Screening and treatment of latent tuberculosis among healthcare workers at low, moderate, and high risk for tuberculosis exposure: a cost-effectiveness analysis

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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
Screening and treatment technologies for latent tuberculosis (TB) were assessed. Screening was compared at 6 months and 1, 2 and 5 years. For those found to be tuberculin reactors, treatment options were treatment with isoniazid for 6 months versus no treatment. For those found to be without tuberculin reactivity, the choice of screening intervals was assessed.

Type of intervention
Secondary prevention (in at-risk individuals) and treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised cohorts of individuals aged 35 years with low, moderate and high risk for TB exposure. The authors used hypothetical patients for input into their model.

Setting
The setting was primary care. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness data were taken from studies published between 1967 and 2003. The cost data were taken from studies published between 1990 and 1997. The prices related to 2002.

Source of effectiveness data
The effectiveness data were derived from a review and synthesis of completed studies.

Modelling
The authors used a decision analytic model to track patients. For HCWs found to be tuberculin reactors at entry, there was a choice of isoniazid for 6 months or no treatment. Those who did not die from isoniazid were assumed to receive either a full course or an incomplete course of treatment, which offered full or partial protection respectively. For those who were not reactors, there was a choice of screening intervals (6 months or 1, 2 or 5 years). Anyone contracting TB during the course of the study was offered isoniazid. Individuals were followed for 12 years. The model took the risk of developing active TB and dying of TB and other courses into consideration, as well as the chance of passing the infection on to others. The outcomes of the model were the number of TB cases, death, life expectancy and costs.
Outcomes assessed in the review
The authors estimated:

the probability of an individual being a reactor,
the probability of dying during treatment,
the probability of converting to a reactor during screening,
the probability of getting TB and
the probability of dying from TB.

Although extensive, the review does not appear to have been systematic. Instead, the authors appear to have chosen those sources providing data relevant to their model.

Study designs and other criteria for inclusion in the review
Life expectancy data were taken from the National Centre for Health Statistics. The authors did not state the study designs or other criteria used for inclusion, but did report that some data came from clinical trials and published decision analyses.

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Thirty-three primary studies were included in the review.

Methods of combining primary studies
The estimates were combined using narrative methods.

Investigation of differences between primary studies
The authors noted differences between the primary studies. In some cases differences between the primary studies were used to define ranges in the sensitivity analyses.

Results of the review
The prevalence of TB infection was 4%.

The annual rate of new TB infection was 0.1%.

The risk of activation in an infected individual was 3% in the first year after initial infection, and 0.1% per year after 10 years. The life expectancy lost for those who died from TB was 20.8 years.
The average efficacy of isoniazid treatment was 70%.

The authors used a 6-month course of treatment.

The mortality rate due to isoniazid prophylaxis was 0.002%.

**Methods used to derive estimates of effectiveness**
The authors made some assumptions, informed by the review, to define their decision model.

**Estimates of effectiveness and key assumptions**
It was assumed that if a patient did not die from isoniazid-induced hepatitis they received either a full course with full benefits of isoniazid or a partial course with partial benefits.

**Measure of benefits used in the economic analysis**
The authors used the number of TB cases prevented, as estimated by their decision model, as the summary measure of health benefits. The health outcomes were discounted by 3%. The number-needed-to-treat (NNT) to prevent cases of TB and death, the number of years before cost-savings could be realised, and the optimal interval between screenings were also estimated.

**Direct costs**
The analysis focused on the costs of 6 months of isoniazid, the cost of treating an active case of TB and the cost of tuberculin testing. The cost of isoniazid covered medication, clinic visits, and evaluation and treatment of complications. The cost of treating an active case of TB covered hospitalisation, daily observed treatment and contact tracing. The cost of tuberculin testing covered nursing time, tuberculin supplies and a chest radiograph as needed. The authors reported that the cost estimates came from published estimates and decision analyses. The estimates were adjusted to 2002 prices using the medical care component of the Consumer Price Index and were discounted by 3%. The quantities were defined by the decision model.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not included in the model.

**Currency**
US dollars ($).

**Sensitivity analysis**
A one-way sensitivity analysis was carried out to estimate the impact of treating individuals for 9 months with isoniazid instead of 6 months.

**Estimated benefits used in the economic analysis**
The NNT to prevent one case of TB was 31 for low-risk individuals, 25 for moderate-risk individuals and 23 for high-risk individuals.

The number of years before a net cost-saving is realised was 4.2 for low-risk individuals, 2.6 for moderate-risk...
individuals and 1.6 for high-risk individuals.

The NNT to prevent one death was 501 for low-risk individuals, 446 for moderate-risk individuals and 417 for high-risk individuals.

The optimal screening interval was 5 years for low-risk individuals, 2 years for moderate-risk individuals and 1 year for high-risk individuals.

Cost results
The cost of 6 months of isoniazid was $110. The cost of treating an active case of TB was $18,200. The cost of tuberculin testing was $10.

Synthesis of costs and benefits
The isoniazid cost per case prevented was $3,400 for low-risk individuals, $2,800 for moderate-risk individuals and $2,500 for high-risk individuals.

The net savings per case prevented were $14,800 for a low risk of TB, $15,400 for a moderate risk and $15,700 for a high risk.

The sensitivity analysis indicated that 9 months of treatment was less cost-effective than 6 months of treatment.

Authors' conclusions
Regular screening and treatment of health care workers (HCWs) was associated with net cost-savings for each case of tuberculosis (TB) prevented. These savings could begin to be realised within the first 5 years.

CRD COMMENTARY - Selection of comparators
The authors assessed screening and treatment strategies for TB following recommendations from the CDC.

Validity of estimate of measure of effectiveness
The authors did not state that a systematic review of the literature was carried out. They seem to have selected studies that provided data relevant for the decision model. Very few details of the search strategy and criteria used for selecting the included studies were reported, which makes it difficult for the reader to assess the quality of the data used. Further detail on which study was used to inform which specific data estimate would have improved the reader's understanding, and their ability to transfer the results to their own setting.

Validity of estimate of measure of benefit
The authors used the number of cases prevented as their summary measure of benefit. They estimated this using a decision model. This estimate is an appropriate measure that makes the results comparable with other studies on the screening for and treatment of TB.

Validity of estimate of costs
A perspective for the costing analysis was not reported. It was therefore not possible to assess whether all the relevant costs were incorporated. The perspective adopted seems to have been that of the direct health care provider (e.g. the hospital), as it focused on the immediate costs of TB screening and treatment. For the reader to fully appreciate the results and their implications a perspective is required, as a technology might be cost-effective from one perspective but not from another. The authors appropriately reported the price year and discounted longer run costs, thereby improving the generalisability of their results.
Other issues
The authors did not compare their results with findings from other studies in order to strengthen the case for regular screening. The issue of generalisability to other settings and populations was considered, with the authors acknowledging that the costs may vary depending on the delivery setting, and hence their estimates may not be applicable to all settings. The authors presented their results thoroughly and these were appropriate to the study question posed. Several limitations were discussed. For example, the use of clinical trial data, and published cost estimates that might be imprecise.

Implications of the study
The authors stated "the results of this analysis indicate that HCWs in all three risk categories who are found to be tuberculin reactors at entry would benefit from treatment of their latent infection with isoniazid for 6 to 9 months". They also recommended that institutions should use their own observations to assess the specific risk category of their HCWs. There were no suggestions for further work.

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