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Cost Effectiveness Analysis of Bacillus Calmette-Guérin Vaccination in Indonesia

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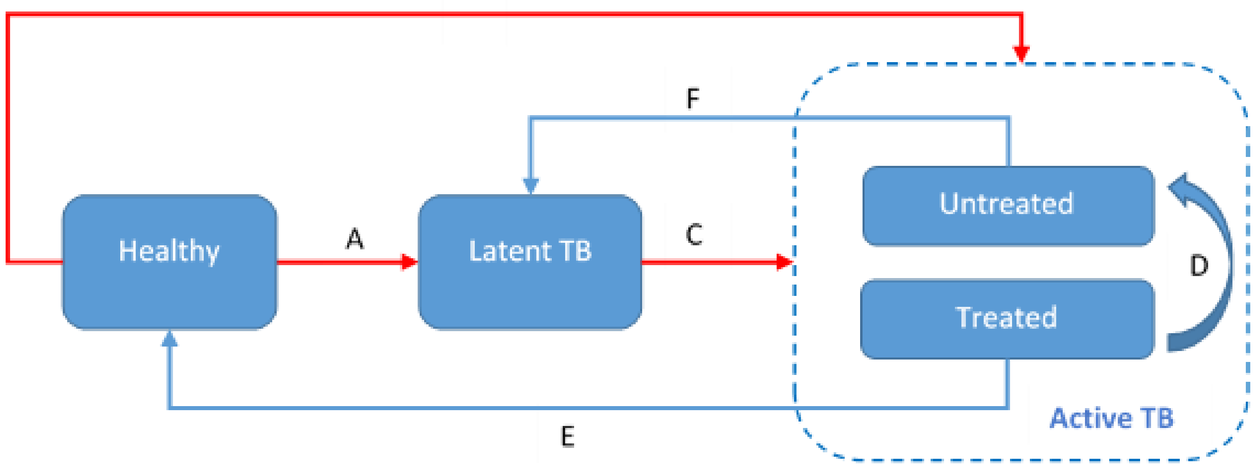
Background and Objective

- Indonesia counts as the third highest tuberculosis (TB) burden worldwide
- Recently, a national program for controlling TB disease has been issued including optimization of vaccination
- The aim of this study is to assess the cost-effectiveness of the current BCG vaccination program in Indonesia

Methods

A Markov model was assessed from both societal and health-care perspectives. Costs and outcomes were discounted at 3%.

Figure 1. Natural history of tuberculosis (TB)



The model was based on age-stratified incidence and implicitly included mortality rate in every stage. A = infection, B = fast activation, C = slow progression, D = treatment failure, E = successful treatment, F = self-cure. Red line is affected by vaccine effectiveness.

Table 1. The input parameters for the analysis

Parameter	Base-case	Distribution (interval)	Ref.
Incidence all form TB disease	Age-stratified	fixed	[1]
Incidence Latent TB	27,27 per 100 000		[1]
RR TB disease in latent TB population	21,00%	Lognormal (14-30%)	[2]
Case Detection Rate	53%	Beta (48-58%)	[1]
Percentage MDRTB	2,74%	Beta (1,90-3,69%)	[1]
Mortality rate (yearly)			
Healthy population	Age-stratified		[3]
Case fatality rate	0,14	Beta (0,12-0,15)	[1]
Latent TB	0,03		[4]
Untreated patients	0,11	Dirichlete (0,05-0,09)	[5]
Probability self-cure	0,03	Dirichlete	[5]
Treatment Outcomes(%)			[1]
DSTB treatment			
Success	85,77%	Dirichlete	[1]
Failed	0,38%	Dirichlete	[1]
Dead	2,46%	Dirichlete	[1]
Lost to follow up	5,38%	Dirichlete	[1]
MDRTB treatment			
Success	47,28%	Dirichlete	[1]
Failed	3,71%	Dirichlete	[1]
Dead	16,17%	Dirichlete	[1]
Lost to follow up	31,12%	Dirichlete	[1]
Vaccine Efficacy			
TB infection	27%	Beta (13-39%)	[6]
TB disease	71%	Beta (42-85%)	[6]
Progression from TB infection to disease	58%	Beta (23-77%)	[6]
Costs (based on US$ 2018)			
Cost of vaccination per patient	14	Gamma (±25%)	
Cost DSTB treatment	35	Gamma (±25%)	[7]
Cost MDRTB treatment	1296	Gamma (±25%)	[7]
Productivity losses			
DSTB (days)	25	Normal (±25%)	[7]
MDRTB (days)	102	Normal (±25%)	[7]
Average net income per day by age (US$ 2018)			
15-24	3,94	Gamma (3,72-4,15)	[8]
25-55	4,82	Gamma (4,70-4,95)	[8]
55+	3,92	Gamma (3,72-4,12)	[8]
Utility			
Healthy	1,00		
Latent TB	0,82	Beta (0,80-0,85)	[9]
Active TB	0,68	Beta (0,65-0,72)	[9]
Treatment	0,68	Beta (0,65-0,72)	

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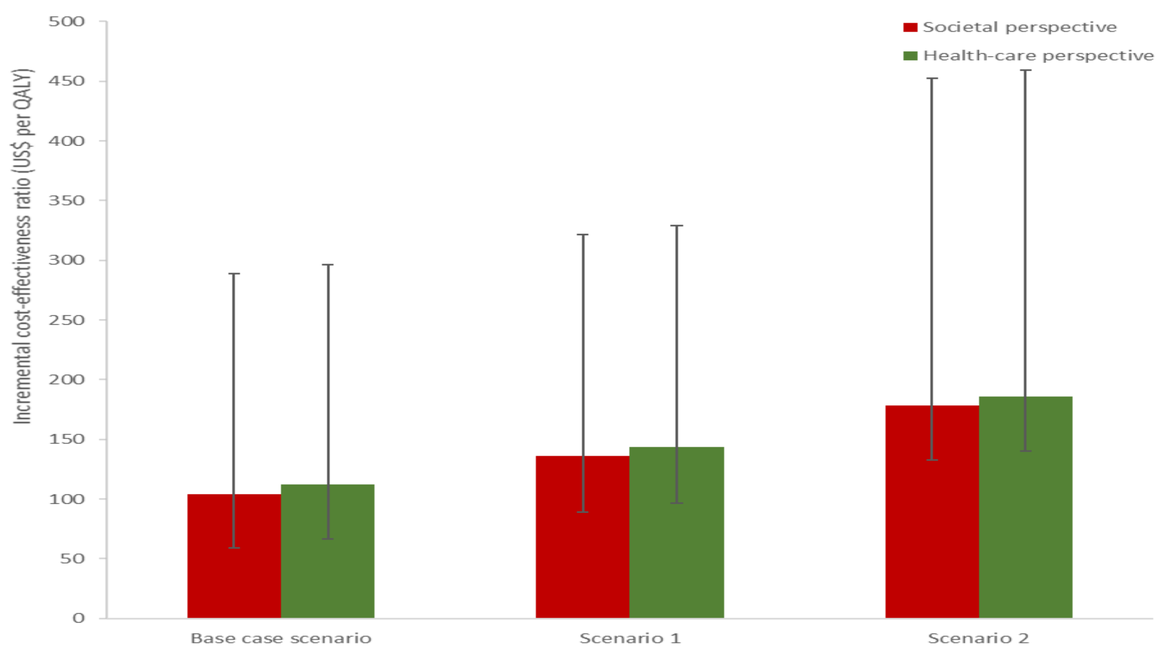
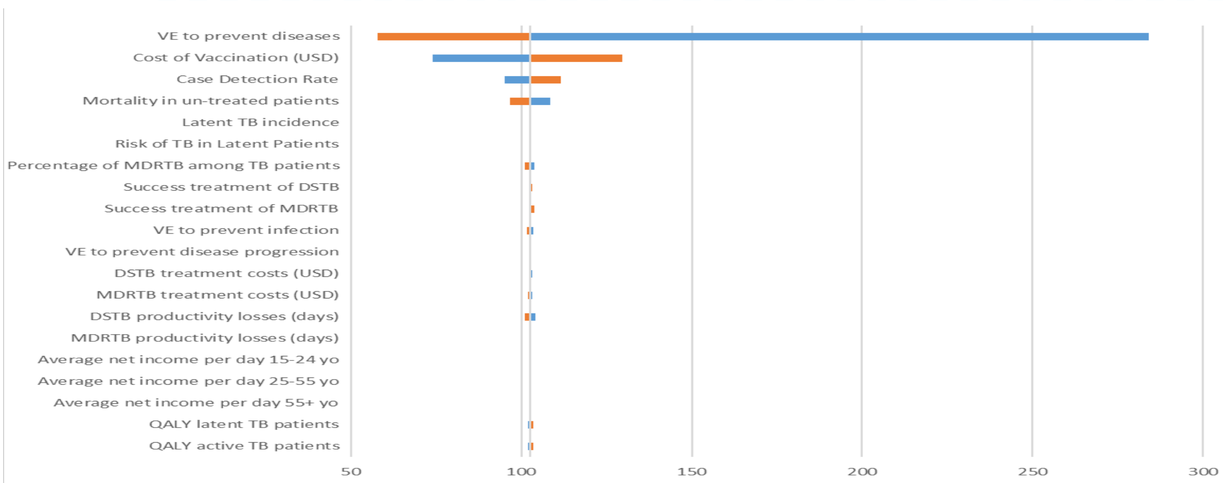
Results

Figure 2. The Incremental cost-effectiveness ration (ICER)



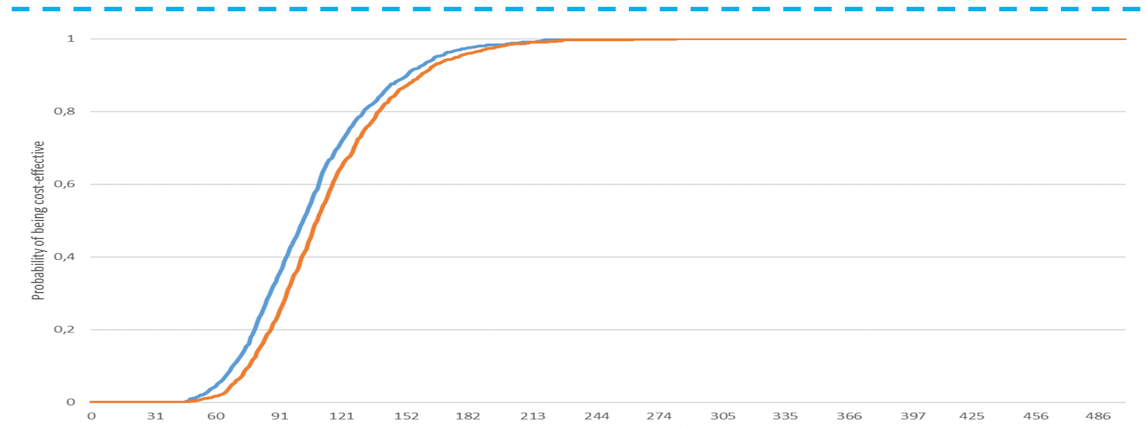
Bar height shows the incremental cost-effectiveness ratios (ICER) at base assumption of 71% vaccine effectiveness against TB diseases while error bars correspond to 42% and 85% as lower and upper band of the effectiveness. 3 different waning protections were applied; first 10 year-only protection (base case), linier waning effect of 20 years (scenario 1), and an exponential waning effect (scenario 2).

Figure 3. The Tornado diagram of the univariate analysis



VE = vaccine effectiveness, TB = tuberculosis, DSTB = drug susceptible tuberculosis, MDRTB = multi-drug resistance tuberculosis, QALY = quality-adjusted life-years.

Figure 4. Cost-Effectiveness Acceptability Curve (CEAC) of the probabilistic sensitivity analysis



Conclusions

- The vaccination was deemed cost-effective at one Indonesian GDP per capita in 2018 ($3.847).
- The most influence parameters for the analysis were vaccine efficacy for TB disease, the vaccination costs, and the case detection rate.

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