

# Guidance on the use of ultrasound locating devices for placing central venous catheters

Technology appraisal guidance  
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Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should [assess and reduce the environmental impact of implementing NICE recommendations](#) wherever possible.

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# 1 Recommendations

- 1.1 Two-dimensional (2D) imaging ultrasound guidance is recommended as the preferred method for insertion of central venous catheters (CVCs) into the internal jugular vein (IJV) in adults and children in elective situations.
- 1.2 The use of 2D imaging ultrasound guidance should be considered in most clinical circumstances where CVC insertion is necessary either electively or in an emergency situation.
- 1.3 It is recommended that all those involved in placing CVCs using 2D imaging ultrasound guidance should undertake appropriate training to achieve competence.
- 1.4 Audio-guided Doppler ultrasound guidance is not recommended for CVC insertion.

## 2 Clinical need and practice

- 2.1 Central venous catheters (CVCs) are inserted for a number of reasons including haemodynamic monitoring, intravenous delivery of blood products and drugs (for example, chemotherapy and antibiotics), haemodialysis, total parenteral nutrition, cardiac pacemaker placement and management of perioperative fluids. Central venous catheterisation may be required for patients undergoing cancer treatment, dialysis, or coronary or other major surgery, and for those admitted to intensive therapy units (ITUs), high dependency units (HDUs) or accident and emergency departments. It has been estimated that about 200,000 CVCs are inserted annually in the NHS.
- 2.2 Central venous access has traditionally been achieved by puncturing a central vein (venepuncture) and passing the needle along the anticipated line of the relevant vein by using surface anatomical landmarks and by knowing the expected anatomical relationship of the vein to its palpable companion artery. This is known as the 'landmark method'. Direct surgical access to a peripheral vein ('cut-down') is a less frequently used method for central venous access catheter insertion.
- 2.3 CVCs are inserted in a wide range of clinical settings by a diverse group of clinicians including radiologists, anaesthetists, nephrologists, oncologists, surgeons, general physicians and paediatricians. In the USA and increasingly in the UK, nurse specialists are also undertaking CVC procedures. The range of settings in which CVCs are inserted includes operating theatres, emergency rooms, nephrology, oncology and other wards, radiology departments, ITUs and HDUs.
- 2.4 Central venous access can be achieved using various puncture sites but the most common are the internal jugular vein (IJV), the subclavian vein (SV), the femoral vein (FV), and the upper limb veins (using peripherally inserted central catheters [PICCs]). The choice of access route depends on multiple factors including the reason for CVC insertion, the anticipated duration of access, the intact venous sites available and the skills of the operator.
- 2.5 Whilst experienced operators using the landmark method can achieve relatively

high success rates with few complications, in the literature failure rates for initial CVC insertion have been reported to be as high as 35%.

- 2.6 The most common complications associated with CVC placement are arterial puncture, arteriovenous fistula, pneumothorax, nerve injury and multiple unsuccessful attempts at catheterisation, which delay treatment. The risks and the consequences of complications vary substantially across different patient groups depending on the patient's anatomy (for example, morbid obesity, cachexia, short neck, or local scarring from surgery or radiation treatment), the circumstances in which CVC insertion is carried out (for example, for a patient receiving mechanical ventilation or during emergencies such as cardiac arrest) and co-morbidities (for example, bullous emphysema or coagulopathy). The National Confidential Enquiry into Perioperative Deaths recently reported that in a survey of over 3,000 CVC procedures undertaken in the NHS, 1 fatality occurred as a result of a procedure-induced pneumothorax.

## 3 The technology

- 3.1 Ultrasound technology has long been used in interventional radiology to guide percutaneous procedures at sites such as the kidneys, liver, arterial and venous circulation, pleural cavity, gallbladder and joints. Real-time ultrasound guidance of CVC insertion provides the operator with visualisation of the desired vein and the surrounding anatomical structures before and during the insertion. The advantages of ultrasound-guided central venous catheterisation include the identification of the precise position of the target vein and the detection of anatomical variants and of thrombosis within the vessel, together with the avoidance of inadvertent arterial puncture. Ultrasound guidance therefore has the potential to reduce the incidence of complications related to initial venous puncture, which is the first stage of CVC insertion.
- 3.2 Two types of real-time ultrasound guidance are described: two-dimensional (2D) imaging ultrasound guidance and audio-guided Doppler ultrasound guidance. 2D imaging ultrasound, which is the more commonly used method, provides a real-time grey-scale imaging of the anatomy. Audio-guided Doppler ultrasound generates an audible sound from flowing venous blood, which helps the operator localise the vein and differentiate it from its companion artery. The portable ultrasound machines can be used in operating theatres, accident and emergency departments, ITUs, HDUs and radiology suites, as well as at the bedside on the hospital ward.
- 3.3 Operators need to be trained to use ultrasound-guided techniques. Training involves not only acquiring the necessary manual skills, but also having a basic understanding of ultrasound principles and being able to interpret ultrasound images.

## 4 Evidence and interpretation

The appraisal committee reviewed the evidence from a number of sources.

### 4.1 Clinical effectiveness

- 4.1.1 Twenty randomised clinical trials (RCTs) were identified. Of these, 6 evaluated audio-guided Doppler ultrasound against the landmark method, thirteen evaluated 2D ultrasound guidance against the landmark method and one evaluated both audio-guided Doppler ultrasound and 2D ultrasound guidance against the landmark method. There were no trials that compared the use of ultrasound locating devices (ULDs) against the surgical cut-down method.
- 4.1.2 Insertion sites were the IJV (15 trials), SV (4 trials) or FV (1 trial). One trial did not specify the insertion point, and 1 investigated both the IJV and the SV as insertion sites. None addressed the placement of PICCs or ports, both of which can be considered types of CVCs.
- 4.1.3 For most of the trials, the setting within the hospital where the cannulation took place was not reported clearly. In 6 of the trials the central venous catheterisation took place in an ITU or trauma unit, and in 2 trials catheterisations took place in emergency rooms. In the 7 studies involving patients scheduled for cardiac surgery, the cannulation is most likely to have taken place on the way into theatre. In only 3 of the trials does it seem likely that CVCs were inserted on wards or in clinics.
- 4.1.4 The CVC procedure was carried out by anaesthetists in 7 studies and by other medical staff in 4 studies. One study involved 2D ultrasound-guided catheterisation by junior radiologists. None of the studies involved nurses. The remaining 9 studies did not make the specialty or profession of the operator clear. The range of experience of the operator, both with respect to medical career and use of the intervention, differed greatly from study to study. Six studies described the operators as having up to 5 years' postgraduate experience, 8 described them as having more than 5 years' experience, and 2 described them as varying in experience. Four trials did not record the career

experience of the operator.

## 2D ultrasound imaging

### Internal jugular vein

- 4.1.5 Pooled results from 7 RCTs suggested that real-time 2D ultrasound guidance was significantly better than the landmark method for all 5 outcome variables measured for insertions into the IJV in adults. Compared with the landmark method, 2D ultrasound guidance was associated with reduced risks of failed catheter placements (86% reduction in relative risk, 95% confidence interval [CI] 67% to 94%,  $p < 0.001$ ), catheter placement complications (57% reduction in relative risk, 95% CI 13% to 78%,  $p = 0.02$ ), and failure on the first catheter placement attempt (41% reduction in relative risk, 95% CI 12% to 61%,  $p = 0.009$ ), and fewer attempts to achieve successful catheterisation (on average, 1.5 fewer attempts, 95% CI 0.47 to 2.53,  $p = 0.004$ ).
- 4.1.6 The difference between the 2D ultrasound method and the landmark method in the time taken to insert a catheter successfully was small and not statistically significant (2D ultrasound-guided catheterisation was 20 seconds faster, 95% CI -83 to 124 seconds). However, there was significant heterogeneity for this endpoint ( $p < 0.01$ ), which indicated that it might not be appropriate to pool these results. In the study which reported the longest time to achieve a successful catheterisation, the time taken to set up the ULD was also included in the outcome measurement. When the analysis was repeated, excluding this study, heterogeneity was no longer significant and the pooled result from the included trials showed that catheterisation was, on average, 69 seconds faster (95% CI 46 to 92 seconds) with the ULD than with the landmark method, which was a highly statistically significant difference ( $p < 0.001$ ). It is acknowledged that the importance of this endpoint will vary between clinical situations.
- 4.1.7 Three trials evaluated the effect of 2D ultrasound guidance on the cannulation of the IJV in infants. In these trials, 2D ultrasound guidance was significantly better than the landmark method in terms of reductions in the risk of failed catheter placements (85% reduction in relative risk, 95% CI 36% to 97%,  $p = 0.01$ ), the risk of catheter placement complications (73% reduction in relative risk, 95% CI 8% to

92%,  $p=0.03$ ), and the number of attempts required before catheterisation was successful (reduced by an average of 2, 95% CI 1.2 to 2.8,  $p=0.001$ ). Using 2D ultrasound guidance, successful cannulation was achieved, on average, 349 seconds (95% CI -103 to 802 seconds) more quickly than with the landmark method, although this result was not statistically significant.

## Subclavian vein

- 4.1.8 Only 1 RCT was identified that analysed the effect of 2D ultrasound guidance on SV catheterisation in adults. In the trial, in comparison with the landmark method, 2D ultrasound guidance was associated with reduced risks of catheter placement failure (86% reduction in relative risk, 95% CI 43% to 96%,  $p=0.006$ ) and catheter placement complications (90% reduction in relative risk, 95% CI 29% to 99%,  $p=0.02$ ). However, in this trial, the operators were relatively inexperienced in both the landmark method and 2D ultrasound guidance. The failure rate with the landmark method was 55%, which is higher than that reported in trials that involved more experienced operators (around 9% to 19%).
- 4.1.9 No studies were found that investigated the effect of 2D ultrasound guidance on SV catheterisation in infants.

## Femoral vein

- 4.1.10 One study was identified that evaluated the effect of 2D ultrasound guidance on femoral catheterisation in adults. In this trial, the operators took, on average, 2.7 (95% CI 0.1 to 5.3) fewer attempts to insert a catheter using 2D ultrasound guidance than using the landmark method ( $p=0.04$ ). Compared with the landmark method, 2D ultrasound guidance reduced the risk of failed catheter placement and the time to successful catheterisation, but the differences were not statistically significant. No studies in infants were found.
- 4.1.11 No studies were found that investigated the effect of 2D ultrasound guidance on FV catheterisation in infants.

## Audio-guided Doppler ultrasound

### Internal jugular vein

4.1.12 Four RCTs were found that compared audio-guided Doppler ultrasound guidance with the landmark method for IJV catheterisation in adults. Pooled results from these RCTs suggest that audio-guided Doppler ultrasound guidance was significantly better than the landmark method in terms of risk of failed catheter placement (61% reduction in relative risk, 95% CI 8% to 83%,  $p=0.03$ ) and the risk of failure on the first catheter placement attempt (43% reduction in relative risk, 95% CI 12% to 63%,  $p=0.01$ ). With the audio-guided Doppler ultrasound method, the risk of catheter placement complications was reduced (57% reduction in relative risk, 95% CI -5% to 83%) and there were fewer attempts to achieve successful catheterisation (0.6 fewer attempts, 95% CI -0.6 to 1.8); however, the differences did not reach statistical significance ( $p=0.06$  and  $p=0.40$ , respectively) so they could have arisen by chance. It took, on average, 35 seconds longer (95% CI -54 to 124 seconds) to successfully insert a catheter using Doppler ultrasound guidance than it did with the landmark method, although this difference was also not statistically significant.

4.1.13 Only 1 trial was identified that studied the effect of audio-guided Doppler ultrasound in infants. The sample size of this study was small ( $n=29$ ) and so it lacked statistical power. It failed to show any differences with the landmark method.

### Subclavian vein

4.1.14 The pooled results from 3 RCTs (all involving adults) suggest that for SV catheterisation there was a significantly increased risk of failed catheter placement when the audio-guided Doppler ultrasound method was used compared with the landmark method (48% increased in relative risk, 95% CI 3% to 114%,  $p=0.03$ ). In other words, the landmark method was preferable to the audio-guided Doppler ultrasound guidance technique. In contrast, the pooled results from 2 of the trials, which reported the risk of catheter placement, showed a 43% fall (95% CI 89% to 188%) in relative risk in the audio-guided Doppler ultrasound group, although this result was not statistically significant.

- 4.1.15 Only 1 study reported the effect of audio-guided Doppler ultrasound guidance on the risk of failure of the first catheter placement in adults. There was a slight increase (4%, 95% CI -24% to 43%) in the risk of catheter placement complications associated with the use of audio-guided Doppler ultrasound guidance compared with the landmark method, although this result was not statistically significant. Only 1 study recorded the effect of audio-guided Doppler ultrasound guidance on the number of attempts required to achieve successful catheterisation. This study found that an average of 0.4 (95% CI 0.2 to 0.6) fewer attempts were needed to achieve successful catheterisation with the audio-guided Doppler ultrasound guidance method compared with the landmark method, a highly statistically significant difference ( $p < 0.001$ ). The same study was the only one to record the effect of Doppler ultrasound guidance on the time to achieve successful catheterisation. Catheterisation using the Doppler ultrasound guidance method was significantly (on average, 209 seconds, 95% CI 175 to 242) slower than catheterisation using the landmark method ( $p < 0.001$ ).

## 4.2 Cost effectiveness

- 4.2.1 No relevant economic evaluations were identified in the literature. Furthermore, none of the submissions made to NICE included economic evaluations.
- 4.2.2 The assessment group developed an economic analysis, based on the evidence from the systematic review of RCTs, to evaluate the cost effectiveness of 2D ultrasound guidance compared with the landmark method. This model is a simple decision analytic model, and is based on a theoretical cohort of 1,000 adult patients who required IJV cannulation before surgery and who had a low to moderate risk of complications.
- 4.2.3 This model adopted a set of conservative assumptions. It was assumed that the operators were experienced in using the landmark method; the time to achieve successful puncture was the same for both methods; complications were limited to arterial puncture; there was a 10-minute delay between the prior failure and the new attempt at another insertion site; there was a 100% success rate at the second insertion site; and each machine was used for 15 procedures per week.
- 4.2.4 The results of the assessment group's model suggested that the ultrasound

guidance not only avoided 90 arterial punctures for every 1,000 patients treated, but also reduced costs by an average of almost £2 per patient. In other words, the 2D ultrasound guidance method was found to be both more effective and less costly than the landmark method.

- 4.2.5 A threshold sensitivity analysis was undertaken to examine by how much key variables in the model needed to change to make the ultrasound guidance method cost-neutral instead of cost-saving. The modelled result was most sensitive to the utilisation of the ultrasound equipment. The cost-saving result was eradicated if the number of ultrasound procedures assumed per machine per week was less than around 11, or if the number of ultrasound procedures carried out by an individual trained practitioner was less than around 3 per month on average.
- 4.2.6 Given that the model used relatively conservative estimates, the assessment group concluded that the results were probably generalisable to all anatomical catheter insertion sites, to infants, and to other sites within the hospital including the clinical wards.

## 4.3 Consideration of the evidence

- 4.3.1 The committee reviewed the evidence on both the clinical effectiveness and the cost effectiveness of ULDs for placing CVCs, having also considered the evidence from clinical experts. Furthermore, the committee was mindful of the need to ensure that its advice took account of the efficient use of NHS resources.
- 4.3.2 The committee took note of the fact that the evidence on the effectiveness of CVC placement into IJVs in adult patients was more robust than that available for other insertion sites. For infants, evidence was available only from trials that evaluated central venous catheterisation of the IJV, and there was very limited evidence on the use of this technology in very small infants (those weighing less than 3 kg). In addition, the economic analysis presented to the committee was based on an evaluation of the cost effectiveness of 2D ultrasound-guided elective CVC placement into the IJV in the operating theatre prior to surgery. The assessment report provided justifications for extrapolating this analysis to other settings including ward-based management, other sites of CVC insertion and also

to CVC placement in infants.

- 4.3.3 Given the constraints outlined in [section 4.2.2](#), the committee concluded that there was evidence of both the clinical and cost effectiveness of 2D imaging ultrasound guidance as an adjunct for placing CVCs in the majority of clinical scenarios, but that the degree to which this technology would be most suitably applied would vary according to the clinical situation and the competence or previous experience of the operator. In addition, there could be potential benefits for patients arising from reduced discomfort from the procedure and reduced risk of complications compared with the landmark method, particularly for IJV insertions.
- 4.3.4 The committee found the evidence for the use of audio-guided Doppler ultrasound guidance less satisfactory, and therefore concluded that the 2D imaging ultrasound guidance should be used in preference to audio-guided Doppler ultrasound guidance.
- 4.3.5 While accepting that, from a patient's perspective, 2D ultrasound imaging guidance in CVC insertion might be more appropriate and probably superior to the traditionally used landmark method in many circumstances, the committee also considered the financial and service implications of purchasing the required equipment and of training sufficient numbers of competent practitioners.
- 4.3.6 The committee also considered that although 2D ultrasound imaging guidance in CVC placement may eventually become the routine method for placing CVCs, the landmark method would remain important in some circumstances, such as emergency situations, when ultrasound equipment and/or expertise might not be immediately available. Consequently, the committee thought it important that operators maintain their ability to use the landmark method and that the method continues to be taught alongside the 2D-ultrasound-guided technique.

## 5 Recommendations for further research

5.1 Good quality studies are needed:

- to investigate the possible economic and clinical implications to the NHS of nurse specialists or other healthcare practitioners carrying out routine insertion of CVCs
- to evaluate the use of ultrasound-guided central venous catheterisation in small infants (those weighing less than 3 kg).

## 6 Resource impact for the NHS

- 6.1 The purchase cost of a portable 2D ultrasound machine currently lies between £7,000 and £15,000. The additional disposables necessary for the ultrasound-guided procedure cost less than £1 per procedure. Estimates made by the assessment group analysis indicate that the additional cost of using ultrasound equipment for the CVC placement procedure is likely to be less than £10 per procedure.
- 6.2 It is likely that the NHS will need to invest in a significant number of additional 2D ultrasound machines, although it is impossible to predict how many will be required as local circumstances will vary considerably. Implementing the guidance will require local decisions regarding optimal number of machines, staff training and device service contracts.
- 6.3 The assessment group analysis suggests that in the long term the implementation of ultrasonic locating devices will be cost-saving. The majority of these savings are likely to be due to releasing resources such as staff, and operating theatre and ITU or HDU time and beds.
- 6.4 A constraint upon the implementation of this technology will be the need to ensure that there are adequately trained competent operators to support the services. Many CVC placement procedures are performed on an emergency basis at the bedside in a diverse number of locations and therefore the necessary skills need to be spread across several related disciplines.

## 7 Implementation and audit

- 7.1 NHS trusts in which CVCs are used, all those who routinely insert CVCs and those responsible for clinical training programmes should review policies and practices regarding the insertion of CVCs to take account of the guidance set out in [section 1](#). The recommendations in this guidance will represent a significant service development for most NHS organisations. The appraisal committee has advised NICE that the nature of the resource consequences of the guidance and the time it will take to put them in place should be brought to the attention of the Department of Health and the Welsh Assembly Government.
- 7.2 Local guidelines or care pathways which relate to the use of CVCs should incorporate the guidance set out in [section 1](#).
- 7.3 To enable healthcare practitioners to audit their own compliance with this guidance, it is recommended that a system is available to identify patients who have a CVC inserted in either an elective or an emergency situation.
- 7.4 To measure compliance locally with the guidance in [section 1](#), the following criteria should be used. Further details on suggestions for audit are presented in [section 10](#).
- When a CVC is being inserted into the IJV of an adult or a child in an elective situation, 2D imaging ultrasound guidance is used.
  - All healthcare practitioners involved in the placement of CVCs using 2D imaging ultrasound guidance undertake appropriate training to achieve competence in this technique.
  - Audio-guided Doppler ultrasound guidance is not used for CVC insertion.
- 7.5 All NHS trusts in which CVCs are used should identify the number of 2D imaging ultrasound units required and the appropriate location for each unit, should plan to train a sufficient number of healthcare practitioners from a range of disciplines in the proper use of the units and should identify other financial and service implications of implementing the guidance in [section 1](#).

7.6 Healthcare practitioners should consider the most appropriate method of CVC insertion that is in the best interest of the patient in his or her specific clinical situation, particularly in terms of minimising the risk of adverse events such as failed catheter placements or catheter placement complications. Trusts should recognise that the decision to use 2D imaging ultrasound guidance or the landmark method will be informed by:

- the competence and previous experience of the operator(s)
- the anatomical site of CVC insertion and other anticipated technical difficulties
- the urgency of clinical need.

## 8 Appraisal committee members

The appraisal committee is a standing advisory committee of NICE. Its members are appointed for a 3-year term. The appraisal committee meets 3 times a month except in December, when there are no meetings. The committee membership is split into 3 branches, with the chair, vice-chair and a number of other members between them attending meetings of all branches. Each branch considers its own list of technologies and ongoing topics are not moved between the branches.

Committee members are asked to declare any interests in the technology to be appraised. If it is considered there is a conflict of interest, the member is excluded from participating further in that appraisal.

The [minutes of each appraisal committee meeting](#), which include the names of the members who attended and their declarations interests, are posted on the NICE website.

The following is a list of the committee members who took part in the discussions for this appraisal.

**Dr Jane Adam**

Radiologist, St George's Hospital, London

**Professor R L Akehurst**

Dean, School of Health Related Research, Sheffield University

**Dr Sunil Angris**

General Practitioner, Waterhouses Medical Practice

**Professor David Barnett (Chairman)**

Professor of Clinical Pharmacology, University of Leicester

**Dr Sheila Bird**

MRC Biostatistics Unit, Cambridge

**Professor Carol Black**

Consultant Physician, Royal Free Hospital & UCL, London

**Professor John Brazier**

Health Economist, University of Sheffield

**Professor Martin Buxton**

Director of Health Economics Research Group, Brunel University

**Professor Mike Campbell**

Statistician, Institute of General Practice & Primary Care, Sheffield

**Dr Karl Claxton**

Health Economist, University of York

**Professor Sarah Cowley**

Professor of Community Practice Development, Kings College, London

**Professor Jack Dowie**

Health Economist, London School of Hygiene & Tropical Medicine, London

**Mr Chris Evennett**

Chief Executive, Mid-Hampshire Primary Care Trust

**Dr Paul Ewings**

Statistician, Taunton & Somerset NHS Trust

**Professor Terry Feest**

Clinical Director and Consultant Nephrologist, Richard Bright Renal Unit, and Chairman of the UK Renal Registry

**Professor Gary A Ford**

Professor of Pharmacology of Old Age and Consultant Physician, Wolfson Unit of Clinical Pharmacology, University of Newcastle

**Mrs Sue Gallagher**

Chief Executive, Merton, Sutton and Wandsworth Health Authority

**Dr Trevor Gibbs**

Head, Global Clinical Safety & Pharmacovigilance, GlaxoSmithKline

**Sally Gooch**

Director of Nursing, Mid-Essex Hospital Services Trust

**Mr John Goulston**

Director of Finance, The Royal Free Hampstead NHS Trust

**Professor Trisha Greenhalgh**

Professor of Primary Health Care, University College London

**Miss Linda Hands**

Consultant Vascular Surgeon, John Radcliffe Hospital, Oxford

**Professor Philip Home**

Professor of Diabetes Medicine, University of Newcastle

**Dr Terry John**

General Practitioner, The Firs, London

**Dr Diane Ketley**

Research into Practice Programme Leader, NHS Modernisation Agency

**Dr Mayur Lakhani**

General Practitioner, Highgate Surgery, Leicester, and Lecturer, University of Leicester

**Ruth Lesirge**

Lay Representative; Director, Mental Health Foundation

**Dr George Levvy**

Lay Representative; Chief Executive, Motor Neurone Disease Association

**Dr Gill Morgan**

CEO, North & East Devon Health Authority

**Professor Miranda Mugford**

Health Economist, University of East Anglia

**Mr M Mughal**

Consultant Surgeon, Lancashire Teaching Hospitals NHS Trust

**Mr James Partridge**

Lay Representative; Chief Executive, Changing Faces

**Siân Richards**

General Manager, Cardiff Local Health Group

**Professor Philip Routledge**

Professor of Clinical Pharmacology, University of Wales

**Dr Rhiannon Rowsell**

Pharmaceutical Physician, AstraZeneca UK Ltd

**Dr Stephen Saltissi**

Consultant Cardiologist, Royal Liverpool University Hospital

**Professor Andrew Stevens (Vice-Chairman)**

Professor of Public Health, University of Birmingham

**Professor Ray Tallis**

Consultant Physician, Hope Hospital, Salford

**Dr Cathryn Thomas**

General Practitioner, and Senior Lecturer, Department of Primary Care and General Practice, University of Birmingham

**Professor Mary Watkins**

Head of Institute of Health Studies, University of Plymouth

**Dr Norman Waugh**

Public Health Consultant, University of Southampton

## 9 Sources of evidence considered by the committee

The following documentation and opinion were made available to the committee:

- Assessment report prepared by the School of Health Related Research (SchARR), University of Sheffield: The effectiveness and cost effectiveness of ultrasound locating devices for central venous access, 24 January 2002.
- Manufacturer/sponsor submissions:
  - KeyMed (Medical & Industrial Equipment) Ltd
  - Jade Medical UK and Dymax Corporation
  - SonoSite Inc
  - Siemens
  - Dynamic Imaging Limited
- Professional/specialist group submissions:
  - British Association of Critical Care Nurses
  - Royal College of Physicians
  - Renal Association
  - Intensive Care Society
  - Royal College of Anaesthetists
  - Lincolnshire Health Authority/West Lincolnshire PCT
  - Royal College of Nursing
  - Royal College of Radiologists
  - Department of Health and Welsh Assembly Government
  - Health Technology Board for Scotland

- Patient/carer group submissions:
  - No submissions received
- Expert perspective:
  - Dr A R Bodenham, Consultant in Anaesthesia and Intensive Care, Leeds General Infirmary.

# 10 Detail on criteria for audit of the use of ultrasound locating devices for placing central venous catheters

## Possible objectives for an audit

An audit on the appropriate use of ultrasound locating devices could be carried out to ensure that:

- when a central venous catheter (CVC) is being inserted into the internal jugular vein (IJV) of an adult or a child in an elective situation, two-dimensional (2D) imaging ultrasound guidance is used
- healthcare practitioners involved in the placement of CVCs using 2D imaging ultrasound guidance have appropriate training
- audio-guided Doppler ultrasound guidance is not used for CVC insertion.

If healthcare practitioners have agreed locally on the clinical circumstances where 2D imaging ultrasound guidance is to be used when a CVC insertion is necessary, the audit also could be carried out to ensure that the technique is used as agreed locally.

## Possible patients to be included in the audit and time period for selection

All patients who have a CVC inserted either in the IJV in an elective situation (or for any purpose on either an elective or emergency basis, if 2D imaging ultrasound is more widely used) over a reasonable period of time for audit data collection, for example, for 1 to 3 months. A sample of patients stratified by clinical areas most likely to be involved, for example, critical care areas, theatres, and accident and emergency, could be used for the audit or the audit could be staged to include 1 clinical area at a time, working through all clinical areas.

**Table 1 Measures to be used as a basis for an audit**

Criterion	Standard	Exception	Definition of terms
2D imaging ultrasound guidance is used when a CVC is being inserted in the IJV in an elective situation	100% of patients with a CVC inserted in the IJV in an elective situation	None	Local clinical teams should agree on the types of elective situations to be included in the audit and should agree to any exceptions for the use of the technique, such as for an infant weighing less than 3 kg
The healthcare practitioner involved in the placement of the CVC is trained in the use of 2D imaging ultrasound guidance	100% of patients having a CVC inserted	None	For audit purposes, it should be agreed at NHS trust level how training to achieve competence in the technique is documented
Audio-guided Doppler ultrasound guidance is not used for CVC insertion	100% of patients having a CVC inserted	None	–

An additional measure that could be used when it has been agreed to use 2D imaging ultrasound guidance for other clinical circumstances in which a patient has a CVC inserted is as follows.

**Table 2 Additional measure for other clinical circumstances**

Criterion	Standard	Exception	Definition of terms
2D imaging ultrasound guidance is used when a CVC is being inserted	100% of patients having a CVC inserted for any purpose	None	Local healthcare practitioners may specify circumstances in which 2D ultrasound guidance is to be used when a CVC is being inserted or may specify exceptions, for audit purposes

## Calculation of compliance with the measure

Compliance with each measure described in tables 1 and 2 is calculated as follows:

Numerator divided by the denominator, multiplied by 100.

Numerator: Number of patients whose care is consistent with the criterion plus the number of patients whose care is consistent with any locally agreed exception.

Denominator: Number of patients to whom the measure applies.

Healthcare practitioners should review the findings of measurement, identify whether practice can be improved, agree on a plan to achieve any desired improvement and repeat the measurement of actual practice to confirm that desired improvement is being achieved.

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