Is it beneficial to increase the provision of thrombolysis? A discrete-event simulation 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.

CRD summary
The study evaluated the costs and consequences of increasing thrombolysis administration among eligible stroke patients. The authors concluded that increased thrombolysis should produce financial savings and increase quality of life for stroke patients. The modelling generally appeared appropriate and was well reported. The study evaluated potential benefits of increasing the proportion of patients who received thrombolysis rather than the cost-effectiveness of thrombolysis.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
The study evaluated the costs and consequences of increasing thrombolysis administration among eligible stroke patients.

Interventions
The study did not compare two interventions; it evaluated potential benefits of increasing the proportion of stroke patients who received thrombolysis from 10% to 50% were that possible.

Location/setting
Northern Ireland/In-patient

Methods
Analytical approach:
The authors developed a discrete event simulation model. The model allowed patients to move between care settings based on probabilities derived from hospital data. The model first split patients into thrombolysed and not thrombolysed and then subdivided patients into four discharge dispositions: home, rehabilitation, institutional care and death. The time horizon of the model was 6,000 days.

Effectiveness data:
Base-case population data were derived from two datasets: a dataset from Belfast City Hospital administrative data spanning January 2003 to December 2007 and a five-year follow-up dataset comprised of known patients in the Belfast City Hospital dataset who had been discharged into community rehabilitation. The primary measure of efficacy was the odds ratio of a reduction in dependency attributable to thrombolysis derived from the National Institute of Neurological Disorders and Stroke (NINDS) study (see Other Publications of Related Interest). Dependency was defined as discharge to institutional care.

The model used Coxian phase type distributions to sort patients into homogenous groups representing the timing of potential movement between phases of treatment on the way to an absorbing state (in this case the absorbing state was the final discharge disposition). Discharge disposition was determined by Kaplan-Meier survival analysis and multinomial Cox regressions using data from Belfast City Hospital.

Monetary benefit and utility valuations:
The model applied utilities to three health states: death, survival in an independent health state and survival in a dependent health state. Utility values were derived from a single study of stroke patients. Death was assigned the customary utility value of zero.
Measure of benefit:
The measure of health benefits was QALYs (quality-adjusted life-years). Benefits were discounted at 3.5% annually.

Cost data:
Unit cost estimates were derived from published UK studies of stroke care and Personal and Social Services Research Unit (PSSRU) costs. Cost categories included thrombolytic therapy, hospital bed occupancy, institutional care and rehabilitation costs. Length of stay in hospital was derived from patient data from Belfast City Hospital. Length of stay in institutional care was assumed till death as the authors found that discharge from institutional care was predominantly by death. Number of hours of community rehabilitation was derived from the five-year follow-up dataset.

Analysis of uncertainty:
The authors conducted one way sensitivity analyses varying costs of thrombolysis, community rehabilitation, institutional care and stay in hospital. A probabilistic sensitivity analysis varied all costs using lognormal distributions and QALYs using the normal distribution.

Results
The model results showed that the overall cost of treating 50% of eligible patients was £6,243 and standard care was £6,355. The authors found that 95.9% of probabilistic sensitivity analysis simulations resulted in 50% thrombolysis being less costly than standard care.

Total QALYs increased from 5.422 under standard care to 5.475 under the 50% thrombolysis intervention. In 97.8% of simulations thrombolysis produced more QALYs than standard care.

Authors' conclusions
The authors concluded that increased thrombolysis should produce financial savings and increase quality of life for stroke patients.

CRD commentary
Interventions:
To compare 50% coverage to 10% coverage is not to compare different interventions. Such an increase would be the result of a health system wide intervention to stimulate that increase. This study evaluates the potential benefits of any such increase were that possible.

Effectiveness/benefits:
The key effectiveness measure (odds ratio of dependence after stroke) was derived from the NINDS study published in 1995 and the authors' study was published in 2012. The methods and justification for selecting the NINDS study were not reported. It was not clear that the odds ratio from the NINDS study was generalisable to stroke care in 2012. However, local clinical data were appropriate for the evidence required. The statistical modelling methods appeared appropriate and were reported in sufficient detail. The authors used appropriate methods to validate model fit.

QALY data came from a single published paper from 2000. The methods and justification for selecting the QALY source were not reported nor were the methods by which the utilities were elicited. The lack of reporting made it difficult to evaluate the validity and generalisability of these QALY data.

Costs:
Costs were reported with sufficient detail and derived from appropriate UK sources. Discount rates were reported for benefits but not reported for costs.

Analysis and results:
As the authors noted, previous analyses evaluated the cost-effectiveness of thrombolysis versus no thrombolysis. That represented the decision facing clinicians when treating stroke patients. The decision of whether or not to increase the proportion of patients receiving thrombolysis would require a health system level intervention, even if that simply meant new guidelines, and this was not costed. Reasons for only 10% of the patients receiving thrombolysis were not discussed. The study provided an estimate of potential benefits from an increase in thrombolytic treatment but if the treated and untreated populations were significantly different the estimate may be biased.
The results of the study indicated that increased thrombolysis in 50% of eligible patients was highly likely to dominate standard care so thrombolysis in 50% of eligible patients would likely result in decreased costs and increased benefits.

Uncertainty was appropriately incorporated in the analysis.

The authors used a robust modelling methodology and conducted strong internal validity checks for length of stay and discharge disposition using appropriate statistical methods.

Concluding remarks:
The modelling generally appeared appropriate and was well reported. The study evaluated potential benefits of increasing the proportion of patients who received thrombolysis rather than the cost-effectiveness of thrombolysis.

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Other publications of related interest

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