

**Economic burden of Tuberculosis among Bangladeshi population and  
Economic Evaluation of the Current Approaches of Tuberculosis Control in  
Bangladesh**

**Mohammad Rifat Haider**

Health Services Policy and Management  
The Norman J. Arnold School of Public Health

University of South Carolina

## **Paper I: The Economic Burden of Tuberculosis in Bangladesh**

### **Abstract**

**Background:** Tuberculosis (TB) is major scourge for human history and causes profound economic burden. Bangladesh is a high burden TB country with 12% of its annual death is caused and 362 thousand people are infected by TB. This study aims to estimates the economic burden of TB on the afflicted Bangladeshi population.

**Methods:** Based on McIntyre's framework on economic consequences of illness, this study collects direct and indirect cost for TB care data from 1,000 drug sensitive TB (DS-TB) and 145 multi-drug resistant (MDR-TB) patients from all over Bangladesh. Provider cost for TB care was also collected from the health facilities. Costs for DS-TB and MDR-TB patients were estimated using Generalized Linear Model and summed up with per patient provider level costs to get the total costs per TB patients.

**Results:** Mean age of DS-TB patients under the study was 45.2 years while mean age of MDR-TB patients were 35.5 years. In aggregate, DS-TB patients incurred total average costs of BDT 21,235 (USD 265) for TB illness; while MDR-TB patients' average costs were BDT 34,975 (USD 437). Including provider costs for each patient (USD 9 for DSTB and USD 2,006 for MDR-TB patients) total average costs for each DS-TB patient was BDT 22,003 (USD 275) and for each MDR-TB patient was BDT 1,95,449 (USD 2443).

Assuming 57% case notification rate, the actual costs for treating TB patients in 2015 was USD 55.6 million. If all DS-TB patients were treated the cost would have been 1 billion USD. For MDR-TB treatment, total cost was USD 12.5 million; treating all MDR-TB patients would have costed USD 23 million.

**Conclusions:** Results show that DS-TB patients incurred about 50% of their household annual income for treatment while that goes up to 66% for the MDR-TB patients. Pre-diagnosis cost constitutes about 63% of total costs for DS-TB patients and 42% of MDR-TB patient costs. This figures show the significant economic burden posed by TB and early diagnosis of the disease can reduce the burden in great extent.

**Keywords:** Economic Burden, Tuberculosis, Bangladesh, Patient Costs, Provider Costs

## **Paper II: Cost Effectiveness of Drug Sensitive Tuberculosis Control programs in Bangladesh**

### **Abstract**

**Introduction:** Bangladesh is high burden Tuberculosis (TB) country and experienced 362 thousand new TB patients and 73 thousand TB deaths in 2015. DS-TB is the most prominent type of TB found in Bangladesh and a 6 month drug regimen (2 month intensive and 4 month continuation phase) is followed. But the directly observed treatment short-course (DOTS) differ in delivery through community health workers (CHW) and community members (CM). This study compares between these two models and conducts a cost-effectiveness analysis.

**Methods:** The incremental cost-effectiveness ratio (ICER) of treating DS-TB patients, 45 years old on average, through CM versus CHW model was compared using a Markov model with life-time horizon (27 years). The measure of effectiveness, Quality adjusted life year (QALY) and cost of treatment was collected from 1,000 MDR-TB patients (598 for CM model and 402 from CHW model) in Bangladesh. Transition probabilities between Markov states were estimated from quarterly outcomes report collected from health facilities and cost and QALY both were discounted at a rate of 3%. Both deterministic and probabilistic sensitivity analyses were conducted in a Monte Carlo Simulation using R.

**Results:** Results show that each DS-TB patient under CM treatment model gains 3.61 QALYs with a cost of BDT 131,555. For the DS-TB patients under the CHW model the cost is 81,650 and the QALY gain is 3.12. The Incremental Cost-Effectiveness Ratio (ICER) is 103,454, i.e., the CM model is cost-effective if per QALY gain if willingness-to-pay is set to the per capita GDP of Bangladesh (BDT 107,360 in 2015).

**Conclusions:** Our study results suggest that community based model of DS-TB treatment is cost-effective even with changed costs and utility values in probabilistic sensitivity analysis. Community members as DOTS provider are more capable of reducing stigma related to TB, enhancing patient adherence and thereby reduce costs and increase utility from the treatment. Community members should also be involved in contact tracing and prevention activities to increase the effect of the involvement in TB control.

**Keywords:** Economic Evaluation, Drug Sensitive Tuberculosis, Cost-effectiveness, Cost, QALY, Community Based Treatment, Bangladesh

## **Paper III: Cost Effectiveness of Multi-Drug Resistant Tuberculosis Control programs in Bangladesh**

### **Abstract**

**Introduction:** Worldwide Tuberculosis (TB) control has been halted by the emergence of multi-drug resistant TB (MDR-TB). Bangladesh has also experienced surge in the number of MDR-TB cases with a 29% of MDR-TB cases were found among the re-treatment of pulmonary TB cases in 2015. In Bangladesh, two MDR-TB treatment regimens (9 month and 20-24 month) are practiced and this study intends to conduct economic evaluation between those two.

**Methods:** The incremental cost-effectiveness ratio (ICER) of treating MDR-TB patients, 35 years old on average, by 9 month regimen versus the 20-24 month regimen was compared using a Markov model with life-time horizon (37 years). The measure of effectiveness, Quality adjusted life year (QALY) and cost of treatment was collected from 145 MDR-TB patients (58 undergone 9 month treatment and 87 from 20-24 month regimen) in Bangladesh. Transition probabilities between Markov states were estimated from two published studies and cost and QALY both were discounted at a rate of 3%. Both deterministic and probabilistic sensitivity analyses were conducted in a Monte Carlo Simulation using R.

**Results:** Based on the study data, each patient under 9 month regimen gained 6.21 QALY with a total cost of BDT 987,418. Whereas, each patient under CHW model gained 5.74 QALY by incurring costs of BDT 1,501,221. Therefore, 9 month regimen is clearly dominating over the 20-24 month regimen because it costs less while it gains more QALY.

**Conclusions:** Our study results suggest that shorter regimen remains cost-effective in Bangladesh setting with changing costs and utility parameters changed in the probabilistic sensitivity analysis. MDR-TB treatment is itself cost-effective in developed countries and with cost-effective shorter regimen both treatment adherence and efficacy of the treatment will be improved.

**Keywords:** Economic Evaluation, Multi Drug Resistant Tuberculosis, Cost-effectiveness, Cost, QALY, Bangladesh Regimen, Bangladesh