School-based screening for tuberculous infection: a cost-benefit analysis

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 for tuberculous infection using Tuberculin Skin Test (TST).

Type of intervention
Primary prevention, treatment, and screening.

Economic study type
Cost-effectiveness analysis.

Study population
Hypothetical cohorts of children of five years of age (18,263, 7.4% of whom were in the 'high risk' group) and children of 14 years of age (15, 639, 21.9% of whom were in the 'high risk' group).

Setting
Community (Schools, health department or private practitioner's office). The economic study was carried out in Santa Clara, California, USA.

Dates to which data relate
The main effectiveness data were taken from 1982 sources (efficacy of preventive treatment for TST reactors) which was complemented with observational data for the location of the economic study in the years 1991-1992 (adherence to preventive therapy). The resource use data were mainly collected during 1992 and 1995. The price date was 1993.

Source of effectiveness data
Estimates of effectiveness were based on opinion.

Modelling
A decision tree model was used to estimate costs and benefits associated with the 'screening all' and 'targeted screening' strategies, relative to the 'no screening' option. A Markov model was used to calculate the cumulative rate of development of active disease (beginning with a hypothetical cohort aged 5 and 14 years respectively, for children in kindergarten and high school children). The model included the phases of screening with TST, treatment of positive cases with isoniazid therapy, the ensuing adverse and no adverse reaction outcomes, the adherence status of the latter group of patients, tuberculosis disease and treatment and the corresponding life expectancy of subjects in all groups. Observational data corresponding to 1991-1992 for the place at which the economic study was conducted were used to provide relevant population-based epidemiological data (coverage of screening take-up was 95% for both kindergarten children and high school entrants in turn in the high-and low-risk groups, prevalence and adherence to preventive therapy).
Methods used to derive estimates of effectiveness
The parameter values for specificity (implicit in the TST reactor rate and development of TB disease data) and rate of side effects were assumed based on published evidence from the literature. No source was reported for the value for the sensitivity of the screening test. Also, the efficacy of isoniazid (INH) therapy of less than 6 months and the efficacy of 6 months of INH therapy were assumed by the authors, with the latter being based on a single study of an INH regimen of the same duration as that in the study under review.

Estimates of effectiveness and key assumptions
The rate of side effects was 1% of children, with such cases resulting in interruption of the 6 months preventive therapy. Whilst no protective effect was assumed for the INH therapy of less than 6 months (even though a 3 month therapy may have some protective effects) since most non-completer children took less than 3 months of preventive therapy in the observational sample used from the study setting, the efficacy of the 6 month therapy of INH ingestion was 70%. The lifetime cumulative rate of active tuberculosis among TST reactors not ingesting isoniazid for 6 months was 7.9% for kindergarteners and 7.6 for high school entrants. The TST reactor rates were as follows (95% CI in parentheses); High-risk students 18% (15.2% - 21.2%) and 29% (26.3% - 32.1%), respectively, for kindergarteners and high school entrants; Low-risk students, 0.6% (0.35% - 0.91%), and 2.4% (1.9% - 3.0%), respectively. The TST reaction (an induration of at least 10mm in diameter using the Mantoux test) was assumed to be 100% sensitive.

Measure of benefits used in the economic analysis
The estimated number of cases of TB prevented per 10,000 children screened for each age group was the measure of benefits used in the analysis. A model was used to estimate such benefits over the lifetime of the patients.

Direct costs
Costs included only direct medical costs, as approximated by charge data from the Santa Clara County in California, for programme costs (including screening, chest radiography and preventive therapy), and all-payer expenditures from 16 states, for hospitalisations, and charges at public tuberculosis control programmes, for outpatient TB treatment and control tracing (costs associated with treatment for tuberculosis disease among reactors, identification of contacts, and either treatment or preventive therapy for contacts with disease or tuberculous infection). The screening costs for contacts were also included in the analysis. Some quantities of resource use were reported separately from the costs. According to the authors "the societal perspective" was used in their analysis. Costs were discounted at a 3% annual rate and total costs were calculated using a model. 1993 price data were used.

Currency
US dollars ($).

Sensitivity analysis
A one-way sensitivity and threshold analyses were carried out on baseline assumptions.

Estimated benefits used in the economic analysis
Using the 'no screening' option as the comparator, the 'screen-all' strategy prevented 6.4, 25.0, and 14.9 cases of TB per 10,000 screened patients, respectively, for kindergarteners, high school entrants, and both groups of children. The targeted screening option had corresponding figures of 74.8, 88.9, and 84.8, respectively.

Cost results
Based on cohorts of 18,263 kindergarteners (children 4 years of age 7.4% of whom were in the 'high risk' group) and 15,639 high school entrants (children 14 years of age 21.9% of whom were in the 'high risk' group), the incremental cost of the 'screen-all' strategy was $195,904 per year, relative to the comparator of 'no-screening'. The corresponding figure for the targeted screening was -$12,092 per year.
**Synthesis of costs and benefits**
The following figures are expressed in 1993 prices and both benefits and costs were discounted using a 3% annual rate. The incremental net cost-effectiveness of the 'screen-all' programme compared with targeted screening was estimated to be $103,758 per additional case of TB prevented for kindergarteners, $17,393 per additional case prevented for high school entrants and $34,666 per additional case prevented when both groups of patients are analysed together. The cost per additional case prevented for screening all children compared with targeted screening ($34,666) was more than twice as high as the figure for the 'treatment and contact tracing for a case of TB' option ($16,392). A threshold analysis showed that a TST reactor rate of 20% or more would lead to the universal screening strategy yielding negative net costs, relative to the 'no screening' option.

**Authors’ conclusions**
Targeted screening of schoolchildren was much less costly than mass screening and was also more efficient than the latter option in the prevention of TB.

**CRD COMMENTARY - Selection of comparators**
The reason for the choice of comparator is clear.

**Validity of estimate of measure of benefit**
The validity of the estimate of benefit rely on the validity of the estimate of efficacy of isoniazid therapy, which was derived from a single 1982 study. Since the estimate of adherence for such therapy was based on retrospectively collected data from 1991, the validity of the corresponding estimate of effectiveness may be biased. The data used to estimate tuberculosis disease in reactors is likely to have led to an over-estimation of benefits for the preventive strategies, due to an over-estimation in the number of cases of tuberculosis that would occur during adulthood in the hypothetical study cohort. The authors considered these biases to be greater in the universal strategy than in the targeted screening option. In addition, the assumed 100% sensitivity of the screening test did not directly affect the estimate of benefit.

**Validity of estimate of costs**
Adequate details about the sources of estimates, some quantities of resource use and the price date were given. However, it was not clear how the net costs of the programmes were derived. Although the authors subtracted from the programme costs those costs associated with TB cases avoided (which they refer to as 'benefits') relative to the 'no screening' option, the way in which the latter were estimated is not clear. The effects of the uncertainty in the data were partly explored in a sensitivity analysis. The implications of uncertainty in the diagnostic value assumed for the screening test (implicit in the assumed incidence of tuberculosis disease among reactors) were not investigated.

**Other issues**
Appropriate comparisons were made with other studies. The issue of generalisability to other countries was addressed by noting the important roles of, on the one hand, the assumption of drug-susceptible infection and disease (the rate of multidrug-resistant tuberculosis in California was 1.6%) and, on the other, the prevalence rate of infection (implicit in the reactor rate) in the study results. The conclusions of the study were formulated in a somewhat confusing fashion: The authors do not show one preventive strategy to be more efficient than the other, but rather that the use of universal screening relative to targeted screening may not be an efficient or cost-effective option.

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None stated.

**Bibliographic details**

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Other publications of related interest

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