The economic impact and cost-effectiveness of urinary neutrophil gelatinase-associated lipocalin after cardiac surgery

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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.

CRD summary
This study assessed the cost-effectiveness of urinary neutrophil gelatinase-associated lipocalin (NGAL) for the diagnosis of acute kidney injury after cardiac surgery. The authors concluded that urinary NGAL appeared to be cost-effective for the early diagnosis of acute kidney injury. The cost-effectiveness framework was valid and key areas of uncertainty were clearly investigated. Limited information on the clinical data sources was given, but the authors’ conclusions appear to be robust.

Type of economic evaluation
Cost-utility analysis

Study objective
This study assessed the cost-effectiveness of urinary neutrophil gelatinase-associated lipocalin (NGAL) for the diagnosis of acute kidney injury after cardiac surgery.

Interventions
NGAL was measured by a spot estimate from a urine sample on four occasions: two hours after surgery, then every six hours. This was compared with conventional diagnosis, which consisted of monitoring of the blood urea nitrogen, blood creatinine, and urine output.

Location/setting
UK/hospital.

Methods
Analytical approach:
The analysis used a decision-analytic model with a hypothetical cohort of 67-year-old male patients undergoing coronary artery bypass graft surgery. A lifetime horizon was considered. The authors stated that a societal perspective was adopted.

Effectiveness data:
Most of the clinical inputs were from published studies. Where published sources were not available, the inputs were estimated using structured telephone interviews with 15 physician experts in the UK, France, Germany, Italy, or Spain. The sensitivity and specificity were from two diagnostic studies of 72 and 426 patients. Studies with smaller samples were not considered. The main outcome was the percentage of patients for whom progression from a risk of acute kidney injury to the injury or a failure stage was prevented. The improvement in this outcome due to an early diagnosis with NGAL was a key input for the model. The severity of acute kidney injury was determined using the risk, injury, failure, loss, and end-stage renal disease (RIFLE) criteria.

Monetary benefit and utility valuations:
The utility values were from the literature and were derived using the time trade-off method.

Measure of benefit:
Quality-adjusted life-years (QALYs) were the summary benefit measure.
Cost data:
The economic analysis included the costs of hospital stay on a general ward and in the intensive care unit (ICU), nurse time, nephrologist's time, serum creatinine test, urine output measurement, NGAL test, dialysis (annual and per treatment), renal transplant, and annual treatment for chronic kidney disease that did not require dialysis. The costs of chronic kidney disease treatment without dialysis were from a database of general practitioners in the UK. Other costs were from official UK sources. All costs were in UK pounds sterling (£) and the price year was 2008.

Analysis of uncertainty:
One-way sensitivity analyses were carried out to assess the uncertainty. The most influential inputs were displayed in a tornado diagram. A probabilistic sensitivity analysis, with 1,000 simulations, was carried out to assess the net monetary benefit, using a multi-way approach.

Results
The expected costs were £4,244 for NGAL and £4,672 for usual diagnosis. The QALYs were 11.86 for NGAL and 11.79 for usual diagnosis. NGAL was dominant as it was more effective and less expensive than usual diagnosis.

NGAL remained the preferred strategy even in a conservative scenario, in which the treatment effect was halved from 25% to 12.5%. The most influential inputs were the previous probability of acute kidney injury and the probability of developing chronic kidney disease.

At a willingness-to-pay threshold of £30,000 per QALY gained, the net monetary benefit was always positive and NGAL was cost-effective in all simulations.

Authors' conclusions
The authors concluded that urinary NGAL, after cardiac surgery, appeared to be cost-effective for the early diagnosis of acute kidney injury.

CRD commentary
Interventions:
The rationale for the selection of the comparators was clear; the proposed biomarker was compared with the usual diagnostic process. Each test was clearly described.

Effectiveness/benefits:
The clinical data were not sufficiently described. No literature review was reported to identify the relevant sources of evidence. The methods and key features of the data sources were not reported, except for two diagnostic studies that were selected for their relatively large samples. Expert opinion was used where data were not available in the literature. In general, it is difficult to judge the validity of the clinical data. The sources for the utility values were not described. QALYs appear to have been appropriate for capturing the impact of the disease on the patients’ health, as they assess survival and quality of life. The time trade-off technique to elicit preferences is generally appropriate.

Costs:
The economic analysis appears to have been restricted to the direct medical costs. It was stated that the perspective was societal, but the authors acknowledged that they could not include the indirect costs, due to difficulties in estimating them. The resource quantities were reported separately from the unit costs and their sources were clearly stated and representative of the UK. All costs were varied in the sensitivity analysis. The price year was reported, making reflation exercises possible. In general, the costs were reported satisfactorily.

Analysis and results:
The results were clearly reported. Average cost-utility ratios were calculated, and an incremental approach was used to synthesise the costs and benefits of the two strategies. The uncertainty was satisfactorily investigated in deterministic and probabilistic analyses and the results were clearly illustrated and discussed. Discounting was not explicitly reported, and it was relevant given the lifetime analysis. An extensive description of the model was provided. The authors acknowledged some limitations of their analysis and these mainly related to the need for several assumptions and the poor quality of some clinical studies. The model was based on patients undergoing coronary artery bypass graft surgery and might not be representative of other surgical patients. The authors stated that this might have underestimated...
mortality and the likelihood of developing acute kidney injury. The results appear to be specific to the UK and their transferability was not discussed.

Concluding remarks:
The cost-effectiveness framework was valid and key areas of uncertainty were clearly investigated. Limited information on the clinical data sources was given, but the authors’ conclusions appear to be robust.

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