. Similar result was found by Krishnadas Bhattacharya et al [25] in their study. No significant difference was found between education of the patient and practice of covering mouth. Krishnadas Bhattacharya et al [25] found this practice significantly differing between the literates and the illiterates. The finding in the present study may be due to majority of the patients' education up to primary level only.

**CONCLUSION**

The important points which have come up in the present study are need for motivating private practitioners for referral of patients to RNTCP to improve treatment for drug susceptible cases, provision of psycho-social support and use of patient incentives and enablers to help the patients continue anti-tuberculosis treatment, enhancing contact tracing of the patients and increasing awareness of patients and their family members regarding sputum disposal practices and precautionary measures to prevent the spread. As the present study was confined only to MDR TB cases and there was no comparison group, definite conclusion regarding the factors responsible for development of resistance cannot be drawn. However, based on the findings of this primary evaluation, further study can be framed out and the relationship between various social, behavioural and environmental aspects and drug resistance can be better examined and understood.

**ACKNOWLEDGEMENTS**

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