Cost effectiveness analysis of strategies for tuberculosis control in developing countries

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The study evaluated four alternative strategies for tuberculosis (TB) control in the two regions classified by the World Health Organization (WHO) as Afr-E (sub-Saharan Africa) and Sear-D (South East Asia).

The minimal Directly Observed Treatment, Short Course (DOTS) strategy was treatment in DOTS programmes for new-smear positive cases only.

The full DOTS strategy was the minimal DOTS strategy plus the treatment of smear-negative and extra pulmonary cases in DOTS programmes.

The minimal DOTS plus resistant case strategy comprised the minimal DOTS strategy plus the treatment of multidrug-resistant cases.

The full combination strategy comprised the full DOTS strategy plus the treatment of multidrug-resistant cases.

DOTS is an internationally recommended TB control strategy. A full description of the components of each strategy was provided in the paper. In addition to the comparison of strategies, each strategy was compared at different coverage levels (50, 80 and 95%).

Type of intervention

Economic study type
Cost-utility analysis.

Study population
The hypothetical population comprised individuals from two areas with very high adult and high child mortality (Afr-D), and high adult and high child mortality (Sear-D).

Setting
The setting was not explicitly stated although, given the nature of the intervention, it is likely to have been an outpatient setting. The economic analysis was conducted in the Afr-E and Sear-D regions, as defined by the WHO.

Dates to which data relate
The effectiveness and resource use data were derived from studies published between 1996 and 2005. The price year was 2000.

Source of effectiveness data
The model input parameters reported in the paper included clinical data on the diagnosis rates and cure rates in DOTS.
programmes, epidemiological data on the incidence and prevalence of TB, and mortality rates. Only limited details were provided in the paper. However, the reader is referred to a downloadable appendix for full details of all parameters.

**Modelling**

Initially, a published epidemiological model was calibrated with corresponding regional data from 1950 to 2000 to provide the incidence of TB, prevalence and mortality for the relevant region. This model was then used to project the incidence of TB, prevalence and mortality for the period 2000 to 2100 for a base-case of no intervention, then subsequently for the other scenarios. These projected data were then combined with health state valuations using a published population model (PopMod; Lauer et al. 2003, see 'Other Publications of Related Interest' below for bibliographic details) to allow the population impact of the various intervention strategies to be captured. The final population model had a lifetime horizon. Full details on all aspects of the modelling were provided in an appendix to the paper.

**Sources searched to identify primary studies**

The clinical data were based on published sources, although details of the study designs were not provided. Much of the epidemiological data were obtained from UNAIDS databases. The mortality data were based on WHO estimates.

**Methods used to judge relevance and validity, and for extracting data**

The process used to identify the data was not reported; only data relevant to the two regions appears to have been used. No inclusion criteria were specified for any parameters. Although published models were used, it is unclear whether the methodology was reported in these papers.

**Measure of benefits used in the economic analysis**

The summary measure of benefit used was the disability-adjusted life-years (DALYs) averted. Health state valuations were taken from the literature. Details of the methods used to value the health states were not provided.

**Direct costs**

The direct costs included were those of the service provider (WHO). These covered diagnostic tests, drug use, health centre visits for supervision and monitoring, and hospitalisation. Resource use was based on WHO treatment protocols and expert opinion. The unit costs of health centre visits and hospital inpatient days were derived from a published study. The drug costs were estimated using WHO negotiated prices, with a mark-up for international and local transportation costs. The costs of diagnostic testing were based on the best available international costing data from the WHO cost database. Limited cost data were provided in the paper. However, full details, including separated resource use and unit costs, were provided in the appendix. It was unclear if discounting was conducted. The price year was 2000.

**Statistical analysis of costs**

The resource use and cost data were treated deterministically.

**Indirect Costs**

The productivity costs do not appear to have been included, although they would have been relevant from a societal perspective.

**Currency**

International dollars (Int$). The conversion from Int$ to US dollars ($) was reported elsewhere (Evans et al. 2005, see 'Other Publications of Related Interest' below for bibliographic details).
Sensitivity analysis
A one-way sensitivity analysis was conducted on a number of parameters. For example, the assumption of different detection rates over the 10-year period, the cure rate for first-line treatment, the cure rate for second-line treatment of resistant cases, and the incidence of TB for year 2000. No justification for the values used in the analysis was provided. The analysis was only conducted for the Afr-E region.

Estimated benefits used in the economic analysis
The results for all four scenarios, with the three alternative coverage levels for both regions, were presented in full in the paper. Only the 95% coverage results for each scenario in the Afr-E region are presented here.

The minimal DOTS strategy with 95% coverage resulted in 44.8 million DALYs averted per year.

The full DOTS strategy with 95% coverage resulted in 47.4 million DALYs averted per year.

The minimal DOTS plus resistant cases strategy with 95% coverage resulted in 45.9 million DALYs averted per year.

The full combination strategy (full DOTS plus resistant cases) with 95% coverage resulted in 48.4 million DALYs averted per year.

Cost results
The results for all four scenarios, with the three alternative coverage levels for both regions, were presented in full in the paper. Only the 95% coverage results for each scenario in the Afr-E region are presented here.

The minimal DOTS strategy with 95% coverage resulted in a total cost of Int$366.3 million per year.

The full DOTS strategy with 95% coverage resulted in a total cost of Int$612.2 million per year.

The minimal DOTS plus resistant cases strategy with 95% coverage resulted in a total cost of Int$495.9 million per year.

The full combination strategy (full DOTS plus resistant cases) with 95% coverage resulted in a total cost of Int$739.4 million per year.

Synthesis of costs and benefits
An incremental analysis was performed. The results for all four scenarios, with the three alternative coverage levels for both regions, were presented in full in the paper. The most cost-effective incremental ratios for the Afr-E region are presented here.

The most cost-effective option was minimal DOTS with a 50%, 80% and 95% coverage level. This resulted in incremental cost-effectiveness ratios (ICERs) of Int$6.2 per DALY averted (50%), Int$8.2 (80%) and Int$14.7 (95%), respectively. The next most cost-effective intervention was full DOTS with a 95% coverage level, which resulted in an ICER of Int$94.5 per DALY averted. The full combination strategy resulted in an ICER of Int$123.2 per DALY averted.

The paper also presented a graphical depiction of an expansion path, which showed the order in which the interventions should be introduced according to their cost-effectiveness. The sensitivity analysis was reported to have had little impact on the results obtained.

Authors’ conclusions
The minimal DOTS (Directly Observed Treatment, Short Course) strategy was the most cost-effective option and should be a first priority in tuberculosis (TB) control.
CRD COMMENTARY - Selection of comparators

The selection of the comparators was well justified. All comparators were based on DOTS, an internationally recommended TB control strategy, with variation to provide more comprehensive levels of treatment.

Validity of estimate of measure of effectiveness

The parameters for all three models were derived mainly from published sources, with regional data being used to obtain the main epidemiological parameters. There were no details in this paper of how the data for the initial TB-HIV model, which had been published elsewhere, were identified and synthesised. In addition, only limited information on the other sources of data was provided. The authors appear to have selected relevant data but details of the methods used to identify suitable sources, or synthesise parameters when necessary, were not provided.

Validity of estimate of measure of benefit

DALYs averted were used as the summary measure of benefit. These were derived from the model using the difference between the healthy years lived in each scenario and the baseline scenario of no intervention. The utilities were taken from the literature, but no details of the valuation method were reported. The use of DALYs may facilitate comparisons with other interventions.

Validity of estimate of costs

The analysis of the costs was reported to have been conducted from a societal perspective, but it was unclear whether productivity costs were considered. The resource use and unit cost data were presented in full in the appendix. The paper itself reported only the total yearly costs of each strategy. The cost data were derived from the WHO database and from published literature. The drug costs were adjusted to include transportation costs. Discounting was relevant, but it was unclear whether it was actually conducted. The costs were reported in international dollars, which can easily be converted (methods detailed in Evans et al. 2005). Overall, the level of reporting in the main paper was limited, but there were ample supplementary data in the appendix.

Other issues

The authors compared their results with those from other relevant studies which, in general, showed agreement. However, this study considered the impact of the various strategies on disease transmission, which makes it a more comprehensive and valuable evaluation. The level of results obtained in some instances (i.e. expansion path and sensitive analysis) forced the authors to present results for only one region. The conclusions reached would appear to reflect the scope of the analysis and an outline of the policy implications was reported. The authors acknowledged a number of limitations to their study, which were mainly related to assumptions that had to be made on account of a lack of data.

Implications of the study

The authors clearly outlined the implications for policy. They stated that their findings reinforce the principle that minimal DOTS should be the basis for any TB control strategy, that there is a strong economic case for the full DOTS strategy, and that substantial scaling up of treatment strategies will be required in the next 10 years if the millennium-related targets for TB control are to be achieved.

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