A comparison of costs of universal versus targeted lead screening for young children

Rolnick S J, Nordin J, Cherney L M

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 lead exposure in children, using blood tests. In cases where the blood lead level was equal to or greater than 15 micrograms per decilitre (dl), the result was confirmed by testing a venous blood sample. Parents or guardians of the children were asked to complete a questionnaire on demographics and factors cited in the literature which were considered to be potentially related to lead exposure.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
Children aged between 6 months and 6 years, identified through collaboration with 17 community health organisations from the twin cities of Minneapolis and St Paul (Minnesota, USA).

Setting
The clinical study took place in a community setting. Both the clinical study and the economic assessment were performed in Minnesota, USA.

Dates to which data relate
Blood samples were collected between 1 September 1992, and 31 August 1993. Direct medical costs were determined for each screening strategy, based on Medicaid reimbursement costs in Minnesota 'over the past several years'; the exact price year was not stated.

Source of effectiveness data
Data were derived from a single study, with methods based on an existing published evaluation.

Link between effectiveness and cost data
Costing was undertaken on the same patient sample as that used in the effectiveness study. It is not entirely clear whether the data relating to costs were concurrent with the effectiveness data, as this is not specifically mentioned by the authors.

Study sample
Children were recruited through collaboration with 17 community health organisations from the cities of Minneapolis and St Paul, including public health clinics, community clinics, supplemental food programmes for women, infants, and...
children (WIC programs), paediatric clinics at county and children's hospitals, and a large health maintenance organisation. The specific organisations are listed in the paper. The sample was not selected randomly; 30% were recruited from the health maintenance organisation and 70% from 16 community based sites considered to serve populations at greatest risk in order to reflect the maximum lead elevation in the community. Overall, 9,603 families were recruited (9,603 individuals). The use of an a priori calculation to determine statistical power was not mentioned. In some cases, clinics were unable to take venous blood samples, and in other instances patients did not return for their confirmatory test. However, the relevant numbers of patients were not provided. Details of excluded participants, and those withdrawing from the study were not provided.

**Study design**
This was a cohort study, using non-random selection of participants.

**Analysis of effectiveness**
The percentage of children with elevated blood levels (elevated identified), the percentage of children with elevated blood levels not identified (elevated missed), and the number of children without elevated blood levels (nonelevateds) having venous blood taken, were calculated for each screening strategy, using thresholds at blood levels equal to or exceeding both 10 and 15 micrograms per decilitre (dl). The authors do not state whether the analysis was carried out on an intention to treat basis.

**Effectiveness results**
Blood testing for the entire population found 88% of children with blood lead levels less than 10 micrograms/dl, 8.5% with levels 10-14 micrograms/dl, 2.1% with levels 15-19 micrograms/dl, and 1.2% with levels equal to or exceeding 20 micrograms/dl. For those with levels greater than 10 micrograms/dl, associated risk factors included race (nonwhite), poverty status (based on geographic location), living in the city, living in housing built before the 1950s, a history of previous lead poisoning, or having a sibling with a history of lead poisoning.

**Clinical conclusions**
Not all children need lead screening. Children living in the centre of cities, or with risk factors of living in housing built before 1950, or a previous history of lead poisoning should be screened.

**Measure of benefits used in the economic analysis**
The benefit measure was cases (elevated blood levels) detected. Parents or guardians were asked to complete a questionnaire on demographics and factors related to lead exposure. Matched blood samples and questionnaires were used for analysis.

**Direct costs**
Costs were calculated based on the initial screening per patient and confirmatory testing for half the cases found to have blood lead levels equal to or exceeding 15 micrograms/dl. The costs considered were those of the health service, and reflected the total number of blood tests required and the cost of specimen collection, handling, and testing per elevated case. Costs and quantities were considered separately. Discounting was not relevant as the period of study was less than one year. No price years were given.

**Statistical analysis of costs**
Not applicable.

**Indirect Costs**
Indirect costs were not considered.
Currency
US dollars ($).

Sensitivity analysis
Not undertaken.

Estimated benefits used in the economic analysis
Strategy 1 would have identified none of those with elevated blood lead at either level, but would not have incurred unnecessary screening.

Strategy 2, for blood lead threshold of 15 micrograms/dl or more: overall 9,603 children were screened, of whom 317 (3.3%) elevateds were identified, and 9,286 (96.6%) nonelevateds received venepuncture. For a blood lead threshold of 10 micrograms/dl or more, 1,140 (11.9%) elevateds were identified, and 8,463 (88.1%) nonelevateds received venepuncture.

Strategy 3A, for threshold of 15 micrograms/dl or more: overall 8,015 children would have been screened, of whom 290 (3.6%) elevateds would have been identified (290/317 - 92%), and 7,725 (96.4%) nonelevateds would have received venepuncture. For threshold of 10 micrograms/dl or more, 1,028 (12.8%) elevateds would have been identified (1,028/1,140 - 90%), and 6,875 (85.8%) nonelevateds would have received venepuncture.

Strategy 3B, for threshold of 15 micrograms/dl or more: overall 5,261 children would have been screened, of whom 254 (4.8%) elevateds would have been identified (254/317 - 80%), and 5,007 (95%) nonelevateds would have received venepuncture. For threshold of 10 micrograms/dl or more, 1,028 (12.8%) elevateds would have been identified (874/1,140 - 77%), and 4,121 (78.3%) nonelevateds would have received venepuncture.

Strategy 4A, for threshold of 15 micrograms/dl or more: overall 6,394 children would have been screened, of whom 287 (4.5%) elevateds would have been identified (287/317 - 90%), and 6,107 (95%) nonelevateds would have received venepuncture. For threshold of 10 micrograms/dl or more, 1,022 (16%) elevateds would have been identified (1,022/1,140 - 90%), and 4,967 (78%) nonelevateds would have received venepuncture.

Strategy 4B, for threshold of 15 micrograms/dl or more: overall 6,469 children would have been screened, of whom 284 (4.4%) elevateds would have been identified (284/317 - 90%), and 6,185 (96%) nonelevateds would have received venepuncture. For threshold of 10 micrograms/dl or more, 1,036 (16%) elevateds would have been identified (1,036/1,140 - 91%), and 5,045 (78%) nonelevateds would have received venepuncture.

An additional analysis of children with blood lead levels of 20 micrograms/dl or more was carried out for this strategy. There were 115 children in this category, of which 105 (91%) would have been identified.

Cost results
The estimated cost per case tested was $17. Strategy 1 would have incurred no screening costs. The overall screening costs for other strategies were $165,945 for strategy 2, $138,720 for strategy 3A, $91,596 for strategy 3B, and $111,138 for strategy 4A. The screening cost for strategy 4B would have been $112,387 at the threshold of 15 micrograms/dl or more of blood lead, and $109,973 at the 10 micrograms/dl or more level.

Synthesis of costs and benefits
Strategy 2: the cost per elevated case identified would be $523.49 for 15 micrograms/dl or more, and $145.57 for 10 micrograms/dl or more.

Strategy 3A: the cost per elevated case identified would be $478.34 at 15 micrograms/dl or more, and $134.94 at 10 micrograms/dl or more.
Strategy 3B: the cost per elevated case identified would be $360.61 at 15 micrograms/dl or more, and $104.80 at 10 micrograms/dl or more.

Strategy 4A: the cost per elevated case identified would be $387.24 at 15 micrograms/dl or more, and $108.75 at 10 micrograms/dl or more.

Strategy 4B: the cost per elevated case identified would be $395.73 at 15 micrograms/dl or more, and $106.15 at 10 micrograms/dl or more.

Authors' conclusions
A geographically based approach (strategy 4B) was able to detect 90% of children with elevated blood levels at two-thirds the cost of universal screening. This strategy would involve blood tests being taken for all children living within city limits; children residing elsewhere would be tested if they were deemed to be at risk of lead exposure on the basis of the age of their housing, whether the child or a sibling had a history of lead poisoning, and whether the child had been seen eating paint chips. The new guidelines from the Centres for Disease Control and Prevention suggest that screening be based on an assessment of housing, population demographics, and community risk and resources.

CRD COMMENTARY - Selection of comparators
The decision to compare various screening strategies with a universal approach appears to be appropriate. A rationale for the choice of comparators was given.

Validity of estimate of measure of benefit
The estimate of measure of benefit is based on published data from a primary study. There is no description of study withdrawals, and it is unclear whether analysis was carried out on an intention to treat basis. The assumption used by the authors that the results of all blood tests are accurate may not be correct; accuracy is likely to vary across different providers.

Validity of estimate of costs
The authors draw attention to the fact that the estimate of $17 per child screened is not an accurate cost figure for all providers, and is likely to be a conservative estimate.

Other issues
The generalisability of this study may be limited. It was conducted in a location that is predominantly low risk relative to other large metropolitan areas and therefore lacks generalisability to other areas in terms of the potentially best approach for the geographic location. In addition, the sample was not fully representative of the area studied. It was not possible to mandate a standardised approach as the test used was based on either venous or capillary blood sampling. Not all children were screened, only those between 6 months and 6 years. The authors rightly draw attention to all these points during their discussion.

Implications of the study
Authors' statement: In making a decision for a policy on screening for elevated lead levels in children, considerations should include a range of options and the potential costs in terms of time and capital as well as the ability of providers to implement whatever approach is selected.

Source of funding
Funded by a grant from the Minnesota Department of Health.