The cost-effectiveness of preventing tuberculosis in physicians using tuberculin skin testing or a hypothetical vaccine

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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
Tuberculin skin testing using the purified protein derivative combined with a 6-month prophylactic isoniazid regimen in preventing pulmonary tuberculosis in physicians.

Type of intervention
Secondary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
A population of 66,629 physicians currently in US medical schools was analysed using lifetime modelling from the age of 24 to 70 years.

Setting
Hospital or managed care organization. The economic study was carried out in Virginia, USA.

Dates to which data relate
Effectiveness data were collected from literature published between 1979 and 1997. Resource and price dates were not stated.

Source of effectiveness data
Effectiveness data were obtained from the literature.

Modelling
A Markov-model was used to estimate final costs and benefits.

Outcomes assessed in the review
The outcomes assessed were the annual rate of infection detected by skin test among health care workers, the probability of an infected person developing pulmonary tuberculosis, and mortality from pulmonary tuberculosis. In addition the following were also assessed: efficacy of isoniazid prophylaxis in infected persons, rate of isoniazid-induced hepatitis and related case-fatality, rates of compliance with skin testing and prophylactic regimen, and rate of isoniazid-resistant strains.
Study designs and other criteria for inclusion in the review
Not stated.

Sources searched to identify primary studies
Not stated.

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

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

Number of primary studies included
Effectiveness data for the model were combined from 8 published studies. Study types were not stated.

Methods of combining primary studies
Not applicable. Each effectiveness outcome was obtained from a different study.

Investigation of differences between primary studies
Not applicable.

Results of the review
The parameter estimates used in the model (range found in the literature in parenthesis) were as follows:
rate of positive skin test was 0.4% (0.2-1.2%),
risk of pulmonary tuberculosis if test positive was 10% (no range reported),
mortality from pulmonary tuberculosis was 5% (1-10%),
compliance with skin testing programmes was 60% (33-100%),
efficacy of prophylactic isoniazid was 85% (65-89%),
compliance with prophylactic scheme was 44% (38-100%),
rate of isoniazid-resistant strains was 9% (1-25%),
rate of isoniazid-induced hepatitis was 0.3% (in persons younger than 35 years) and 1.75% (35 years and older),
the case fatality rate for isoniazid hepatitis was 0.02%.
The hypothetical vaccine was assumed to be 50% effective, with a booster dose being required every 10 years, and compliance rate being 80%.

Measure of benefits used in the economic analysis
Three outcome measures were used in the economic analysis: life-years saved, number of cases of pulmonary tuberculosis prevented, and number of tuberculosis deaths prevented.
Direct costs
Costs included cost estimates for a skin test and for treatment of a case of pulmonary tuberculosis, based on an earlier study of which no details were given. Some costs and quantities were reported separately. Items included in the treatment cost estimate were reported in addition to cost per case. The cost boundary adopted was that of a hospital. Costs were discounted at 5%. Price date was not reported.

Currency
US Dollars ($).

Sensitivity analysis
Multi-way sensitivity analyses were carried out on two sets of parameters: (1) skin test conversion rate, cost of pulmonary tuberculosis, and mortality from pulmonary tuberculosis and (2) compliance rates with both skin testing and prophylactic regimen. One-way sensitivity analysis was conducted on risk of pulmonary tuberculosis, cost per case of tuberculosis, efficacy of prophylaxis, rate of isoniazid-resistant strains, and risk of isoniazid-induced hepatitis. The effect of discounting benefits at 5% (instead of 0% used for the base-case) was studied only in the case where income losses were included in the model. Analysis addressed the uncertainty related to data sources and generalisability to other settings.

Estimated benefits used in the economic analysis
In the base-case, the annual skin testing regimen, if applied to 66,629 physicians now in US medical schools, would prevent 137 cases of tuberculosis and 7 deaths and would save 182 life-years compared with no skin testing. Benefits (in the base case) were not discounted.

Cost results
Neither the total cost of the intervention or the total cost of comparator were reported separately from the final cost-effectiveness results. The cost of the hypothetical vaccine was assumed to be $10 per dose. Costs were discounted at 5%.

Synthesis of costs and benefits
The study reported cost/life-year saved, cost/case of pulmonary tuberculosis averted and cost/death prevented to be $29,000, $39,000 and $800,000, respectively. The respective cost-effectiveness ratios for hypothetical vaccine were $1,300, $1,600 and $33,000. Costs were discounted at 5% and all benefit measures were discounted at 0%. The base case results represented incremental cost-effectiveness of annual testing compared to no testing. In the multi-way sensitivity analysis on skin test conversion rate, cost of pulmonary tuberculosis, and mortality from pulmonary tuberculosis the cost/life-year saved was $3,000 for the best-case scenario and $300,000 for the worst-case scenario. Following sensitivity analysis the hypothetical vaccination was found to remain the dominant strategy unless the cost per dose approached $100 or its efficacy fell below 10%.

Authors' conclusions
Annual tuberculin skin testing saves lives, reduces the number of cases of pulmonary tuberculosis, and is cost-effective. If available, a moderately effective vaccine would be more cost effective than tuberculin skin testing programs.

CRD COMMENTARY - Selection of comparators
A justification was given for the comparators used. Skin testing (annual and biannual) programmes are recommended by recent guidelines. In the future there remains hope that a vaccine will become available.

Validity of estimate of measure of effectiveness
The study was based on a non-systematic review of published literature. The quality of studies used as a basis for estimating health benefits was not assessed in the study. However, in most cases the base line values for the model parameters were chosen within the range of results reported in reviewed studies. Selection of values was carried out in a subjective manner by the authors, and claimed to represent conservative outcomes from analysed technologies. In the case of the hypothetical vaccine, no effectiveness data were available, and the model was based on the published results of BCG vaccine trials.

**Validity of estimate of costs**
The quantities of items included in the estimated cost per case of tuberculosis were reported in addition to the total cost per case. Unit costs for skin test and dose of vaccine were also provided, but neither the cost nor quantities of the isoniazid prophylactic regimen were reported. Details of the assumed cost structure for the hypothetical vaccine were inadequate. The cost date was not reported.

**Other issues**
The basic results concerning the cost-effectiveness of annual skin testing seem to be fairly justified, although as multi-way sensitivity analysis indicated clearly, worse, as well as better performance may be expected in some settings. Conclusions concerning the vaccination strategy which, at the moment does not exist, should be treated with extra caution. Generalisability of results to other settings was addressed in the sensitivity analysis. Results from studies on other relevant strategies (respiratory protection) were briefly discussed, but no thorough comparison with those studies was carried out. Discounting costs at 5% and benefits at 0% are likely to result in more favourable cost-effectiveness ratios than discounting both at equal rates. The sensitivity analysis did not address this problem directly.

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