Cost-effectiveness of screening for deep vein thrombosis by ultrasound at admission to stroke rehabilitation

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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 examined two strategies for the diagnosis of deep vein thrombosis (DVT) in patients surviving ischaemic stroke. The first strategy was to screen all patients with acute ischaemic stroke for DVT, using Doppler ultrasound (US), on admission to stroke rehabilitation. The second strategy was clinical surveillance for signs or symptoms of DVT, with treatment after confirmation by Doppler US. Under the screening strategy, patients who tested positive for proximal DVT were given the standard treatment of intravenous heparin followed by oral anticoagulation, while patients who tested negative were continued on prophylactic subcutaneous heparin. Under the clinical surveillance strategy, patients were continued on subcutaneous heparin and received Doppler US when clinical symptoms, such as new onset unilateral oedema or pain, suggested DVT.

Type of intervention
Screening.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of patients admitted to a stroke rehabilitation unit after an acute ischaemic stroke.

Setting
The setting was an inpatient stroke rehabilitation unit. The economic study was carried out in the USA.

Dates to which data relate
The clinical data were derived from studies published between 1973 and 2004. Some costs and resource use data were obtained from studies published between 1996 and 2004. The price year was 2004.

Source of effectiveness data
The clinical and epidemiological parameters used in the model were:

- the prevalence of occult lower-extremity proximal DVT on admission to rehabilitation,
- the sensitivity and specificity of Doppler US in symptomatic and asymptomatic patients,
- the sensitivity of clinical surveillance in detecting DVT,
- the rate of PE in patients receiving anticoagulation for DVT and in those receiving only prophylactic doses of heparin,
death from PE after diagnosis of PE,
the rate of major haemorrhage while on oral anticoagulation,
Deaths from major haemorrhage, and
life expectancy.

**Modelling**
A standard decision tree was constructed to evaluate the clinical and economic impact of the routine screening strategy in comparison with no screening. The structure of the decision tree was represented graphically. The authors described all pathways and assumptions of the decision tree. Patients could move on different pathways on the basis of test accuracy and ability of diagnosing DVT by clinical surveillance; this could be followed by several events such as pulmonary embolism (PE) or major haemorrhage. The model had a short-term time horizon.

**Sources searched to identify primary studies**
Data on the accuracy of Doppler US in symptomatic and asymptomatic patients came from a published literature review of several studies. The rate of major haemorrhage and deaths from major haemorrhage came from two meta-analyses. The rate of PE in patients receiving anticoagulation for DVT came from a published review that pooled 25 clinical trials and prospective cohort studies. Information on the design of the other sources was not given.

**Methods used to judge relevance and validity, and for extracting data**
No systematic search for data was reported, but much of the evidence came from published reviews or meta-analyses. When several sources were available, the authors justified the choice of some point estimates from among those available in the literature.

**Measure of benefits used in the economic analysis**
The summary benefit measure was the expected number of quality-adjusted life-years (QALYs). These were estimated by combining survival with quality of life (QoL) data in the decision model. QoL estimates were derived from a study of health-related QoL in patients with stroke (the NEMESIS study). Life expectancy was not discounted because of poor patient survival.

**Direct costs**
The cost analysis included only those medical costs associated with drugs (warfarin, heparin), Doppler US and the treatment of complications (major haemorrhage and PE). The unit costs and quantities of resources used were presented separately for drugs and US only. Other costs were presented as macro-categories. The drug costs were based on average wholesale price from the Topics Red Book. The costs of the tests came from the Clinical Diagnostic Laboratory Fee Schedule, while the costs of complications were estimated from published studies. Little information on resource use was given. Discounting was not relevant as the short-term costs were considered. The price year was 2004. Older costs were inflated to 2004 prices using the medical component of the Bureau of Labor Statistics Consumer Price Index.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
Productivity costs were not considered.
Currency
US dollars ($).

Sensitivity analysis
A deterministic sensitivity analysis was carried out to identify those model inputs with the greatest impact on the results of the analysis. Tornado diagrams were constructed (but not presented). Both one- and two-way sensitivity analyses were performed. Alternative ranges of values were derived from the literature or were based on authors’ assumptions. Threshold analyses were also conducted.

Estimated benefits used in the economic analysis
The expected QALYs were 1.8748 with US screen and 1.8722 with no screen (difference 0.0026).

Cost results
The total costs per patient were $330 with US screen and $162 with no screen (difference $168).

Synthesis of costs and benefits
An incremental cost-utility ratio was calculated in order to combine the costs and benefits of the alternative strategies.

Under base-case assumptions, the incremental cost per QALY gained was $67,222 with US screen over no screen.

The sensitivity analysis showed that the most influential parameters were the probability of dying from PE while receiving anticoagulation for DVT, the sensitivity of clinical detection of DVT, the prevalence of DVT on admission, the sensitivity of US in asymptomatic patients, and the probability of PE after DVT and not receiving anticoagulation. Clearly, those scenarios favourable to screening (i.e. a reduction in the cost of US) make the routine screening strategy more cost-effective. Specifically, there were five scenarios in which the incremental cost per QALY gained with US screening was below the commonly used threshold for cost-effectiveness of $50,000 per QALY:

- 94% sensitivity of Doppler US in asymptomatic patients (base-case 97%);
- 69% probability of death from PE in those receiving anticoagulation for DVT (base-case 26%);
- 11% sensitivity of clinical DVT detection (base-case 38%);
- cost of $100 for Doppler US (base-case $181.93); and
- 18% prevalence of DVT on admission (base-case 12%).

Authors’ conclusions
The high cost per quality-adjusted life-year (QALY) gained with routine Doppler ultrasound (US) screening for deep vein thrombosis (DVT) in patients with stroke at the time of admission to rehabilitation casts some doubts on the cost-effectiveness of this strategy in comparison with a more conservative strategy of clinical surveillance for signs or symptoms of DVT.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparator (i.e. no screening) was clear and appropriate, although the authors stated that routine screening has become the standard of care in several rehabilitation centres in the USA. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The clinical data were derived from published studies. The methods and conduct of a systematic review of the literature...
were not reported and no systematic search for data appears to have been carried out. However, most of the evidence was taken from published literature reviews or meta-analyses and this should ensure high internal validity. When a single study was selected for a clinical variable, the authors justified their choice. Published ranges were used in the sensitivity analysis, to account for uncertainty around the base-case estimates.

**Validity of estimate of measure of benefit**
The benefits (QALYs) were appropriately modelled. The sources of QoL data were described. The approach used to calculate the QALYs was reported. QALYs were appropriate given the impact of the interventions on both QoL and survival. QALYs have the further advantage of being comparable with the benefits of other health care interventions.

**Validity of estimate of costs**
The analysis of the costs appears to have been carried out from the viewpoint of the third-party payer since only direct medical costs were included. Other costs, such as those related to productivity or those borne by the patients, were not considered. The sources of the costs were reported. Since some costs were presented as macro-categories, a cost breakdown was not provided. This could limit the possibility of replicating the economic analysis in other settings. The use of alternative cost estimates was investigated in the sensitivity analysis. The price year was reported, which will facilitate refutation exercises in other time periods.

**Other issues**
The authors reported the results from other studies involving patients with common neurological conditions for whom screening was cost-effective. However, differences in methodological aspects and patient survival might explain the contrasting results. The authors noted some limitations to their analysis, such as the use of data from studies that might not resemble real-world clinical practice, or the use of a short-term horizon. The issue of the generalisability of the study results to other settings was implicitly addressed in the sensitivity analysis, in which alternative estimates for model inputs were considered. The authors pointed out that the model results were applicable to ischaemic stroke survivors without contraindication for prophylaxis and who were receiving prophylaxis, and would not be generalisable to the entire population entering stroke rehabilitation. Thus, caution will be required when extrapolating the results of the analysis.

**Implications of the study**
The authors stated that future studies should examine the impact of risk factors on a selected application of screening programmes, in order to identify those patients for whom screening might be cost-effective.

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None stated.

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**Other publications of related interest**
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