Is the G-6-PD activity assay more cost effective than the methaemoglobin reduction test in screening for G-6-PD deficiency

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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 investigated the use of the methaemoglobin reduction test (MRT) in screening for glucose 6-phosphate dehydrogenase (G-6-PD) deficiency.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised neonates delivered at the Chulalongkorn University Hospital, Bangkok.

Setting
The setting was secondary care. The economic study was carried out in Bangkok, Thailand.

Dates to which data relate
The dates to which the effectiveness, resource use and cost data referred were not reported. The price year was not reported.

Source of effectiveness data
The effectiveness data were derived from a previous study (Sanpavat et al. 2001, see 'Other Publications of Related Interest' below for bibliographic details).

Link between effectiveness and cost data
The costing was carried out retrospectively on the same patient sample as that used in the effectiveness study.

Study sample
The following information was derived from the study by Sanpavat et al. 2001.

No power calculations were conducted to determine the sample size. The authors justified the patient sample on the basis of the prevalence of G-6-PD deficiency in Thailand. Umbilical cord blood samples were randomly taken from neonates in the hospital’s delivery room. Peripheral blood samples were taken from 229 infants with hyperbilirubinaemia (140 males and 89 females). Cord blood samples were taken from 522 neonates (350 males and 172 females).
Study design
This was a diagnostic accuracy study that was conducted in a single centre. The authors reported that all samples were tested by the MRT and G-6-PD activity assay independently. The timeframe for collecting data on the two tests was not reported. The MRT and G-6-PD activity assay produced deficient or normal results. However, MRT may also produce intermediate results, thus these results were considered as incorrect diagnoses.

Analysis of effectiveness
The primary outcomes used were measures of screening test accuracy (sensitivity, specificity and predictive values) for MRT, using the G-6-PD activity assay as the reference test, and the percentage prevalence of G-6-PD deficiency.

Effectiveness results
The sensitivity of MRT in cord blood screening was 85.7% and the specificity was 95.1%. The positive predictive value was 65.7%, whilst the negative predictive value was 98.9%.

In jaundiced infants, the sensitivity of MRT was 60% and the specificity was 91.0%. The positive predictive value was 61.5%, whilst the negative predictive value was 92.0%.

The prevalence of G-6-PD deficiency derived from cord blood samples was 11.1% in males and 5.59% in females. In jaundiced infants, this was 22.1% in males and 10.1% in females.

Clinical conclusions
G-6-PD deficiency is a common condition within the Thai population. The MRT provided poorer sensitivity for screening than the G-6-PD activity assay. In addition, the sensitivity of MRT was lowered when applied to peripheral blood samples from jaundiced infants.

Measure of benefits used in the economic analysis
The measure of benefit used was the number of accurate positive results detected.

Direct costs
The cost of the tests conducted at the Special Laboratory, Bangkok, were included in the analysis. The resource data were taken from the Chulalongkorn University Hospital. The resource use quantities (number of tests and positive or negative results) were reported separately from the costs per test. The price year was not reported.

Statistical analysis of costs
The data were deterministic.

Indirect Costs
In line with the adopted perspective, the indirect costs were not reported.

Currency
US dollars ($), with $1 = Thai baht 44.

Sensitivity analysis
A sensitivity analysis was not carried out.
Estimated benefits used in the economic analysis
The benefits used in the economic analysis were the number of accurate positive results. From the Sanpavat study, there were 66 accurate positive results with the MRT and 89 with the G-6-PD activity assay. In the present study, the authors reported that the number of accurate positive results was 66 with the MRT and 89 with the G-6-PD activity assay. It appears that the authors have considered the intermediate results with MRT (2 in cord blood screening and 1 in neonates with jaundice) as deficient results (i.e. accurate positive results). In this case, the sensitivity of MRT would be 89.8% instead of 85.7%.

Cost results
The cost per MRT was $0.02. The cost per G-6-PD activity assay was $0.46.

Synthesis of costs and benefits
The costs and benefits were summarised in the form of an average cost-effectiveness ratio, by dividing the total costs for each strategy by the number of accurate positive results detected.

For the MRT, the authors reported that the cost per accurate positive result detected was $0.15 with the MRT and $2.67 with the G-6-PD activity assay. However, the calculations would appear to be incorrect. In cord blood screening, of the 522 neonates tested, 49 were G-6-PD deficient and 44 were MRT deficient (of which 2 were MRT intermediate). Therefore, the cost per accurate positive result detected was, in effect, $4.90 with the G-6-PD activity assay and $0.237 with the MRT. In peripheral blood screening, of the 229 neonates tested, 40 were G-6-PD deficient and 25 were MRT deficient (of which 1 was MRT intermediate). Therefore, the cost of an accurate positive result detected was, in effect, $2.63 with the G-6-PD activity assay and $0.183 with the MRT. Overall, the cost per accurate positive result detected was $6.42 with the G-6-PD activity assay and $0.36 with the MRT.

Authors' conclusions
Although the methaemoglobin reduction test (MRT) showed poorer sensitivity in the screening for glucose-6-phosphate dehydrogenase (G-6-PD) deficiency, its lower cost meant that this test was cost-effective in comparison with the current reference standard.

CRD COMMENTARY - Selection of comparators
The choice of the comparators was justified on the basis that the MRT had been widely used as a screening test for G-6-PD deficiency in Thailand, while the G-6-PD activity assay was considered the 'gold' standard for G-6-PD deficiency screening. You should decide if these comparators represent widely used technologies in your own setting.

Validity of estimate of measure of effectiveness
The analysis was based upon a published diagnostic accuracy study, which was appropriate for the comparison of screening tests. Limitations of the study methodology included the absence of power calculations to determine the sample size, the lack of detail on test measurement timeframes, and the random nature of sample selection. In addition, in the present study, the authors recalculated the sensitivity of MRT including the intermediate results in deficient results. This biased the measure of "accurate positive" results.

Validity of estimate of measure of benefit
The measure of benefit was appropriate to the study question. As reported in the previous section, there was a bias in the measure of the “accurate positive” results detected.

Validity of estimate of costs
The evaluation of the costs from a narrow perspective (laboratory costs) should be borne in mind when interpreting the findings. The costs were reported separately from resource use, thus enhancing the reproducibility of the study in other

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The retrospective nature of the economic analysis and the failure to report the dates when the data were collected represent potential threats to the reliability of the findings. A further potential threat was the absence of sensitivity, statistical or any other analyses of the prices. The price year was not reported, hence impeding any future reflation exercises. Discounting was not relevant and, appropriately, was not reported.

**Other issues**
As there was no strictly dominant strategy (i.e. both were more effective and less costly), an incremental cost-effectiveness ratio would have been a better measure of the relative value of the screening strategies than the average cost-effectiveness ratios. The authors’ findings on prevalence compared favourably with other studies. The authors justified their main conclusion in light of the current economic climate in Thailand. A point of concern is the low sensitivity of the MRT (in jaundiced infants) in the context of its reported cost-effectiveness. The issue of generalisability to other settings was not addressed. Although the measure of benefit may be prone to bias, in general, the authors do not appear to have presented their results selectively and their conclusions reflected the scope of the analysis. The authors did not report any limitations of their study.

**Implications of the study**
The authors recommended that the MRT is useful for screening programmes for large populations, but not for diagnostic purposes. Future prospective studies are needed to investigate the link between G-6-PD deficiency and the development of jaundice requiring intervention.

**Source of funding**
None stated.

**Bibliographic details**
Wiwanitkit V. Is the G-6-PD activity assay more cost effective than the methaemoglobin reduction test in screening for G-6-PD deficiency. Haema 2005; 8(1): 61-63

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by CRD

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