

# Improving the outcomes of deep vein thrombosis: optimising the diagnostic pathway

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Venous thromboembolism (VTE) is estimated to cause 25,000 deaths annually in the UK and is the most frequent cause of preventable death for hospital inpatients.<sup>1</sup> Additionally, patients who survive VTE continue to require the use of healthcare resources. Elective treatment for deep vein thrombosis (DVT) patients is calculated to cost £499 per patient on average, while treatment for emergency DVT patients averages £1941.<sup>1</sup> In the US, treatment for post-thrombotic syndrome, a condition arising in 30% of DVT patients, is estimated to amount to \$3,800 per patient in the first year of diagnosis.<sup>2</sup> Another study found that such treatment can reach \$7,000 per patient per year.<sup>3</sup>

Diagnosis of DVT in the UK typically begins in a primary care setting, with a GP conducting a physical examination to exclude other possible causes. If DVT

remains as a possibility, a two-level Well's score is carried out in

which a patient is screened against a number of clinical features that might indicate an increased risk of DVT.

Current guidelines from The National Institute for Health and Care Excellence recommend carrying out a proximal leg vein ultrasound scan within four hours of a Well's score assessment that is suggestive of DVT, or within 24 hours if low molecular weight heparin (LMWH) is utilised in the interim.<sup>4</sup> However, given the large number of care pathways that depend on ultrasound procedures and the limited capacity of equipment and practitioners for any given care setting, such recommendations are not always followed. Variability in the number of patients requiring assessment for DVT adds to the difficulty in scheduling ultrasound scans and, therefore, to adhering to the guidelines. Ultrasound diagnosis can typically be delayed by a number of days, with undiagnosed DVT patients vulnerable to clot dislodgement and possibly fatal pulmonary embolism (PE) in the interim.<sup>4</sup> Additionally, with the majority of cases presenting as symptomatic DVT, patients can be in pain while waiting for an ultrasound-confirmed diagnosis.

With rapid DVT diagnosis shown to reduce the risk and severity of several ensuing conditions and the costs associated with a lengthy diagnosis process, recent research has focused on identifying and investigating

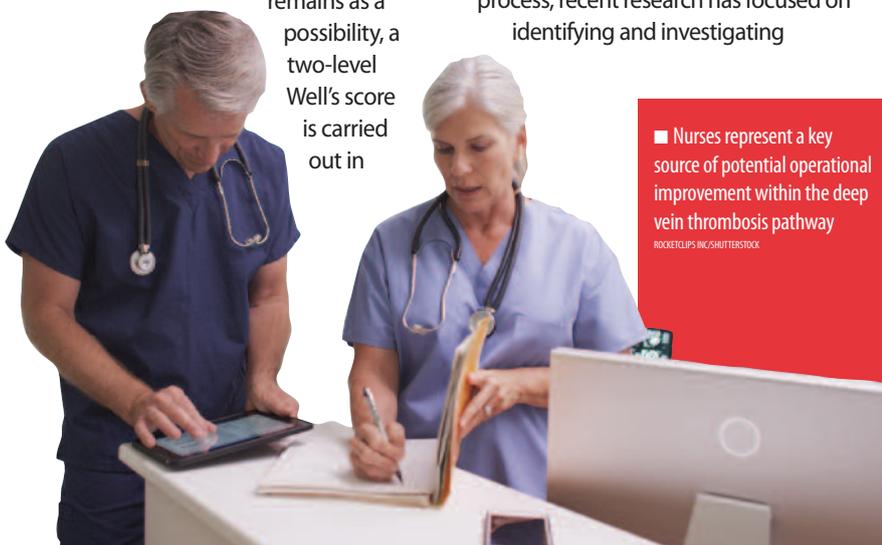
opportunities for improvement within the DVT care pathway, including individual improvement strategies addressing the hypothesised areas of suboptimal outcomes or 'pain points'.<sup>5,6</sup> Using a systematic approach to evaluate the entire care pathway will enable the identification of additional patient 'pain points' and, subsequently, elucidate the presence of further opportunities for improvement. Mapping the entire care pathway would enable a better understanding of the downstream effects and economic benefits of each improvement strategy, and would also allow for the identification of possible synergies between various improvement strategies. Following a search of the literature, no article discussing a holistic assessment of the DVT care pathway using observational techniques was found. We conducted an observational study to assess the DVT patient journey and created a comprehensive DVT care map. From this process, we propose changes to improve the DVT care pathway.

## Methods

An exploratory research approach with an observational data collection method was selected as the most appropriate. Over two days, nurses were shadowed in the DVT department of a 1,250-bed acute teaching hospital. A total of nine patients referred by GPs were observed. All patient interaction events were logged and any background administration work associated with the care of patients in the DVT department was recorded. All variables in the pathway, such as a positive or negative ultrasound scan, were investigated and mapped. Data were recorded independently by two researchers from GE Healthcare. Findings were shared with, and validated by, the DVT nurses and departmental colleagues. The resulting DVT diagnosis pathway is depicted in Figure 1.

## Findings

Analysing this pathway highlights numerous 'pain points' for both nurses and



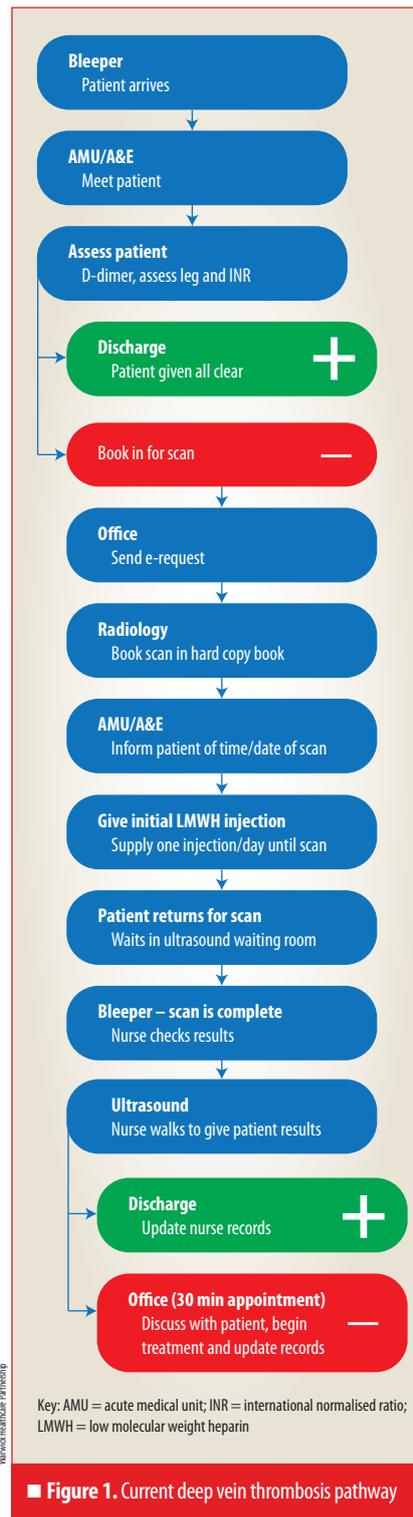
patients. Chronologically, the first patient issue is represented by the delay in receiving an ultrasound. Patients who meet the eligibility criteria for an ultrasound are typically classified as symptomatic DVT patients meaning they can be waiting in pain or discomfort for significant periods of time.

The utilisation of daily, self-administered LMWH injections as a consequence of a delayed ultrasound represents the second patient issue. As well as the purchasing costs associated with the utilisation of LMWH injections, valuable nurse time is sequestered as a result of the time required for self-injection training. Additionally, patients can be uncomfortable with the task of self-injection and return to the medical decision unit or emergency department to be aided by a healthcare professional. This occurs in around 5% of cases.<sup>7</sup> Alternatively, if patients cannot travel to the emergency department, community nurses are required to visit patients' homes to administer LMWH.

Further inconvenience arises from the need to return to the hospital to complete an ultrasound. Roughly 30% of patients (in particular the elderly) have other morbidities that demand the use of an ambulance in their return for an ultrasound diagnosis.<sup>7</sup> Scheduling a return time that is suitable for the ultrasound, ambulatory and DVT departments, as well as the patient, represents another time-consuming task to be completed by the nurses. Nurse time is further drained by the journey between departments, with the escorting of patients to and from the ultrasound department being a notable example. Therefore, there is an opportunity to improve the timely provision of ultrasound scans in the DVT care pathway.

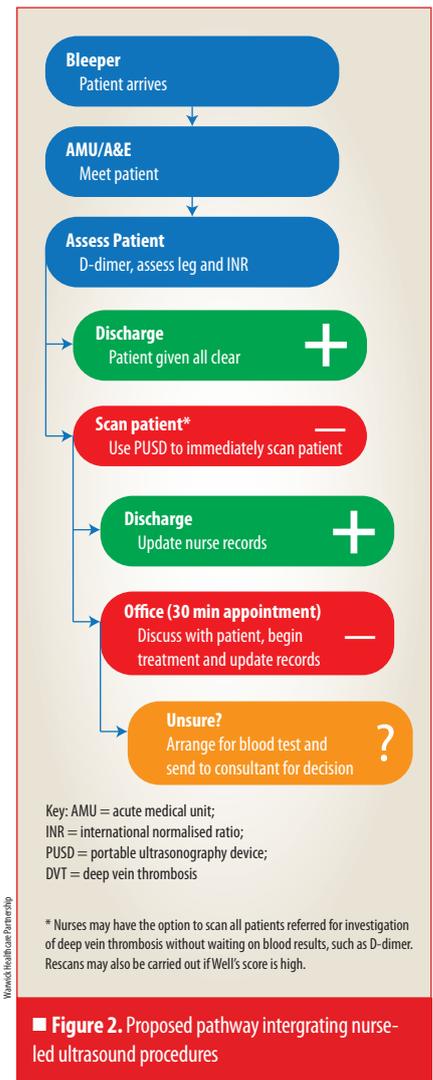
## Discussion

Given their crucial role throughout the DVT care pathway, nurses represent a key source of potential operational improvement. Recent research has shown that nurses are capable of accurately detecting DVT using compression ultrasonography, while a case study has reported significant cost benefits of nurse-led ultrasound procedures.<sup>8,9</sup> Additionally, a number of studies have recently shown encouraging results for the utilisation of portable ultrasonography devices (PUSDs) in the diagnosis of DVT and in accurately identifying other



conditions following relatively brief training periods.<sup>10-12</sup>

There are a number of synergistic benefits for the combination of nurse-led ultrasound procedures with the utilisation of PUSDs (see Figure 2) or other ultrasound scanners. The 377,000 nurses registered in the NHS outnumber the 15,000 registered diagnostic radiographers, and are, therefore, likely to have more face-time with patients.<sup>13</sup> As a



result, nurses are the ideal healthcare professional to be equipped with PUSDs. Patients, who are typically in pain as a result of DVT symptoms, would not have to move between departments and would be able to receive an ultrasound at the point of care. This would translate to shorter waiting times and improved patient experience. Nurses would also save time as a result of the reduced need to schedule patient scans and train patients for LMWH injections, so would be granted more time to spend with other patients. More crucially, the immediate availability of nurse-performed ultrasound with PUSDs, and the ensuing rapid diagnosis of DVT, could significantly improve patient satisfaction and health outcomes.

However, to implement such a pathway, a number of barriers need to be overcome. Firstly, a post-graduate ultrasonography course would need to be designed for nurses to undergo training and receive the appropriate qualifications. Secondly, to ensure high clinical standards, there should

be processes and facilitating IT systems in place for the review of inconclusive images by experienced ultrasonographers or radiologists. Thirdly, an audit process should be established to ensure consistently high standards and the optimisation of the ultrasound procedure process to drive improvements in patient health outcomes.

## Benefits of pathway improvement

Implementing nurse-led ultrasound diagnosis of DVT has potential clinical, economic and resource use benefits. Reducing the time to diagnose DVT could potentially avoid the use of self-injected LMWH by patients. This may reduce the expenditure on LMWH and the ambulatory expenses required to transport patients between appointments. Reallocating the use of the nurses for diagnosis will also optimise time with patients. Additionally, the transition of ultrasound responsibilities from the ultrasound department to DVT ward nurses would release ultrasound appointments for other conditions; a recent study found that an average of 4.2 scans are required by their DVT department on a daily basis.<sup>9</sup> Furthermore, the immediate availability of PUSDs raises the possibility of potentially conducting ultrasound scans for every patient suspected of DVT, without the need to wait for blood tests results.

Avoidance of possible complications that arise from LMWH treatment may also provide clinical and financial benefits. In the current pathway, LMWH is given prophylactically to patients suspected of DVT. This process safeguards against potentially fatal PE for DVT patients that are yet to be diagnosed, with a study finding that one episode of PE is avoided for every 400 patients given LMWH prophylactically. However, the same study found that two incidences of major bleeding are triggered for every 400 patients receiving prophylactic LMWH treatment.<sup>14</sup> A recent meta-analysis has estimated that 16 patients will experience major bleeding for every 1,000 patients treated with LMWH for three months or longer.<sup>15</sup>

A study in Germany estimated treatment costs ranged from €2,602–€3,724 per major bleeding episode after the prophylactic use of LMWH and similar figures in the US were identified, with costs ranging from \$4,016–\$6,694 per

incident.<sup>16,17</sup> Another complication, thrombocytopenia, which occurs in 0.5% of patients treated with LMWH, has been calculated to cost from \$7,561–\$12,601 per incident.<sup>17</sup> Given the number of patients receiving prophylactic LMWH, implementing a revised care pathway that provides immediate nurse-performed ultrasound scans with PUSDs could reduce the incidences of such complications.

## Further research

The small sample size, short observational period and single centre approach of this study limits the application of our results to other hospitals or regions. Additionally, the degree of physician oversight necessary to support a sustainable service needs to be considered, as well as the processes required for a formal quality audit.

To validate the feasibility of the nurse-led ultrasound pathway, a pilot study is planned in which nurses will provide training and undertake ultrasound procedures by means of PUSD to diagnose DVT. Such a pilot will be designed to address the limitations of this current study and provide a clearer picture on many of the discussed hypotheses, including the improved time to diagnosis, and the ensuing improvements in patient satisfaction, treatment costs and resource allocation ■

### Declaration of interest

This study was conducted and written by GE Healthcare employees in collaboration with University Hospital Coventry and Warwickshire NHS Trust as part of a wider partnership. GE Healthcare currently manufactures and distributes portable ultrasonography devices, as well as a range of other imaging products.

WH, SE, OC, AL and AY declare that they have no conflict of interests.

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## Key points

- Given their crucial role throughout the deep vein thrombosis (DVT) pathway, nurses represent a key source of potential operational improvement.
- The immediate availability of portable ultrasonography devices (PUSD) raises the possibility of potentially conducting ultrasound scans for every patient suspected of DVT, without needing to wait for blood tests results.
- Implementing nurse-led ultrasound diagnosis of DVT has potential clinical, economic and resource use benefits. Reducing the time to diagnose DVT could potentially avoid the use of self-injected low molecular weight heparin by patients.
- A pilot study is now planned in which nurses are provided training and undertake ultrasound procedures by means of PUSD to diagnose DVT. It will be designed to address the limitations of this current study and provide a clearer picture on many of the discussed hypotheses.