

# Measurement of the clinical and cost-effectiveness of non-invasive diagnostic testing strategies for deep vein thrombosis

S Goodacre,<sup>1\*</sup> F Sampson,<sup>1</sup> M Stevenson,<sup>2</sup>  
A Wailoo,<sup>2</sup> A Sutton,<sup>3</sup> S Thomas,<sup>4</sup> T Locker<sup>1</sup>  
and A Ryan<sup>2</sup>

<sup>1</sup> Medical Care Research Unit, University of Sheffield, UK

<sup>2</sup> School of Health and Related Research (SchARR),  
University of Sheffield, UK

<sup>3</sup> Department of Health Sciences, University of Leicester, UK

<sup>4</sup> Academic Vascular Unit, Northern General Hospital, Sheffield, UK

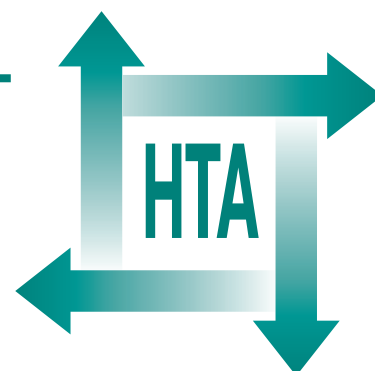
\* Corresponding author



## *Executive summary*

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## Executive summary

### Background

A wide range of diagnostic tests may be useful in diagnosing deep vein thrombosis (DVT), including clinical assessment, D-dimer, plethysmography, rheography, ultrasound, computed tomographic (CT) scanning, magnetic resonance imaging (MRI) and venography. These may be used in isolation or combined as an algorithm.

### Objectives

The objectives of the study were:

- To estimate the diagnostic accuracy of non-invasive tests for proximal DVT and isolated calf DVT, in patients with clinically suspected DVT or high-risk asymptomatic patients, and identify factors associated with variation in diagnostic performance.
- To identify practical diagnostic algorithms for DVT, and estimate the diagnostic accuracy, clinical effectiveness and cost-effectiveness of each.

### Methods

#### Data sources

Diagnostic test data and diagnostic algorithms were sought from electronic searches of MEDLINE, EMBASE, CINAHL, Web of Science, Cochrane Database of Systematic Reviews, Cochrane Controlled Trials Register, Database of Reviews of Effectiveness, NHS Economic Evaluations Database, Health Technology Assessment database, BIOSIS and the ACP Journal Club, 1966–2004. Additional diagnostic test data were sought from the bibliographies of articles included in the review and contact with manufacturers of assays and instruments.

A postal survey of hospitals in the UK was undertaken to describe current practice and availability of tests, and identify additional diagnostic algorithms.

### Study selection

Diagnostic cohort studies published in English, French, Spanish or Italian that compared a non-invasive diagnostic test for DVT to an acceptable reference standard were included in the review.

### Data extraction

Details of study setting, recruitment, exclusions, population characteristics, reference standard, operator and results were extracted. Quality was judged against validated criteria.

### Data synthesis

Pooled estimates of sensitivity, specificity and likelihood ratios were obtained for each test using random effects meta-analysis (MetaDISC software). The effect of study-level covariates was explored using random effects metaregression. A decision-analytic model was used to combine estimates from the metaanalysis and estimate the diagnostic performance of each algorithm in a theoretical population of outpatients with suspected DVT. The net benefit of using each algorithm was estimated from a health service perspective, using cost–utility analysis, assuming thresholds of willingness to pay of £20,000 and £30,000 per quality-adjusted life-year (QALY). The model was analysed probabilistically and cost-effectiveness acceptability curves were generated to reflect uncertainty in estimated cost-effectiveness.

### Results

Individual clinical features are of limited diagnostic value, with most likelihood ratios being close to 1. Wells clinical probability score stratifies proximal, but not distal, DVT into high-, intermediate- and low-risk categories. Unstructured clinical assessment by experienced clinicians may have similar performance to Wells score. In patients with clinically suspected DVT, D-dimer has 91% sensitivity and 55% specificity for DVT, although performance varies substantially between assays and populations. D-dimer specificity is dependent on pretest clinical probability, being higher in patients with a low clinical probability of DVT. Plethysmography and

rheography techniques have modest sensitivity for proximal DVT, poor sensitivity for distal DVT, and modest specificity. Ultrasound has 94% sensitivity for proximal DVT, 64% sensitivity for distal DVT and 94% specificity. Computed tomography scanning has 95% sensitivity for all DVT (proximal and distal combined) and 97% specificity. Magnetic resonance imaging has 92% sensitivity for all DVT and 95% specificity. The diagnostic performance of all tests is worse in asymptomatic patients.

The most cost-effective algorithm discharged patients with a low Wells score and negative D-dimer without further testing, and then used plethysmography alongside ultrasound, with venography in selected cases, to diagnose the remaining patients. However, the cost-effectiveness of this algorithm was dependent on assumptions of test independence being met and the ability to provide plethysmography at relatively low cost. Availability of plethysmography and venography is currently limited at most UK hospitals, so implementation would involve considerable reorganisation of services.

Two algorithms were identified that offered high net benefit and would be feasible in most hospitals without substantial reorganisation of services. Both involved using a combination of Wells score, D-dimer and above-knee ultrasound. For thresholds of willingness to pay of £10,000 or £20,000 per QALY the optimal strategy involved discharging patients with a low or intermediate Wells score and negative D-dimer, ultrasound for those with a high score or positive D-dimer, and repeat scanning for those with positive D-dimer and a high Wells score, but negative initial scan. For thresholds of £30,000 or more a similar strategy, but involving repeat ultrasound for all those with a negative initial scan, was optimal.

## Conclusions

### Implications for healthcare

Diagnostic algorithms based on a combination of Wells score, D-dimer and ultrasound (with repeat if negative) are feasible at most UK hospitals and are among the most cost-effective. Use of repeat scanning depends on the threshold for willingness to pay for health gain. Further diagnostic testing for patients with a low Wells score and negative D-dimer is unlikely to represent a cost-effective use of resources.

### Recommendations for research

The recommendations for further research include the following:

- Evaluation of the costs and outcomes of using the optimal diagnostic algorithms in routine practice,
- The development and evaluation of algorithms appropriate for specific groups of patients with suspected DVT, such as intravenous drug abusers, pregnant patients and those with previous DVT,
- The evaluation of the role of plethysmography: interaction with other diagnostic tests, outcome of low-risk patients with negative plethysmography and measurement of the costs of providing plethysmography,
- Methodological research into the incorporation of meta-analytic data into decision-analytic modelling.

## Publication

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# NHS R&D HTA Programme

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