Should all pregnant diabetic women undergo a fetal echocardiography? A cost-effectiveness analysis comparing four screening strategies

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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 compared four foetal echocardiography screening strategies for congenital heart defects.

- Strategy 1 was no screening, in which no ultrasound was performed.
- Strategy 2 was selective foetal echocardiography after abnormal or suspected cardiac views during a detailed anatomic survey.
- Strategy 3 was foetal echocardiography only for women with high haemoglobin (Hb) A1c levels.
- Strategy 4 was universal foetal echocardiography for all diabetics.

Type of intervention
Screening.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 40,000 diabetic women who were pregnant.

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

Dates to which data relate
The effectiveness data were derived from studies published between 1998 and 2003. The cost data were derived from studies published between 1982 and 2001. The price year was 2004.

Source of effectiveness data
The epidemiological data used in the model included the probability of a major congenital heart defect in diabetics, and the proportion of mothers carrying infants with major congenital heart defects and opting to terminate the pregnancy. The screening parameters used in the model were the sensitivity and specificity of the HbA1c, detailed anatomic survey and foetal echocardiography strategies, and the probability of abnormal results with each of these screening tests.

Modelling
The authors developed an analytic decision tree model to estimate the cost-effectiveness of foetal echocardiography.
strategies for pregnant diabetics. The time horizon used in the model was that of the life expectancy of the newborn.

**Sources searched to identify primary studies**
All clinical, epidemiological and screening data were derived from published studies, for which the authors provided no further details.

**Methods used to judge relevance and validity, and for extracting data**
The authors reported that a review of the literature was performed. They searched English literature using the MeSH terms "fetal cardiac anomalies", "fetal echocardiography", "diabetes in pregnancy", "cardiac malformations", "prenatal ultrasound" and combinations of these. No further details were provided on how the identified studies were selected for relevance or inclusion, or if and how the studies were synthesised.

**Measure of benefits used in the economic analysis**
The measure of benefits used was the quality-adjusted life-years (QALYs). The utilities were derived from studies using the Health Utilities Index to evaluate patients with various health states (including cardiac diseases). Utilities were converted to QALYs by multiplying them by the expected life expectancy for each outcome. As the outcomes could be incurred over a long time, future outcomes were discounted at an annual rate of 3%.

**Direct costs**
The direct costs to the health care service were included in the analysis. These included the costs of screening, the costs of complications, and the costs of raising a child with a cardiac defect over and above those for a normal child. The costs of raising a child with a cardiac defect were derived from a published study (Waitzman et al. 1994, see 'Other Publications of Related Interest' for bibliographic details). Medicare data were used for the other costs when available; when unavailable, local hospital charges were multiplied by a cost-to-charge ratio to approximate Medicare reimbursements. As the costs of screening were incurred immediately, discounting of these costs was not relevant and was therefore not performed. For the costs of raising a child with cardiac defects, discounting was relevant as these costs were incurred over the lifetime of the child. However, it was unclear if these costs were discounted as the authors provided no details. The study reported the average costs. The resource quantities and the unit costs were not reported separately. The price year was 2004.

**Statistical analysis of costs**
The cost data were deterministic.

**Indirect Costs**
It was unclear whether productivity costs (e.g. the parents taking days off work to care for their child) were included in the analysis as part of the costs of raising a child with a cardiac defect.

**Currency**
US dollars ($).

**Sensitivity analysis**
The authors undertook a series of one- and two-way sensitivity analyses as well as Monte Carlo (probabilistic) sensitivity analyses on all model variables.

**Estimated benefits used in the economic analysis**
The discounted lifetime QALYs gained using each option were:
22.30 with selective echocardiogram after abnormal detailed anatomic survey;
21.41 with foetal echocardiogram after abnormal HbA1c;
21.87 with universal foetal echocardiography; and
21.95 with no screening.

Cost results
The average lifetime cost of each screening option was:
$278.30 for selective echocardiogram after abnormal detailed anatomic survey;
$464.50 for foetal echocardiogram after abnormal HbA1c;
$6,234.20 for universal foetal echocardiography; and
$8,652.00 for no screening.

Synthesis of costs and benefits
The costs and benefits were combined using an incremental cost-utility ratio (i.e. the additional cost per QALY gained). The results from the analysis showed that selective echocardiogram after abnormal detailed anatomic survey was dominant (i.e. less costly and more effective) than the other three screening options.

The results of the two-way sensitivity analysis showed that the model was sensitive to variations in the cost and specificity of detailed anatomic survey. The results of the Monte Carlo simulation showed that, in over 80% of simulations, selective foetal echocardiography remained cost-effective with incremental cost-utility ratios of less than $13,900 per QALY gained.

Authors' conclusions
Selective echocardiogram after abnormal detailed anatomic survey was cost-effective in comparison with universal foetal echocardiography as a screening strategy for cardiac defects in pregnant diabetics.

CRD COMMENTARY - Selection of comparators
A justification was given for the comparators used. For example, the authors reported that, in the USA, a policy of universal foetal echocardiography for all diabetics had been adopted in many centres. You should decide if the comparators used represent current practice in your own setting.

Validity of estimate of measure of effectiveness
The parameters used in the model were derived from published research, but the authors did not report how results derived from the primary studies were combined. There were very few details of the methods used in the review of the literature, and only the MeSH terms used in the search were reported. No justification was given for the parameter estimates selected. As the authors provided no details of the studies used to derive the model parameters, it is not possible to assess or comment on the quality and appropriateness of the primary studies included.

Validity of estimate of measure of benefit
The estimation of health benefit (QALYs) was derived appropriately from a decision tree model and future QALYs were appropriately discounted. The utilities were derived from the published literature, with details of the valuation methods being provided in the discussion section of the article.
Validity of estimate of costs
The authors reported that the study had been undertaken from a societal perspective. However, only the direct medical costs were included in the analysis. Consequently, the perspective adopted in the cost analysis appears to have been that of the health care service. If this was in fact the case, it would appear that all the relevant costs were included. However, if the perspective was societal, it was unclear whether all the relevant costs had been considered. The costs were derived from published sources. Again, given the lack of detail of the sources from which the costs were derived, it was unclear whether cost categories where discounting was relevant (i.e. costs of raising a child with a cardiac defect) were actually discounted or not. The price year was appropriately reported, which will aid any future inflation exercises. The costs and the quantities were not reported separately, which will limit the generalisability of the authors’ results.

Other issues
The authors reported that this was the first cost-effectiveness analysis devoted to the utility of foetal echocardiography in diabetics. However, a previous study had suggested a cost-saving from prenatal diagnosis of cardiac anomalies, assuming a 45 to 50% rate of pregnancy. The issue of generalisability to other settings was not addressed. The authors do not appear to have presented their results selectively and their conclusions reflected the scope of the analysis. However, they should have provided some essential details about the studies used to derive both the effectiveness and cost data.

The authors reported a number of further limitations to their study. First, they only considered the direct medical costs. Second, it was difficult to obtain reliable and generalisable point estimates for the model probabilities. Third, utilities were derived from patients with various health states that could differ from those of pregnant diabetic women. Finally, the model implicitly assumed that all medical practitioners were comfortable with using each screening option.

Implications of the study
The authors suggest that future clinical studies are needed to confirm their findings and to change clinical policies.

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None stated.

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Other publications of related interest
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**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Cost-Benefit Analysis; Decision Support Techniques; Echocardiography /economics /utilization; Female; Heart Defects, Congenital /embryology /ultrasonography; Hemoglobin A, Glycosylated /metabolism; Humans; Pennsylvania; Predictive Value of Tests; Pregnancy; Pregnancy in Diabetics /blood /ultrasonography; Sensitivity and Specificity; Ultrasonography, Prenatal /economics /utilization

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