Cost-effectiveness of primary percutaneous coronary intervention versus thrombolytic therapy for acute myocardial infarction

Selmer R, Halvorsen S, Myhre K I, Wisloff T F, Kristiansen I S

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 use of primary percutaneous coronary intervention (PCI) versus thrombolytic therapy for acute ST-segment elevation myocardial infarction (STEMI).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised 65 year-old-men with an acute STEMI.

Setting
The setting was tertiary care. The economic study was carried out in Norway.

Dates to which data relate
The effectiveness and resource use data were modelled using data published between 2000 and 2004. The price year was not reported.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of published studies, augmented with estimates of effectiveness based on opinion when necessary.

Modelling
A Markov state transition model was developed, using TreeAge Data software, to estimate the clinical effectiveness, resource use and total costs of the two treatment options included in the study. A graphical representation of the model was presented in the paper. The initial cycle length was 3 months and subsequent cycles were 1 year. The model was run for the lifetime of the hypothetical patient population. In addition, two separate scenarios were considered. In the first, one group lived near a tertiary hospital, while in the second, one group lived far enough away from a tertiary hospital to require air ambulance transfer to such a hospital. A full description of the health states and possible transitions was reported.

Outcomes assessed in the review
The authors fully presented all of the transition probabilities that were used in the model for all three strategies. These
included:
mortality (before arrival, after 30 days with or without a new event), from heart failure, in asymptomatic and normal populations, etc.;
the probability of reinfarction within 30 days;
the probability of stroke within 30 days;
the probability of heart failure without reinfarction within 30 days; and
the probability of developing symptomatic coronary disease within 30 days.

Further parameters (which did not differ between the treatment groups) were also identified.

**Study designs and other criteria for inclusion in the review**
Although the authors stated that the transition probabilities were derived from one systematic review and five observational studies, no further details were provided.

**Sources searched to identify primary studies**
Not reported.

**Criteria used to ensure the validity of primary studies**
Not reported.

**Methods used to judge relevance and validity, and for extracting data**
Not reported.

**Number of primary studies included**
Six studies were used to identify the model input parameters.

**Methods of combining primary studies**
The method of combining the studies was not reported, although it was stated that the systematic review used had involved a meta-analysis.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
Some of the main probabilities for the PCI strategy were:

- probability of reinfarction within 30 days, 0.025;
- probability of stroke within 30 days, 0.007;
- probability of heart failure without reinfarction within 30 days, 0.1; and
- probability of developing symptomatic coronary disease within 30 days, 0.11.
Some of the main probabilities for the thrombolytic therapy strategy were:

- probability of reinfarction within 30 days, 0.066;
- probability of stroke within 30 days, 0.02;
- probability of heart failure without reinfarction within 30 days, 0.12; and
- probability of developing symptomatic coronary disease within 30 days, 0.35

Methods used to derive estimates of effectiveness
Where model input parameters could not be identified from the literature they were based on expert opinion. These were clearly identified in the paper.

Estimates of effectiveness and key assumptions
For the PCI strategy, the probability of heart failure within 30 days after reinfarction was 0.15 and the probability of developing symptomatic coronary disease within 30 days after reinfarction was 0.165.

For the thrombolytic therapy strategy, the probability of heart failure within 30 days after reinfarction was 0.18 and the probability of developing symptomatic coronary disease within 30 days after reinfarction was 0.525.

Measure of benefits used in the economic analysis
The measure of health benefit used in this study was life expectancy. However, the life expectancy data were not combined with the cost data so, in effect, a cost-consequences analysis was performed.

Direct costs
The direct costs of the health care provider covered initial PCI, initial thrombolytic therapy, transport for the alternative scenarios, readmission, and additional costs of stroke or heart failure or asymptomatic coronary disease. Resource use was taken from the model that provided the clinical effectiveness evidence. The unit costs of hospital treatment were taken from diagnostic-related group price lists, while the unit costs of outpatient and general practitioner visits were taken from a Norwegian fee schedule. The drug costs were taken from market prices and the unit cost of air ambulance transfer was taken from a large helicopter ambulance operator in Norway. The price year was not reported. Undiscounted costs and costs discounted at the rate of 5% per annum were reported.

Statistical analysis of costs
The cost data were treated deterministically in the base-case. The authors also conducted a Monte Carlo analysis in which the costs parameters, in addition to the rest of the model, were treated probabilistically (a normal distribution was used for the cost parameters).

Indirect Costs
Inline with the perspective adopted, no indirect costs were included.

Currency
Euros (EUR).

Sensitivity analysis
A series of sensitivity analyses and a Monte Carlo analysis were performed to assess variability in the data. Sensitivity
analyses that varied the age of the model cohort to 50 and 80 years were undertaken. The ranges for the one-way sensitivity analysis appear to have been taken from the literature. For the Monte Carlo analysis, probabilities were assigned a beta distribution or, when this created values which were outside the 0 - 1 range, a triangular distribution.

**Estimated benefits used in the economic analysis**
Patients who received PCI (both scenarios) had a life expectancy of 8.3 years compared with 7.6 years for patients who received thrombolytic therapy.

**Cost results**
The total undiscounted cost of PCI was EUR 19,250 for patients close to a tertiary hospital (scenario one) and EUR 24,000 for those who would require air transport to a tertiary hospital (scenario two), compared with EUR 29,250 for thrombolytic therapy.

When the total costs were discounted at a rate of 5% per annum, the cost of PCI was EUR 15,500 for scenario one and EUR 20,000 for scenario two, compared with EUR 22,625 for thrombolytic therapy.

**Synthesis of costs and benefits**
The one-way sensitivity analysis and the analysis of 50- and 80-year-old patients showed treatment with PCI to be dominant in all cases. In 16 of the 10,000 Monte Carlo runs the undiscounted cost of PCI exceeded that of thrombolytic therapy.

**Authors’ conclusions**
The use of PCI for the treatment of acute myocardial infarction results in greater health benefits and lower costs in comparison with thrombolytic therapy.

**CRD COMMENTARY - Selection of comparators**
The authors compared PCI with thrombolytic therapy for the treatment of acute myocardial infarction. No explicit justification for the choice of thrombolytic therapy as a comparator was provided in the paper. You should consider how these treatment options compare with usual practice in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness data were derived from published studies, but no details of the methods used to identify and assess the primary studies were given. Although the authors indicated that some of the model input parameters had been taken from a systematic review that had conducted a meta-analysis of trials, the method of combining data from more than one primary study to provide a model input parameter was not reported. The authors fully presented the transition probabilities, ranges and the source of each. However, the limited reporting of the methods used to identify the literature from which the parameters were derived makes it difficult to ascertain if the best available evidence has been used to populate the model.

**Validity of estimate of measure of benefit**
No summary measure of health benefit was combined with the cost data. The authors presented life expectancy, which was derived from the model, but no synthesis was performed.

**Validity of estimate of costs**
The perspective was stated to have been that of the health care provider. As such, it would appear that all the appropriate costs have been included. Some breakdown of the resource use and unit costs was provided. Two sensitivity analyses were undertaken to assess the variability in the study data. In addition, the authors performed a Monte Carlo
analysis for which distributions were applied to all model parameters. The cost parameters were defined using a normal distribution. Undiscounted and discounted total costs were reported. These factors assist the generalisability of the study results. No price year was reported and this prevents any future reflation exercises.

Other issues
The authors do not appear to have presented their results selectively and their conclusion reflected their analysis. They did not compare their results with similar studies, nor did they directly consider how the results of this study could be applied in other countries. The authors acknowledged that the study was limited by the lack of information on the impact of a delay in receiving treatment, owing to transport time in both treatment groups, and the lack of longitudinal data on the outcomes and costs.

Implications of the study
The authors called for clinical trials to assess the impact of combining PCI and thrombolytic therapy in the treatment of myocardial infarctions.

Source of funding
None stated.

Bibliographic details

PubMedID
16269397

DOI
10.1080/14017430510035988

Other publications of related interest
PCI in acute myocardial infarction. SMM-report 2002;5.

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aged, 80 and over; Angioplasty, Balloon, Coronary /economics; Cost-Benefit Analysis /statistics & numerical data; Female; Health Care Costs; Humans; Life Expectancy; Male; Markov Chains; Middle Aged; Models, Econometric; Myocardial Infarction /economics /therapy; Thrombolytic Therapy /economics

AccessionNumber
22006006002

Date bibliographic record published
31/08/2006

Date abstract record published
31/08/2006