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Cost of Illness of Tuberculosis in Tehran in the Year 2011

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ABSTRACT

Aim: Present study calculates and analyzes Cost of illness of tuberculosis in Tehran. **Patients and methods:** This study was a descriptive analytical study conducted among 121 patients in two stages in 2011. In the first stage, questionnaires were collected by reviewing patient records and phone interviews with patients. The second stage deals with the calculation of costs. For cost calculation, we used incidence based and bottom-up approach, and for calculating indirect costs, human capital approach was used. The vision used for this study was community-based in which all costs are included. **Result:** The average costs per patient were calculated to be as follows: 28,467,737 Rials(2588 dollars) for direct medical costs, 1,011,360 Rials(92 dollars) for indirect medical costs and 5,533,020(503 dollars) Rials for indirect costs. On the whole, average costs per patient was 35,056,170 Rials most of which were related to hospital costs (62/11%). Also, the average time away from work was 47 days. Cost calculated for all patients with tuberculosis in Tehran in 1390, including indirect costs caused by premature deaths of patients, was 101,900,501,328 Rials (9,263,681 U.S. \$). **Conclusion:** To sum up, in Tehran in 2011 on average every day about 279,179,456 Rials (25,380 dollars) was spent on TB patients. Moreover, heavy costs caused by TB, which are usually imposed to the households in two or three months, have significant effect of decreasing households' quality of life which calls health policy makers' attention.

Keywords: Tuberculosis, Cost of Illness, Tehran

1. INTRODUCTION

Tuberculosis is a chronic infectious disease which is caused by mycobacterium tuberculosis (1). This disease is one the oldest known diseases that affects humans (2), and after AIDS, it is the second factor of mortalities caused by single-agent infectious diseases (3). Tuberculosis has a significant position in statistics of Public Health because it is considered as one of the 10 main factors of death in the world (4); it has also remained as one of the main problems of health in the world (5). About 8.8 million new tuberculosis (TB) patients and 12 million cases of prevalence have been reported in 2010 globally. The highest number of cases occurred in resource-poor countries including Asia (59%) and Africa (26%) (6). Moreover, in 2012, about 8.6 million people were affected by tuberculosis and 1.3 million died of this disease (5).

It is estimated that 10 million people are annually ranked below poverty threshold due to the economic burden of this disease (7) and many patients are finally drawn into a desperate situation that is incurred by two factors of inability to work and to cover treatment costs (8). If an individual is affected by tuber-

culosis, he/she will lose 3-4 months of his/her working time on average, which will lead to losing 20-30% of annual household income (9). Consequently, the total costs can be devastating for patients. Often the greatest financial risk for patients is to lose their income. For this reason, patients should make sure of receiving fair health care services in a way that their direct and indirect costs are minimized. It should also be made sure that TB patients and the affected families have alternative earnings and receive other desirable social supports (10).

On the other hand, the highest economic burden of tuberculosis, as measured in Disability Adjusted Life Years (DALY), is incurred by premature death of young adults (4). Economic impact of tuberculosis results from heavy direct and indirect costs that are imposed on patients due to losing their income (20-30% of household income on average) and premature death (15 years of lost income) (11). The final purpose of measuring burdens of diseases is to provide the most realistic evidence needed for policy-making, designing and managing health plans, prioritizing strategic investigations about population health, developing and dedicating human and financial resources, and enhancing

the capacities of organizations in designing, implementing, and assessing cost-effective interventions of prevention, treatment, and rehabilitation (12).

Managing tuberculosis (TB) can be useful in reducing a significant rate of economic burden in countries with high TB prevalence and incidence. Economic analysis can help maximize welfare, and economic research about different health interventions can be used to identify the most effective way of using the available resources (6). Therefore, the purpose of this paper is to calculate and analyze the economic burden of tuberculosis disease in Tehran.

2. PATIENTS AND METHODS

This is a descriptive-analytical study, and its data have been collected from three sources: information from Ministry of Health and Medical Education, patients' cases in health centers, and telephone interviews. In order to obtain the sample, two studies were conducted in pilot manner in two different health centers, and finally 121 patients were selected by random sampling. Data related to the incurred costs were collected by referring to health centers and contacting them by phone. In order to estimate economic cost of tuberculosis, cost-of-illness method has been used and human capital method has been considered (13, 14). This is a clear and simple method, but three issues should be taken into account when using it: 1) Should the research be based on prevalence or incidence? 2) Should data analysis be done in top-down or bottom-up method? 3) How are the direct and indirect costs calculated? (15)

In this study, the prevalence-based approach was used to calculate economic burden of tuberculosis. Calculating disease costs based on prevalence has the advantage of considering total annual costs of health care, and it is especially useful for chronic diseases such as diabetes, cancer, etc. which require long-term treatment (16). In order to analyze data, since there was no suitable and accurate database, bottom-up method was used (15). In this method, the process starts from a subset of a specified population with the disorder of interest, and then all costs related to that disease are recorded. After that, costs of this subgroup is used to estimate the total cost of the population.

Perspective of the present study is society-oriented and encompasses all medical, illness, mortality, transportation, and non-medical costs. A study on disease costs may be conducted from different perspectives each of which has slightly different costs. These perspectives may measure costs incurred on the society, health care system, third-party payers, business, government, and participants and their families (17, 18).

In order to calculate costs for a visit to the doctor, the number and the costs of visits that were made for TB diagnosis as well as TB patients monitoring during the treatment were obtained by asking patients. In cases patients could not remember the costs of a visit to the doctor, costs were calculated according to the approved tariffs of Ministry of Health in 2011.

In order to calculate the cost of diagnostic tests, payments made by the patients were asked in an interview, separated by the frequency of the tests taken. In cases patients had free examination of sputum by health centers, or they had paid less money because of being insured, or they could not remember costs of the tests such as scans and graphics, tariffs of Radiology Association and Laboratory Services were used to calculate costs. Moreover, costs of buying drugs were asked from patients and

considered in computations, separated by purchase frequency. Costs of the drugs that patients received freely were calculated according to the drug costs of 2011.

Hospitalization cost of patients was computed based on the cost that they paid when being discharged from the hospital. For those who had paid less money due to being insured, not only the payments made personally, but also the total costs were calculated according to the approved tariffs of Ministry of Health. Moreover, in order to estimate direct medical costs, patients were asked about the number of their visits to doctors and their expenses for disease diagnosis, number and costs of the tests (including pathology, radiography, etc.), number and costs of drug purchase (whether with or without doctor's prescription), expenses of being hospitalized and having a surgery, and the costs related to nursing at home.

Non-medical direct costs include transportation, commuting and food costs of patients and their families during their visit to medical centers, the cost of purchasing extra health products which are consumed due to the illness, the cost of residing in other cities for treatment, and nursing patients at home, which were all calculated by asking patients. For those who had paid money for taxi, cab, or bus, the total cost was computed. And for those who had used personal car for transporting within the city, no cost was calculated.

In order to measure indirect economic burden, a human capital approach was used. Indirect costs of each family depend on daily income, the number of sick leaves, average daily income of each patient's companion, and duration of absence from work resulting from nursing and taking care of the patient. Individuals' wages were used to calculate the lost income. For those patients who were not willing to declare their income, and also for those housekeepers and students between 15-65 years of age, daily wage of Ministry of Labour was used as the average wage. Additionally, in order to calculate lost years resulting from premature death of the patients, the following formula was used:

| | Variable | Tehran University | Shahid Beheshti University | Studied sample |
|----------------------|----------------|-------------------|----------------------------|----------------|
| Gender | Male | 240 (48.5%) | 605 (46.6%) | 55 (45.5%) |
| | Female | 255 (51.5%) | 693 (53.4%) | 66 (54.5%) |
| Type of tuberculosis | Pulmonary | 341 (69%) | 817 (63%) | 75 (62%) |
| | Extrapulmonary | 154 (31%) | 481 (37%) | 46 (38%) |
| Nationality | Iranian | 326 (66%) | 975 (75%) | 99 (81.8%) |
| | Non-Iranian | 169 (34%) | 323 (25%) | 22 (18.2%) |
| Age range | Under 15 years | 22 (4%) | 48 (4%) | 8 (6.6%) |
| | 15-65 years | 350 (71%) | 876 (67%) | 80 (66.1%) |
| | Over 15 years | 123 (25%) | 374 (29%) | 33 (27.3%) |

Table 1. Demographic features of the studied patients

$$P_t = \sum_{i=1}^N \frac{W \times (1 + g)^i}{(1 + r)^i}$$

Where *W* is gross production per capita, *g* is economic growth rate, *i* is average lost years due to illness, and *r* is discount rate (in this study, discount rate is 5%).

3. RESULTS

All 121 tuberculosis patients from different regions of Tehran were randomly interviewed. Demographic features of the patients are presented in Table 1.

| Type of cost | Type of cost | Total cost (Rial) | Average cost for each patient (Rial) |
|--------------------|-----------------------------|-------------------|--------------------------------------|
| Medical direct | Visit to the doctor | 197,775,000 | 1,634,500 |
| | Tests | 299,592,000 | 2,475,967 |
| | Drugs | 154,225,600 | 1,274,590 |
| | Nursing at home | 161,750,000 | 1,336,780 |
| | Surgery and hospitalization | 2,631,254,200 | 21,745,900 |
| | Total | 3,239,026,800 | 28467737 (81.30%) |
| Non-medical direct | Travelling | 122,374,000 | 1,011,360 (2.90%) |
| Indirect | Lost income | 669,495,420 | 5,533,020 (15.80%) |
| | Total | 4,236,466,220 | 35,012,118 |

Table 2. Direct and indirect cost of tuberculosis patients studied during 2011

Medical direct costs:

The total cost calculated for the studied patients was as follows: 197,775,000 rials (6%) for visit to the doctor, 299,592,000 rials (9.2%) for diagnostic tests, 154,225,600 rials (4.8%) for consumed drugs, 161,750,000 rials (5%) for nursing at home, and 2,425,684,200 rials (75%) for hospitalization. Correspondingly, costs of each patient on average and separated by cost items were as follows: 1,634,500 rials for visit to the doctor, 2,475,967 rials for diagnostic tests, 1,274,590 rials for consumed drugs, 1,336,780 rials for nursing at home, and 20,046,977 rials for hospitalization.

Non-medical direct costs:

Total non-medical direct cost calculated for patients during reception of medical services was estimated as 122,374,000 rials. Correspondingly, average non-medical direct cost for each patient was 1,011,360 rials.

Patients' indirect costs:

Total lost days for all studied patients and their companions were estimated about 5645 days, which means that for each patient, nearly 47 days have been lost. Based on the lost income of patients and their companions (except for age range under 15 years and over 65 years), the total lost income, i.e. the total indirect cost, was estimated as 669,495,420 rials. Correspondingly, average indirect cost for each patient is 5,533,020 rials.

Indirect costs of TB patients death in 2011 in Tehran

According to statistics of Ministry of Health, the number of tuberculosis patients in 2011 in Tehran was 1915 persons out of which 39 have died.

In 2011, gross production per capita was estimated as 49,786,000 rials (4526 dollars), and the economic growth rate according to the average economic growth rate in the last 3 decades was considered as 3.7%. Average lost years was obtained as 13.3 years, and in order to calculate lost production, discount rate of 5% was used.

$$P_l = \sum_{i=1}^{13.3} \frac{49,786,000 \times (1 + 0.037)^i}{(1 + 0.05)^i} = \sum_{i=1}^{13.3} 635,995,320$$

$$P_l = 635,995,320 \times 39 = 24,803,817,492$$

Therefore, the total lost production resulting from premature death of TB patients in 2011 was obtained as 24,803,817,492 rials.

4. DISCUSSION

Obtained results showed that the lost working days were 47 days on average for each patient. This finding is in accordance

with the study conducted by Rey et al. in India (19). Findings also showed that the age range which has the highest number of patients was 15-65 years old. In a study conducted by Veis et al. in Tanzania, age range of 25-44 years was found as the age range with highest number of TB patients (20). Also, the study conducted by Rey et al. in India showed 15-59 years age range as the one with the most exposure (19). All the three studies show that those who are able to have economic production consist the primary part of the people who suffer from tuberculosis. On the other hand, people placed in this age group are mostly those parents that are responsible for growing and developing their families and children.

Findings indicated that surgery and hospitalization costs devoted greater part of the incurred costs to themselves, while in a study conducted by Elamin et al. in Malaysia, transportation costs (non-medical direct costs) consisted the greatest part of the costs (11). Moreover, in other studies done by Kick et al. in Netherlands, Jackson et al. in China, Rey et al. in India, and Veis et al. in Tanzania, the greatest part of the costs was related to indirect costs and the lost productivity (19-22). The difference between these results can be attributed to difference in perspective of these studies as well as the percent of the population under insurance in different countries. Another reason for this difference can be found in calculation of patients and companions' lost wages. Disregarding indirect costs, results of this study showed that among direct cost items, the greatest part is related to hospitalization costs. This result conforms to the results of the study conducted by Kick et al. in Netherlands (21).

Similar to other studies in India, China, and Tanzania, results of the present study shows that non-medical direct costs devote a smaller share to themselves than medical direct costs and indirect costs (19, 20, 22). In the present study and most of the studies in other countries, transportation and travelling costs of patients consist the greatest share of non-medical direct costs. The most important reason for small rate of this type of cost compared to other costs can be the implementation of DOTS approach which enables patients to receive the required services for their treatment from the closest center to their houses. In Tehran, availability of health centers all over the province is an evidence of the above-mentioned claim.

In 2011 in Tehran, the number of new tuberculosis patients was 1915 persons. Since the present study is based on prevalence, the number of estimated prevalence cases in this year was obtained as 2202 persons. Disregarding the number of people died of tuberculosis, if we multiple the number of TB patients in 2011 in Tehran by the average cost of each patient, the incurred cost for all TB patients in Tehran will be obtained. This amount is equal to 77,096,683,836 rials (7,008,789 dollars, considering 11,000 rials = 1 dollar in 2011). If we add the lost production resulting from the death of TB patients to this digit, the obtained result would be 101,900,501,328 rials (9,263,681 dollars). This means that in 2011 in Tehran, a cost equivalent to 279,179,456 rials (25,380 dollars) on average per day is spent for tuberculosis patients.

5. CONCLUSION

As shown by the obtained results, costs of tuberculosis are very high. The main part of the costs was related to hospitaliza-

tion costs which most of them were incurred by extrapulmonary tuberculosis patients. In cases where the disease was diagnosed on time, costs were relatively less than the cases where delay in disease diagnosis led to the worsening of the disease. The present study is the first one considering tuberculosis costs, which will definitely provide valuable information for policy makers, managers of health, doctors, all health care providers, and other people. More advertisements for familiarizing people with diagnostic tests and also free treatment of TB patients can be effective in reducing costs. Furthermore, insuring more patients by health insurances can help them prevent catastrophic costs.

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CONFLICT OF INTEREST: NONE DECLARED.

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