Screening and prevention of venous thromboembolism in critically ill patients: a decision analysis and economic evaluation

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 assessed cost-effectiveness of weekly compression ultrasound screening plus investigation for clinically suspected deep vein thrombosis to reduce morbidity from venous thromboembolism in critically-ill patients. Weekly screening led to very small potential improvements in quality-adjusted survival that did not justify the additional cost of compression ultrasound. Programmes that achieved increased adherence to best-practice venous thromboembolism prevention were highly cost-effective. The study used a valid cost-effectiveness framework that should ensure the conclusions were robust.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
To evaluate the cost-effectiveness of weekly compression ultrasound screening plus investigation for clinically suspected deep vein thrombosis (DVT) to reduce morbidity from venous thromboembolism in critically-ill patients.

Interventions
The intervention was screening plus case finding, which consisted of weekly bilateral compression ultrasound screening plus investigation for clinically suspected DVT. The comparator was case finding alone, in which ultrasound compression was carried out only where symptoms or signs of lower-extremity DVT were present. A hypothetical programme to increase adherence to DVT prevention using pharmacologic prophylaxis was considered and was compared to routine DVT case findings.

Location/setting
USA/hospital.

Methods
Analytical approach:
Markov decision analytic model in a hypothetical 65-year-old mechanically ventilated patient admitted to a medical-surgical intensive care unit (ICU). A lifetime horizon was considered. The authors stated that the perspective was society.

Effectiveness data:
A systematic review of the literature was undertaken to identify relevant sources of evidence. Studies were systematic reviews and randomised controlled trials. Prophylaxis for Thromboembolism in Critical Care Trial (PROTECT) and other prospective studies were included. A key input of the model was the accuracy (sensitivity and specificity) of compression ultrasound estimated from a prospective study in critically-ill patients with DVT and other data from ambulatory and surgical patients. Some assumptions were made.

Monetary benefit and utility valuations:
Utility valuations were derived from published studies in critically-ill patients.

Measure of benefit:
Various benefit measures included quality-adjusted life-years (QALYs), DVT cases detected, pulmonary embolism
cases avoided, recurrent venous thromboembolism cases avoided, ICU days avoided and hospital days avoided. A 3% annual discount rate was applied to QALYs. QALYs were the sole benefit measures assessed over patient lifetimes.

Cost data:
The economic analysis included variable costs of ultrasound (radiologist, nursing, consumables and reporting costs), costs of DVT treatment (including drugs and complications) during hospital stay and costs occurring after hospitalisation for patients who were living at home and in long-term care (medications, outpatient appointments, home care and rehabilitation related to venous thromboembolism and critical illness). Most costs related to hospitalisation were derived from the 20 hospitals in Canada, USA and Australia involved in the economic evaluation of the PROTECT study. Long-term costs and other costs not available from the clinical trial were derived from other published sources. Direct and indirect costs were included. Costs were in US dollars ($). The price year was 2010. Costs were discounted at an annual rate of 3%.

Analysis of uncertainty:
One-way sensitivity analyses were performed for all inputs of the model using published confidence intervals (CIs) or ranges of values defined by the authors. Alternative thromboprophylaxis strategies were considered in alternative scenarios. A probabilistic sensitivity analysis was carried out using a Monte Carlo simulation for 10,000 iterations and conventional probabilistic distributions for model inputs. Cost-effectiveness acceptability curves were depicted.

Results
In the lifetime analysis, screening increased lifetime costs compared with case finding ($185,703,084 versus $185,510,890 per 1,000 patients) and improved quality-adjusted survival by 0.92 QALYs per 1,000 patients. The incremental cost per QALY gained with screening was $209,093 (far above the conventional cost-effectiveness threshold of $50,000 per QALY). When only duration of hospitalisation was considered, the screening strategy was dominated using ICU days avoided and major bleeding episodes as outcome measures. Cost per DVT detected was $3,823, cost per venous thromboembolism avoided was $19,139 and per pulmonary embolism avoided was $71,995.

Sensitivity analysis showed that base case results were sensitive to variations in the cost of screening ultrasound and the probability of proximal DVT: the incremental cost per QALY was less than $50,000 when the probability of proximal DVT exceeded 11% per week or when screening ultrasound cost less than $49. In the probabilistic analysis, screening cost was more than the threshold of $50,000 per QALY in 85% of the simulations.

The hypothetical programme to improve thromboprophylaxis use was cost-effective with an incremental cost per QALY of $22,749 assuming no additional intervention cost and $27,953 assuming a cost of $100 per patient additional intervention cost.

Authors' conclusions
The authors concluded that weekly screening of critically-ill patients who received standard venous thromboembolism prevention strategies led to very small potential improvements in quality-adjusted survival. The potential improvements did not justify the additional cost of compression ultrasound. Programmes that achieved increased adherence to best-practice venous thromboembolism prevention were highly cost-effective.

CRD commentary
Interventions:
The selection of the comparators appeared appropriate for this patient population and was generalisable to other health care systems.

Effectiveness/benefits:
A valid approach was used to identify relevant sources of evidence. Limited information was reported on the methods and conduct of the review. Some data on transition probabilities were derived from a multicentre clinical trial and from systematic reviews (generally considered to be valid sources). Key evidence on screening accuracy was taken from a prospective study as no clinical trials were available for critically-ill patients. No details of other data sources were reported. Extensive sensitivity analysis was conducted on all clinical parameters. Various benefit measures were used in the short-term analysis but QALYs were the most appropriate in the long term to capture the overall impact of the interventions on patient health. Utility valuations were derived from the literature and from a relevant population. The
authors did not describe how patient preferences were obtained.

Costs:
A broad range of cost categories were considered in accordance with the societal perspective adopted. Indirect costs appeared irrelevant given the age of patients and the severity of the disease. Most evidence on resource use and hospital costs were taken from 20 institutions involved with a clinical trial and so accurate data collection was likely. It was unclear whether these hospitals were representative of real-world practice in USA. Other data were taken from published sources; these were not fully described but referred to the USA context. Fixed costs of the ultrasound machines were not included as they were already available at most hospitals. Details such as the price year and discount rate were provided.

Analysis and results:
The study results were clearly reported. An incremental approach was used appropriately to synthesise costs and benefits of the alternative strategies. The issue of uncertainty was satisfactorily investigated with deterministic and probabilistic approaches and the methods and results were presented clearly. The main details of the simulation model were reported. The authors acknowledged limitations of their analysis from some poor quality data for critically-ill patients and the need for assumptions. The issue of transferability of the study results was not addressed explicitly and the authors’ conclusions should be considered specific to the USA context.

Concluding remarks:
The study used a valid cost-effectiveness framework that should ensure the robustness of the authors’ conclusions.

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