

# The economics of managing tuberculosis in cancer patients in an oncology center in eastern India

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*To the Editor*—Cancer increases the chance of tuberculosis because of decreased immunity from disease and treatment (eg, chemotherapy). An intermediate tuberculosis (TB) prevalence country (South Korea) reported a cancer-specific standardized incidence ratio (SIR) for TB of 2.22 among all cancer patients, with the highest rate observed in those with hematologic malignancies (SIR, 6.67) and lowest in those with biliary tract cancers (SIR, 1.34).<sup>1</sup> Understanding the problem of TB in the context of cancer is important because (1) cancer may develop in the background of a previous TB infection; (2) TB may exist concurrently with malignancy in the same patient or clinical specimen; and (3) many diagnostic challenges arise from the multifaceted presentations of these 2 disorders.<sup>2</sup> Furthermore, TB leads to direct costs for diagnosis, treatment, and admission, as well as indirect costs from loss of productivity and other societal costs. It has been estimated that 42% of the households with TB patients incurred catastrophic health expenditures from hospitalization due to TB in India compared to 79% for households with cancer patients in 2014. In addition, the likelihood of incurring financial distress was 3.2 times higher for those hospitalized for cancer and 2.6 times for TB patients.<sup>3</sup>

This retrospective study was undertaken in a cancer hospital in eastern India between June 2011 and May 2016 among all patients with culture-confirmed tuberculosis to evaluate the direct healthcare costs attributable to TB in cancer patients. The period chosen to calculate costs spanned from 90 days prior to the TB diagnosis to 1 year after the diagnosis to limit the research primarily to the costs surrounding TB, rather than the costs incurred due to cancer. In total, we identified 118 patients with culture-confirmed TB during the study period of 60 months (~2 patients per month). The median age of the TB patients was 48.2 years (range, 6.3–82.1 years); 63 were women (53%) and 55 were men (47%). Of 118 patients, 45 (38%) had a hospital admission during the stipulated follow-up duration for either investigation or treatment. The number of deaths within this period was 4 (3.4%), with 3 deaths occurring in the first 30 days, no deaths in the 90-day period, and 1 death within 1 year of TB confirmation. The mean duration of follow-up of the patients after TB culture positivity was 204 days (6.8 months).

The average cost per patient was Indian rupees (Rs.) 19,295 (US\$266; 46.1%) for investigation, Rs. 18,686 (US\$258; 44.7%) for

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**Table 1.** Details of Cost Analysis in Treatment of Tuberculosis

Type of Tuberculosis	Cost	
	Rs.	USD
<b>Pulmonary TB</b>		
Intensive phase	1,140	15.72
Continuation phase	1,020	14.07
Total (includes vitamin B6)	2,448	33.76
<b>Extra-pulmonary TB</b>		
Intensive phase	1,140	15.72
Continuation phase	2,550	35.17
Total (includes vitamin B6)	4,266	58.83
<b>MDR-TB</b>		
5 drugs, 6 mo	75,060	1,035.11
4 drugs, 12–18 mo	108,360–162,540	1,494.34–2,241.51
Total	183,420–237,600	2,529.45–3,276.62

Note. Rs., Indian rupees; TB, tuberculosis; MDR, multidrug-resistant.

admission cost, and Rs. 3,864 (US\$53; 9.2%) for consultation fees. The investigation costs were divided into 2 categories: radiology (Rs. 10,383, US\$143) and laboratory tests (Rs. 8,912, US\$123). The laboratory costs were divided into 3 subcategories: hematology laboratory (Rs. 2,397, US\$33), biochemistry (Rs. 3,613, US\$50), and mycobacteriology (Rs. 2,902, US\$40). When all costs were considered, the total average cost for 1 patient within the 15-month period was Rs. 41,846 (US\$577 without anti-TB drugs and \$636 with anti-TB drugs) (Tables 1 and 2 and Supplementary Fig. 1).

Tuberculosis treatment drains healthcare and social resources. From the provider perspective, the mean drug-sensitive-TB treatment cost per patient varies among countries depending on the state of the economy, from US\$14,659 in high-income countries to US\$258 in low-income countries. The costs for treating multidrug-resistant (MDR)-TB ranges from US\$83,365 in high-income countries to US\$1218 in low-income countries. Productivity losses (calculated based on time lost due to seeking treatment and being ill; and taking into account country income) from TB have been estimated to be 16% in high-income countries and 38% in low-income countries.<sup>4</sup> A study from rural India reported that the mean direct cost per patient due to TB was US

**Table 2.** Doses and Regimens for Drug-Sensitive and Drug-Resistant Tuberculosis and Cost of Treatment

Regimen and Dose	Cost	
	Rs.	USD
<b>Drug-Sensitive TB<sup>a</sup></b>		
Pulmonary: 6-mo therapy		
4 drugs for 2 mo (INH, rifampicin, ethambutol, pyrazinamide)	1,140	15.72
2 drugs for 4 mo (INH, rifampicin)	1,020	14.07
vitamin B6, 6 mo	288	3.97
Total	2,448	33.76
Extra-pulmonary: 12-mo therapy		
4 drugs, 2 mo (INH, rifampicin, ethambutol, pyrazinamide)	1,140	15.72
2 drugs, 10 mo (INH, rifampicin)	2,550	35.17
vitamin B6, 12 mo	576	7.94
Total	4,266	58.83
<b>MDR-TB</b>		
Amikacin, 750 mg IV Q24H	116	1.60
Moxifloxacin, 400 mg PO Q24H	27	0.37
Pyrazinamide, 1,000 mg PO Q24H	10	0.14
Ethionamide, 1,000 mg PO Q24H	64	0.88
Cycloserine, 1,000 mg PO Q24H	200	2.76
All 5 drugs, 6 mo	75,060	1,035.11
4 drugs (amikacin IV excluded), 12–18 mo	108,360–162,540	1,494.34–2,241.51
Total	183,420–237,600	2,529.45–3,276.62

Note. Rs., Indian rupees; TB, tuberculosis; MDR, multidrug-resistant; IV, intravenous; PO, per oral; Q24H, per 24-hour period.

<sup>a</sup>Adult standard dose: INH, 300 mg PO Q24H (5 mg/kg); rifampicin, 600 mg PO Q24H (<50 kg: 450 mg PO Q24H) (10 mg/kg); pyrazinamide, 2000 mg PO Q24H (<50 kg: 1500 mg PO Q24H) (15–30 mg/kg); ethambutol, 1200 mg PO Q24H (<55 kg: 800 mg PO Q24H) (15 mg/kg).

\$35, the mean indirect cost per patient was US\$527, and the total mean cost per patient was US\$563.<sup>5</sup> Of the smear-positive TB patients, 25% had to be admitted to the hospital, at a mean cost of \$279 per admission.<sup>5</sup> Our study showed a higher admission rate (38%) but a similar admission cost compared to the southern Indian study, despite the fact that our cohort had sicker patients (due to cancer-related comorbidities) and that our hospital is a not-for-profit private trust. In a Turkish series of 16 cases of TB with cancer, 5 patients (31.3%) died during treatment, a mortality rate significantly greater than in our cohort (3.4%).<sup>6</sup>

The mean total spending on hospitalization for tuberculosis has been estimated to be Rs. 13,121 (US\$202) in India, with 99.9% being out-of-pocket expenditure by patients.<sup>7</sup> However, our study revealed a higher expenditure (US\$258). In India, for cancer treatment, the total mean cost of hospitalization was reported to be Rs. 62,349 (\$860), but 8.2% reimbursement was received from the government.<sup>7</sup> In an Indian study from Tamil Nadu on patients with pulmonary tuberculosis, patients experienced a median of 6 days of time to treatment initiation and 21 days of health system delay.<sup>8</sup> Between 2012 and 2016, the mycobacteriology workload in our hospital increased from 258 to 651

samples (an increase of 152%), and new patient registrations increased from 10,606 to 15,479 (an increase of 45%). In parallel, the hospitalization rate in India due to tuberculosis increased by 24% (all ages combined) from 1995 to 2014, whereas for cancer a 216% increase occurred during the same period.<sup>7</sup> In conclusion, the current study provides insight regarding the cost of TB management under the wider spectrum of cancer care. Hospitalization rates due to TB and cancer in India are 50 and 87 per 100,000 population, respectively, and TB continues to be an important infection in oncology patients. The economic impact of TB needs to be factored in while planning healthcare resource requirements of patients with cancer.

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**Supplementary materials.** To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2018.284>

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