The costs and benefits of community thrombolysis for acute myocardial infarction: a decision-analytic model

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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 use of community thrombolysis versus hospital thrombolysis for the treatment of patients with suspected acute myocardial infarction (AMI).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of patients with strong clinical suspicion of AMI, within 4 hours of the onset of symptoms, and without contraindications to thrombolysis.

Setting
The setting was community care (provided by general practitioners, GPs) for community thrombolysis, and secondary or tertiary care for hospital thrombolysis. The economic study was conducted in the UK.

Dates to which data relate
The effectiveness evidence was obtained from literature published from 1979 to 1996. Resource use was obtained from sources published from 1992 to 2001. Prices for 2000 to 2001 were used.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of completed studies.

Modelling
A decision analytic model was used to assess the costs and benefits of community compared with hospital thrombolysis. A hypothetical cohort of patients with suspected AMI either received community thrombolytic therapy by a GP before being admitted to hospital for further treatment, or were directly admitted to hospital. The time horizon of the analysis was established so as to cover costs until discharge from hospital. However, the benefits were estimated over a lifetime.

Outcomes assessed in the review
The outcomes assessed included the probabilities of:

- a patient presenting to a GP with suspected AMI and alive,
a patient having an AMI after presenting to a GP with suspected AMI,
thrombolysis following GP's incorrect diagnosis of AMI,
death following transit to hospital after GP's diagnosis of AMI,
a patient self-presenting to the hospital in an ambulance,
a patient presenting at the hospital dead,
a hospital's correct diagnosis of AMI,
a hospital's incorrect diagnosis of AMI (AMI not present), and
thrombolysis accompanied by a hospital's correct diagnosis of AMI.

The average number of survival days in a 4-year follow-up period and the proportion of patients surviving this follow-up period were also estimated.

**Study designs and other criteria for inclusion in the review**
No specific criteria for inclusion in the review were stated. However, the average number of survival days in a 4-year follow-up period and the proportion of patients surviving this follow-up period were derived from the Grampian Region Early Anistreplase Trial (GREAT). This was a randomised double-blinded trial of anistreplase administered either at home by a GP (n=163) or later in hospital (n=148). The trial was conducted between December 1988 and December 1991 (Rawles 1994 and Rawles 1996, see 'Other Publications of Related Interest' below for bibliographic details).

**Sources searched to identify primary studies**
It was stated that the probabilities were obtained from a review of MEDLINE, limited to years 1986 to 1996, using search terms and free text search terms related to thrombolysis or fibrinolysis and AMI. Other parameters were derived from the GREAT trial.

**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**
Nine primary studies were included in the review.

**Methods of combining primary studies**
The results of the individual primary studies were combined using narrative methods.

**Investigation of differences between primary studies**
Potential differences between the primary studies were not discussed.

**Results of the review**
The following probabilities were derived from the review of the literature:
a patient presenting to a GP with suspected AMI and alive, 0.8;

a patient having an AMI after presenting to a GP with suspected AMI, 0.2;

thrombolysis following the GP's incorrect diagnosis of AMI, 0.349;

death in transit to the hospital after the GP's diagnosis of AMI, 0.026;

patient presenting at the hospital dead, 0.219; and

thrombolysis accompanied by the hospital's correct diagnosis of AMI, 0.435.

Methods used to derive estimates of effectiveness
Mathematical formulae and further assumptions were used to combine effectiveness parameters taken from the review, to estimate parameters for which no data were available in the published literature. The survival over the lifetime horizon was derived from the GREAT trial and the Declining Exponential Approximation of Life Expectancy (DEALE) method.

Estimates of effectiveness and key assumptions
The probability of the hospital's correct diagnosis of AMI was 0.615; the probability of the hospital's incorrect diagnosis of AMI (AMI not present) was 0.048.

The true- and false-positive rates of AMI diagnosis by GPs were based on assumptions. The true-positive rate of AMI diagnosis at the hospital was multiplied by a parameter (0.75) to give the true-positive rate of AMI diagnosis by GPs. Similarly, the false-positive rate of AMI diagnosis at the hospital was divided by this parameter to give the false-positive rate of AMI diagnosis by GPs. These calculations resulted in a probability of the GP's correct diagnosis of AMI (true-positive rate) equal to 0.461, and a probability of a GP's incorrect diagnosis of AMI (false-positive rate) equal to 0.064.

The proportion of people presenting directly to the hospital was assumed to be 0.80, while the proportion of people presenting directly to the hospital who used an ambulance was assumed to be 0.75. The effectiveness of the hospital's administration of anistreplase was assumed to be the same as the hospital's administration of streptokinase.

Life expectancy was 15.57 years after community thrombolysis, 13.34 years after hospital thrombolysis, 12.78 years after AMI but no thrombolysis, and 16.61 years when no AMI was present and no thrombolysis was attempted.

Measure of benefits used in the economic analysis
The measure of benefits used was the number of life-years gained by applying each of the strategies assessed. This was expressed as the average life expectancy per patient. The benefits were provided undiscounted, but the effect of discounting benefits at annual rates of 2% and 6% was demonstrated.

Direct costs
The direct costs comprised medical costs only. These were for GP time, drugs and administration. The administration costs included training of GPs, drug storage, wastage through expiry and holding sufficient drug reserves, ambulance transport to the hospital, hospital assessment, and hospital care (i.e. CCU and inpatient care subsequent to the CCU). The costs of electrocardiogram (ECG) machines potentially used by GPs in community thrombolysis were not included in the base-case analysis.

Details of the prices and quantities were provided for some cost components, such as those associated with GP time and training, ambulance transport and hospital care. The quantities were estimated using actual data derived from a clinical trial (undertaken in the Grampian Region between 1988 and 1991), additional data provided by the Grampian University Hospitals NHS Trust, and further discussions with clinicians. The unit costs were taken from nationally
The total costs were derived using modelling. All the costs were expressed in 2000 to 2001 prices. Discounting was not necessary since the costs were incurred during less than one year.

**Statistical analysis of costs**
The costs were treated deterministically. No statistical analysis of the costs was undertaken.

**Indirect Costs**
The indirect costs were not included in the analysis.

**Currency**
UK pounds sterling (€).

**Sensitivity analysis**
A sensitivity analysis was carried out to investigate the robustness of the results under the uncertainty surrounding the parameters of the model. One-way sensitivity analyses were undertaken by varying the values of all model parameters by +/- 20%. Parameters found to affect the results more significantly were then examined in more detail. A scenario involving the use of ECG machines by GPs was investigated in an additional sensitivity analysis.

**Estimated benefits used in the economic analysis**
The average life expectancy per patient was 12.48 years following community thrombolysis and 12.39 years following direct hospital thrombolysis. Community thrombolysis provided an additional 0.09 years of life expectancy in comparison with hospital thrombolysis. These values were not discounted.

**Cost results**
The total NHS cost per patient was 361 for community thrombolysis and 300 for hospital thrombolysis.

Community thrombolysis resulted in an additional cost of 61 per patient in comparison with hospital thrombolysis.

The costs reflected the short-term care of suspected AMI (apparently until hospital discharge) and, therefore, were not discounted.

The costs of adverse events due to treatment were not included in the estimation of costs.

**Synthesis of costs and benefits**
The costs and benefits were summarised in the form of an incremental cost-effectiveness ratio (ICER), by dividing the incremental costs by the incremental benefits.

The ICER of community thrombolysis versus hospital thrombolysis was 667 per additional life-year gained.

This result was most sensitive to changes in life expectancy. It was reported that even a small reduction (approximately 1%) would result in hospital thrombolysis being dominant.

The result was also strongly influenced by GP diagnostic accuracy of AMI (true- and false-positive rates of diagnosis).

**Authors' conclusions**
From the perspective of the UK National Health Service (NHS), implementing community thrombolysis might lead to extra survival but at an extra cost over hospital thrombolysis. Although the incremental cost per life-year gained was modest, a judgement should be made as to whether the extra benefits are worth the additional resources required.
local context in which the service might be introduced should also be considered.

**CRD COMMENTARY - Selection of comparators**
Although no explicit justification was given for the comparator used (hospital thrombolysis), it apparently represented standard practice in the authors' setting. You should consider whether the comparator reflects routine practice in your own setting.

**Validity of estimate of measure of effectiveness**
It was not explicitly stated that a systematic review of the literature had been undertaken, although this was likely to have been the case. The methods and conduct of the review were not adequately reported. The authors reported the sources searched for relevant studies, but did not report the inclusion and exclusion criteria used. The authors primarily used one randomised controlled trial to gather data on survival, supplementing this with parameter estimates from other studies. Potential differences between the primary studies were not discussed. Parameters for which no data were available in the published literature were derived from calculations and authors' assumptions. Effectiveness parameters that were characterised by uncertainty were investigated in a sensitivity analysis.

**Validity of estimate of measure of benefit**
The estimation of benefits was modelled. The decision analytic model used for this purpose was appropriate, as it incorporated a chain of potential health states and events related to AMI and thrombolytic therapy, with transition probabilities taken from published literature.

**Validity of estimate of costs**
It was stated that the study adopted the perspective of the UK NHS. Most of the costs relevant to this perspective were included in the analysis. The costs associated with side effects of treatment were not estimated, but these were likely to have been similar for both strategies assessed, therefore their omission is unlikely to affect the results of the analysis significantly. The long-term treatment costs were not considered in the analysis, and this might affect the relative cost-effectiveness between the interventions assessed. Details of the prices and quantities were provided for some cost components, thus enhancing the reproducibility of the findings. A sensitivity analysis of the costs was undertaken, in which base-case values were varied by +/- 20%. Discounting was not applied, but this was not necessary since the costs were incurred during less than one year. The year to which the prices referred was reported, and this increases the generalisability of the results.

**Other issues**
The results of the analysis were not compared with the findings of other relevant studies. The issue of the generalisability of the results to other settings was addressed. The authors reported as limitations of their analysis, the omission of long-term costs of care and the lack of quality of life adjustments regarding benefits. The results were adequately reported and the authors' conclusions reflected the scope of the analysis.

**Implications of the study**
The results suggested that community thrombolysis may be considered an alternative to hospital thrombolysis on cost-effectiveness grounds, after taking the local context in which such a service would be introduced into consideration. The authors noted that adopting such a strategy would have resource implications involving a transfer of workload and costs from secondary to primary care.

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Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

MeSH
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