Cost-effectiveness of alternative strategies for tuberculosis screening before kindergarten entry

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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 examined the following three strategies for tuberculosis (TB) screening before kindergarten entry in children aged 4.5 to 6 years.

Universal screening: all children received routine tuberculin skin testing (TST) before kindergarten entry.

Targeted TST based on risk factors: all children received risk factor screening for TB using the risk factor questionnaire (RQ). Children with positive results for at least 1 risk factor received TST.

No screening: TST was not administered unless a provider suspected TB.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of children aged 4.5 to 6 years.

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

Dates to which data relate
The effectiveness data were derived from studies published between 1974 and 2001 for the base-case analysis, but older and newer publications (between 1939 and 2006) were used in the sensitivity analysis. No dates for resource use were reported. The price year was 2004.

Source of effectiveness data
The clinical data used in the decision model were:

the probability a child being risk factor positive,

the probability a risk factor-positive child being TST positive,

the probability a risk factor-negative child being TST positive,

the risk of progression to disease,
test accuracy, and the probability of treatment completion given TST positivity.

Modelling
A deterministic, decision tree model was constructed and presented graphically. The time horizon of the analysis was 20 years. The model considered the presence of latent TB infection and compliance with therapy in a hypothetical cohort of 100,000 children. All possible model pathways were described, together with key model parameters (test accuracy, prevalence of TB and probability of a risk factor-positive result).

Sources searched to identify primary studies
The clinical data were mainly derived from US cohort studies. For example, the baseline estimate of the proportion of risk factor-positive children and the probability that a risk factor-positive or -negative child was TST positive were taken from a cohort of children in the Northern California Kaiser Permanent. The probability of disease progression was taken from several sources including reviews, historical population and cohort studies. The specificity and sensitivity of screening data were obtained from several published diagnostic studies, but few details of these analyses were given.

Methods used to judge relevance and validity, and for extracting data
The medical literature was searched using MEDLINE. In addition, references were searched manually and personal questions were addressed to TB control experts.

Measure of benefits used in the economic analysis
The summary benefit measure was the number of TB cases averted. These were estimated using a modelling approach. The benefits were discounted at an annual rate of 3%.

Direct costs
The analysis of the costs was performed from the perspective of the health care system. It included the costs of TST (performance and results), RQ (nurse and physician time), treatment and follow-up care for positive TST results, and the evaluation and treatment of TB disease. The costs of treating hepatotoxicity were not considered. The unit costs and the quantities of resources used were not presented separately for all items. The costs of TST, RQ and treatment were based on Medicare reimbursement rates. Resource consumption was mainly based on authors' assumptions. Medication costs came from average wholesale prices. Personnel costs were estimated using Bureau of Labor Statistics data. Hospitalisation costs came from the Centers for Disease Control and Prevention Cost of Hospitalisation Study, which included all costs of hospitalisation for TB according to age group. Other minor costs were derived from the US Public Health Service study and published studies. Discounting was relevant, given that 20-year costs were evaluated, and an annual discount rate of 3% was used. All costs were inflated to 2004 values using the Consumer Price Index.

Statistical analysis of costs
Statistical analyses of the costs were not performed.

Indirect Costs
Productivity costs were not considered.

Currency
US dollars ($).
Sensitivity analysis
A deterministic sensitivity analysis was carried out to assess the robustness of the cost-effectiveness results to variations in key clinical inputs. Both one- and two-way sensitivity analyses were performed. Alternative ranges of values were derived from the literature.

Estimated benefits used in the economic analysis
In a hypothetical cohort of 100,000 children screened, the expected number of TB cases over a 20-year time horizon was 6,496 with no screening, 4,652 with targeted TST and 3,904 with universal TST.

Cost results
In a hypothetical cohort of 100,000 children screened, the total costs over a 20-year time horizon were $61,393 with no screening, $1,029,532 with targeted TST and $1,531,294 with universal TST.

More than 95% of costs in the two screening strategies were associated with programme costs, whereas medical care costs associated with TB were minimal.

Synthesis of costs and benefits
Incremental cost-effectiveness ratios (ICERs; i.e. the incremental cost per TB case averted) were calculated in order to combine the costs and benefits of the screening strategies.

The ICER was $524,897 with targeted TST over no screening and $671,398 with universal TST over targeted TST.

The sensitivity analysis showed that the ICERs were very sensitive to variations in the probability of TST positivity and to variations in the risk of disease progression.

In the comparison between the two screening strategies, the ICER of conducting universal testing instead of targeted TST did not fall below the threshold of $100,000 when any plausible range for risk factor prevalence was combined with any plausible range for the prevalence of TST positivity in risk factor-negative children.

The ICER of using targeted TST instead of no screening fell below $50,000 only when the prevalence of risk factor positivity was 18% or more and the prevalence of TST positivity among risk factor-positive children was 13% or more.

The survey carried out in California suggested that those counties that required TST before school entry included the largest health jurisdictions. In 2004, more than 50% of California children lived in health jurisdictions that required TST before kindergarten entry and approximately 252,405 children entered kindergarten in areas of California that required universal TST. The use of targeted TST instead of universal TST in California would save approximately $1.27 million and result in only 1.89 additional cases of TB over the next 20 years.

Authors' conclusions
The cost-effectiveness of the two screening strategies was very high. However, a switch from universal tuberculin skin testing (TST) to targeted TST would generate cost-savings that could be invested in more cost-effective strategies to prevent TBT. Universal TST should be limited only when the prevalence of risk factor positivity and the prevalence of TST positivity among risk factor-positive individuals are high enough to make this screening strategy more cost-effective from the perspective of the health care system.

CRD COMMENTARY - Selection of comparators
The selection of the comparators was clearly justified and was appropriate. The choice of the alternative compared reflected the current practice in the USA. You should decide whether they are valid comparators in your own setting.
Validity of estimate of measure of effectiveness
The clinical evidence used in the model was obtained through a review of the literature, some details of which were given. Some information on the design and other characteristics of the primary studies included in the review was provided. Much of the data came from large US cohort studies, while some reviews were used to obtain test accuracy. These generally represent good sources of clinical data. Details of the approach used to extract and then combine the primary estimates were not given. The authors stated that, in the base-case analysis, the best available estimates were used.

Validity of estimate of measure of benefit
The summary benefit measure was obtained using the modelling approach. It represents a disease-specific measure that cannot be compared with the benefits of other health care interventions. However, the number of cases averted is quite commonly used in the evaluation of the clinical benefits of screening programmes.

Validity of estimate of costs
The analysis of the costs appears to have been consistent with the perspective adopted in the study. The authors justified the exclusion of some costs (i.e. costs of hepatotoxicity). The sources of the costs were reported for all items. However, data on the unit costs and quantities of resources used were not given for all items; some costs were presented as macro-categories, which may limit the possibility of replicating the analysis in other settings. The cost estimates were treated deterministically and the impact of using alternative estimates was not investigated. The price year was reported, which has a significant implication for the generalisability of the study results. Appropriate discounting was performed.

Other issues
The authors stated that their findings differed from those obtained in a previous study carried out in the Santa Clara area. They gave some potential explanations for these discrepancies, such as the determination of risk status and prevalence of TST positivity. The issue of the generalisability of the study results to other settings was not explicitly addressed but the sensitivity analysis enhanced, to some degree, the external validity of the study. Some limitations of the analysis were also highlighted. First, it was difficult to estimate some clinical inputs, such as the risk of progression to disease and the specificity of TST in children. Second, some model assumptions might not reflect actual patterns of disease and health care. For example, it was assumed that universal screening or targeted TST did not detect cases of active TB disease in pre-kindergarteners. Finally, the model did not incorporate adjustments for quality of life, such as quality-adjusted life-years, owing to the paucity of published data.

Implications of the study
The study results support the recommendations of the Pediatric Tuberculosis Collaborative Group for discontinuing universal TST of children. Further, screening might become more cost-effective in older children, given the low prevalence of latent TB among kindergarteners compared with school-aged children. The authors noted that future studies should determine whether increased non-adherence and hepatotoxicity in older children outweigh the benefits of later screening.

Source of funding
Supported by a grant from the National Center for Research Resources.

Bibliographic details

PubMedID
17606566

DOI
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Indexing Status
Subject indexing assigned by NLM

MeSH
California; Child; Child, Preschool; Cost-Benefit Analysis; Costs and Cost Analysis; Humans; Mass Screening /economics; Risk Factors; Sensitivity and Specificity; Tuberculin Test /economics; Tuberculosis /diagnosis /economics /prevention & control

AccessionNumber
22007001504

Date bibliographic record published
30/11/2007

Date abstract record published
30/11/2007