

# Development of the UK Vessel Health and Preservation (VHP) framework: a multi-organisational collaborative

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## Abstract

Vascular access is an important part of many patient care management plans but has some unwanted risks. Previous work published by Moureau et al. (2012) inspired a working group led by the UK Infection Prevention Society (IPS) to produce a vessel health and preservation (VHP) framework. This was with the intention of producing a resource for frontline staff to be able to assess and select the best vascular access device to meet the individual patient's needs and to preserve veins for future use.

The working group produced a framework that used available evidence, expert opinion and some small scale testing of the components of the framework. The work so far has received positive feedback but further work is required to formally evaluate the VHP framework in clinical practice to measure both staff knowledge and patient outcomes.

## Keywords

vessel health, vessel health and preservation, vascular access device selection, vascular access evaluation, vein assessment

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## Introduction

Vascular access along with the administration of intravenous drugs and fluids is common practice in healthcare today and plays an important part in the care and management of many patients (Gabriel, 2013; Jackson et al., 2013). Vascular access can be life-saving for patients; however, it can also result in a range of both minor and life-threatening complications including phlebitis, thrombus, infection and damage to the vessel (Moureau et al., 2012). Blood stream infections associated with vascular access devices are potentially among the most dangerous complications associated with healthcare (Loveday et al., 2014).

Poor decision-making combined with inexperience has been identified as resulting in the default choice for administering intravenous (IV) therapy via peripheral venous cannula (PVC) routes (Jackson et al., 2013). In addition, those inserting peripheral cannulae may not necessarily appreciate fully the implications and associated complications (Jackson et al., 2013). There have also been concerns from staff about patients being cannulated numerous times using small fragile veins which fail quickly due to the

inadequate blood flow (Oliver, 2015). The implications for patients of failed cannulation include pain and delayed IV fluids, antibiotics and analgesia resulting in increased length of hospital stay (Alexandrou, 2014). A personal account of where numerous PVCs over a few weeks were inserted into veins that were inadequate to support therapy resulted in, among other negative impacts, a needle phobia, phlebitis and an overall poor patient experience (Horsfield, 2013).

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Cannulation decisions are often left to junior healthcare staff who lack support in clinical decision-making around vascular access. In addition to this because complications of suboptimal vascular access are so costly to both the patient and the organisation (Jackson et al., 2013), it was decided to explore how improvements could be made in the way vascular access is managed in the UK.

The evidence-based Vessel Health and Preservation (VHP) concept of vascular access management described by Moureau et al. (2012) was originally introduced in the US with the aim of providing a proactive patient focused approach to vascular access. The essence of the US VHP model is timely intentional vascular access device selection, during the first 24 h of a patient requiring vascular access (often on entry into the healthcare system), followed by placement of a clinically appropriate device within 48 h. Once placed, the focus then shifts to daily maintenance and care of the device using a daily assessment to determine the health of the patient's blood vessels as well as continued necessity for the device. Along with observation, VHP also encourages the timely replacement or removal of the device when clinically indicated (Moureau et al., 2012).

## Background to the development of the VHP Framework in the UK

The Infection Prevention Society (IPS) became aware of the original VHP work developed in the US, where the focus is on the patient's vessel health rather than the actual device itself. While there are joint benefits, the focus on the patient rather than the device promotes individualised patient assessment.

The IPS Intravenous Special Interest Group provided the ideal opportunity to explore the US VHP tool with a view to adapting for UK use. A small working group (The UK VHP Development Group, thereafter referred to as 'the VHP Group') was set up and led by the IPS. The group comprised interested members of the IPS and invited representatives of the Royal College of Nursing (RCN) and the National Infusion and Vascular Access Society (NIVAS) in the UK with the first meeting commencing late 2011. The VHP group also invited a consultant anaesthetist and clinical lead for vascular access and vascular access nurse specialists.

Initially a literature search was undertaken to provide an integrated overview of the literature and research articles that were available around the subject of vessel health and preservation (Parahoo, 2006; Beavan and Craig, 2007). A search of the Discovery, Medline, Cinhal and Cochrane databases was conducted, utilising search terms including: 'vascular access', 'vascular access devices', 'venous access' and 'vessel health preservation'. Only articles written after 2009 were considered, and only English articles were included. The search demonstrated that although there were many articles on the subject of venous access devices, vascular access and venous access, there were no articles

on the use of vessel health preservation tools to aid clinical decision-making other than the work of Moureau et al. (2012) describing the US model for VHP.

It was recognised by the VHP group that the implementation of VHP in the UK may be challenging due to the different models and processes used to manage vascular access across different healthcare teams. Some acute hospitals in the UK had developed IV teams managing the insertion of vascular access devices with a variety of nurse led or clinician led teams. These teams could also be attached to critical care or radiology teams with an emerging model of IV teams also being attached to infection prevention and control teams. This resulted in open and frank discussions with many questions and debates as to how the US framework could be adapted for use in the UK. Nevertheless the interest was certainly enough to continue with the process.

At first, attempts were made to anglicise the US VHP tool. Subsequently the adapted tools were tested using improvement methodology with small tests of change (Taylor et al., 2013). The findings from this small scale testing indicated that the US VHP tools were complex and complicated with what appeared to be some repetition. The VHP Group found from the testing that the US VHP tools, even when modified, were not suitable for use by nursing, medical and other healthcare professionals in the NHS. This resulted in the VHP Group using the original US VHP concept but adapting this into a UK VHP framework, hereafter called the framework, to assist frontline staff in their choice of vascular access device in the UK. Using the then available evidenced-based guidelines, epic 2 (Pratt et al., 2007) and Centre for Disease Control and Prevention (CDC) (O'Grady et al., 2011) and expert consensus within the group a revised UK VHP framework was developed. The epic2 (Pratt et al., 2007) guidelines were subsequently updated with epic3 (Loveday et al., 2014), enabling the framework to include the current guidance.

The overall aim of the VHP Group was to establish a standardised approach to vascular access in order to support practitioners undertaking vessel assessment and decision-making regarding suitable devices for vascular access and administration of medication and/or fluids.

## Designing the framework

The framework was designed using an action research methodological approach with the following elements described by Sagor (2000):

1. Selecting a focus
2. Clarifying theories
3. Identifying research questions
4. Collecting data
5. Analysing data
6. Reporting results
7. Taking informed action

The first element, selecting a focus, involved concentrating the VHP group's attention on vascular assessment and device selection. The second, clarifying theories, is concerned with values, beliefs and theoretical perspectives relating to the research focus. Initial concepts were based upon beliefs and experience of the VHP group and using the US VHP principles as underpinning philosophy.

The starting focus for the framework included the following:

- Suitable for frontline staff in acute or planned settings
- Based on individual patient need and risk assessment
- Divided into relevant sections recognising the different stages of vascular assessment and therapy
- Suitable to be used either in its entirety or as individual sections

It was acknowledged that the framework would not be appropriate for use in emergency situations.

The first part of the actual framework asks the question, 'Is IV therapy required and have other routes been considered and excluded'? The VHP group considered it to be critical to ensure the many other routes to provide medication and fluids including topical, sublingual, rectal, subcutaneous, transcutaneous, inhaled and nasal have been considered for more optimal patient safety.

Following on from the initial question the framework consisted of four clinical decision aides:

- Peripheral vein assessment tool
- Suitability of IV fluids/medications for peripheral vein administration

- Right line decision tool
- Re-evaluation of vascular access device

Poor quality of peripheral veins often results in escalation to a central venous catheter but earlier recognition of 'difficult to cannulate' patients or patients with regular failing cannulation could provide a better selection for the most appropriate device. In addition, there are a range of technologies that can enable successful cannulation in patients assessed as having poor quality of peripheral veins.

The UK group felt that there were inconsistencies with peripheral vein assessment and veins often described subjectively as 'good' or 'poor' with little description in between. This led to the development of a score-based assessment tool (Table 1) providing a definition of vein quality and management guidance to be used for drugs or infusions suitable for peripheral administration.

The VHP group explored definitions and the language used to describe peripheral vasculature, considering existing definitions and accepted language such as 'palpable' and 'visible veins' (Weinstein, 2006) and the initial tool was shaped, including a 1 to 5 categorisation of vein suitability.

During the data collection process the initial peripheral vein assessment tool was shown to experienced nurses who undertake frequent peripheral vascular assessments and perform cannulations daily. Feedback from the data collection process led to changes again in the language of the tool, in an attempt to gain more clarity, precise and universal terminology. Using a basic questionnaire to gain feedback on how useful the nurses found the tool was used with 95 peripheral vascular assessments. The results showed 96% of assessments were either viewed useful or very useful with 4% undecided.

**Table 1.** Peripheral vein assessment tool.

Grade	Vein quality	Definition of vein quality	Insertion management*
1	Excellent	4–5 palpable/visible veins suitable to cannulate	Cannula may be inserted by trained/authorised healthcare practitioner
2	Good	2–3 palpable/visible veins suitable to cannulate	Cannula may be inserted by trained/authorised healthcare practitioner
3	Fair	1–2 palpable/visible veins suitable to cannulate (veins may be small, scarred or difficult to find and require heat packs to aid vasodilation)	Cannula may be inserted by trained/authorised healthcare practitioner but may require Infrared Viewer or ultrasound
4	Poor	Veins not palpated/visible (requires ultrasound assistance or Infrared Viewer)	Cannula may be inserted by an experienced practitioner† in cannulation. Use Infrared Viewer, ultrasound, transillumination or other aids
5	None identifiable	No visible (naked eye or aids) or palpable veins	Peripheral cannulation should not be performed

\*The number of attempts for cannulation before escalation should be reflected in local policy.

†To be determined locally.

The data led to changes made to the peripheral vein assessment tool before adding to the framework in light of these findings. The process was in line with action research approach – if the data formed patterns, trends and led to a theme/s then informed changes were made to the tool to refine the tool and improve reliability.

An example list of drugs was devised with the support from a local pharmacist with further reference for practitioners to use local guidance in clinical settings (Table 2). A complete list of drugs could not be provided within the framework as there are in excess of 200 drugs that can be given intravenously (Injectable Medicines Guide, 2007) nor could the drug list in the original US VHP tool be replicated due to differences between UK and US drug licensing. The potential suitability of drugs for peripheral infusion is a complex decision requiring assessment for the individual patient, drug and best route of access with each treatment (University College Hospital, London 2014). In broad terms, the safety of a drug infusion to prevent damage to the vessel will relate to factors for example pH, osmolarity, viscosity, volume of dilution, speed of infusion, and the size and fragility of the peripheral vein.

Guidelines previously produced by the Royal College of Nursing (2010), and currently under revision, suggest peripheral cannulae and midlines are unsuitable for the following:

- Continuous vesicant chemotherapy
- Parenteral nutrition exceeding 10% dextrose and/or 5% protein

- Solutions and/or medications with pH less than 5 or greater than 9
- Solutions and/or medications with osmolarity greater than 600 mOsm/L

The decision tree for selection the vascular access device (Figure 1) was created using the evidence-based guidelines provided in the CDC guidelines (O'Grady et al., 2011) and epic3 (Loveday et al., 2014). It became apparent when early versions of the VHP framework were shared among colleagues that midlines were not offered as a vascular access device option in some hospitals; this appeared to be due to competency requirements of staff for using such devices. Midline catheters although peripherally inserted can be inserted into larger veins where the blood flow is faster and can provide an alternative to a central line with reduced risk of complications (Anderson, 2005; Dawson and Moureau, 2013). Midlines can be left in place for up to 28 days (Loveday et al., 2014) saving multiple cannulations (Dawson and Moureau, 2013).

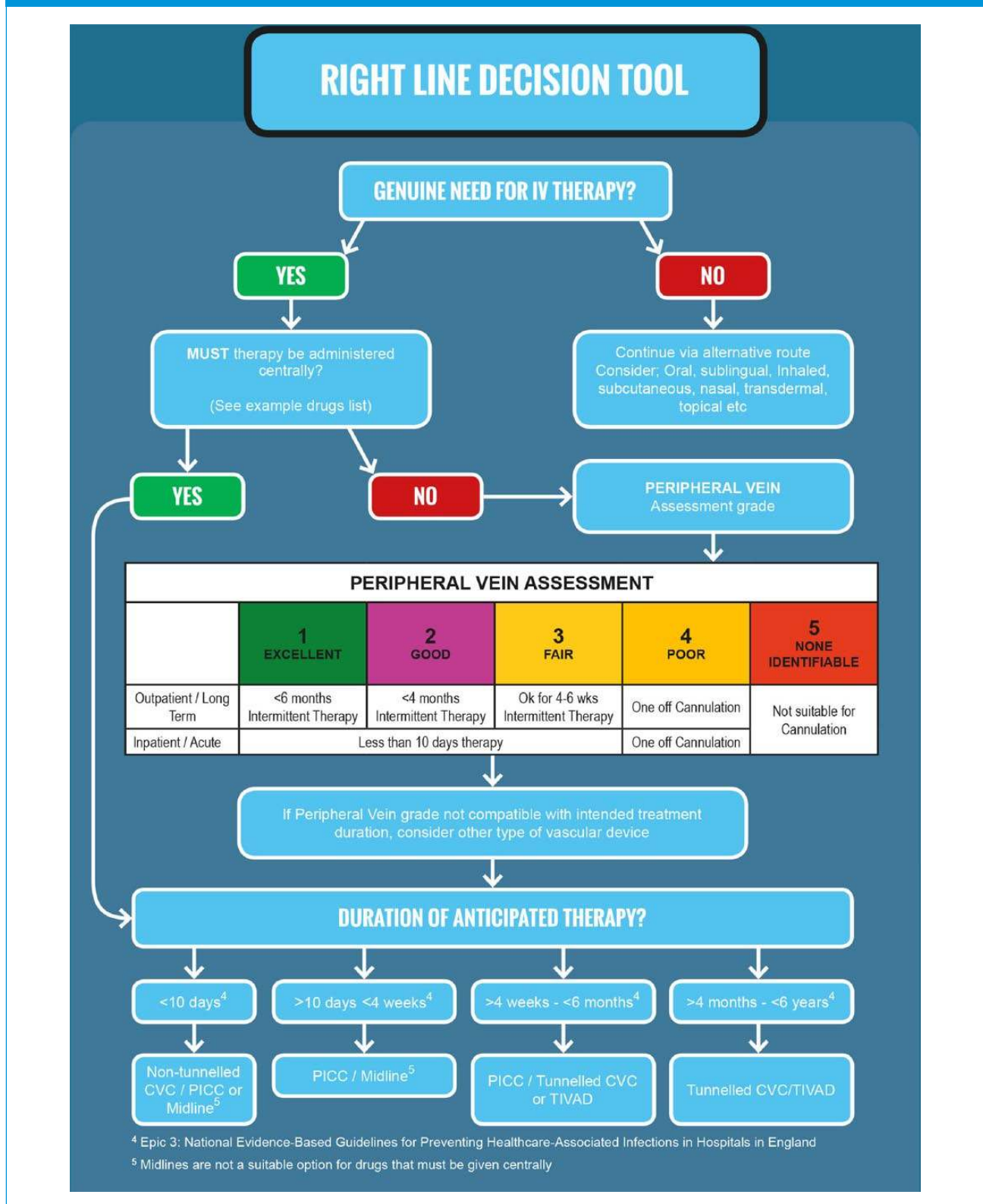
A number of additional factors needed to be considered in device selection including patient preferences and lifestyle. The original US VHP tools included a contraindication tool for additional information to be considered before the final decision on device was made. The VHP group attempted to simplify this by providing some additional questions to be considered, before the final device selection is made (Figure 2).

Finally, in line with the US VHP model, a re-evaluation section needed to be added to ensure that the right device is

**Table 2.** Example drugs list.

Definitely central	Consider central
Amiodarone (except emergency in cardiac arrest)	Vancomycin (especially when more than just a few days)
Some cancer chemotherapy drugs	Labetalol
Dobutamine	Argipressin
Dopamine	Caffeine
Epinephrine (adrenaline) infusion (except bolus dose in cardiac arrest)	GTN
Norepinephrine (noradrenaline)	Co-trimoxazole
Potassium >40 mmol/L	Dantrolene
TPN (unless only for first 1–2 days of therapy)	Phenoxybenzamine
Dopexamine	Foscarnet
Glucose >15%	Nitroprusside
Nimodipine	Phenytoin
Sodium bicarbonate 4.2% or 8.4%	Gancyclovir
Sodium chloride 1.8% +	Pentamidine

Figure 1. Decision Tool.



still required and there are no signs of complications (Figure 3). The daily assessment should consider any complications and whether the device is still required and

appropriate, preserving vessel health and comfort for the patient. In addition, observation of the vascular access device insertion site should be performed at each shift. The

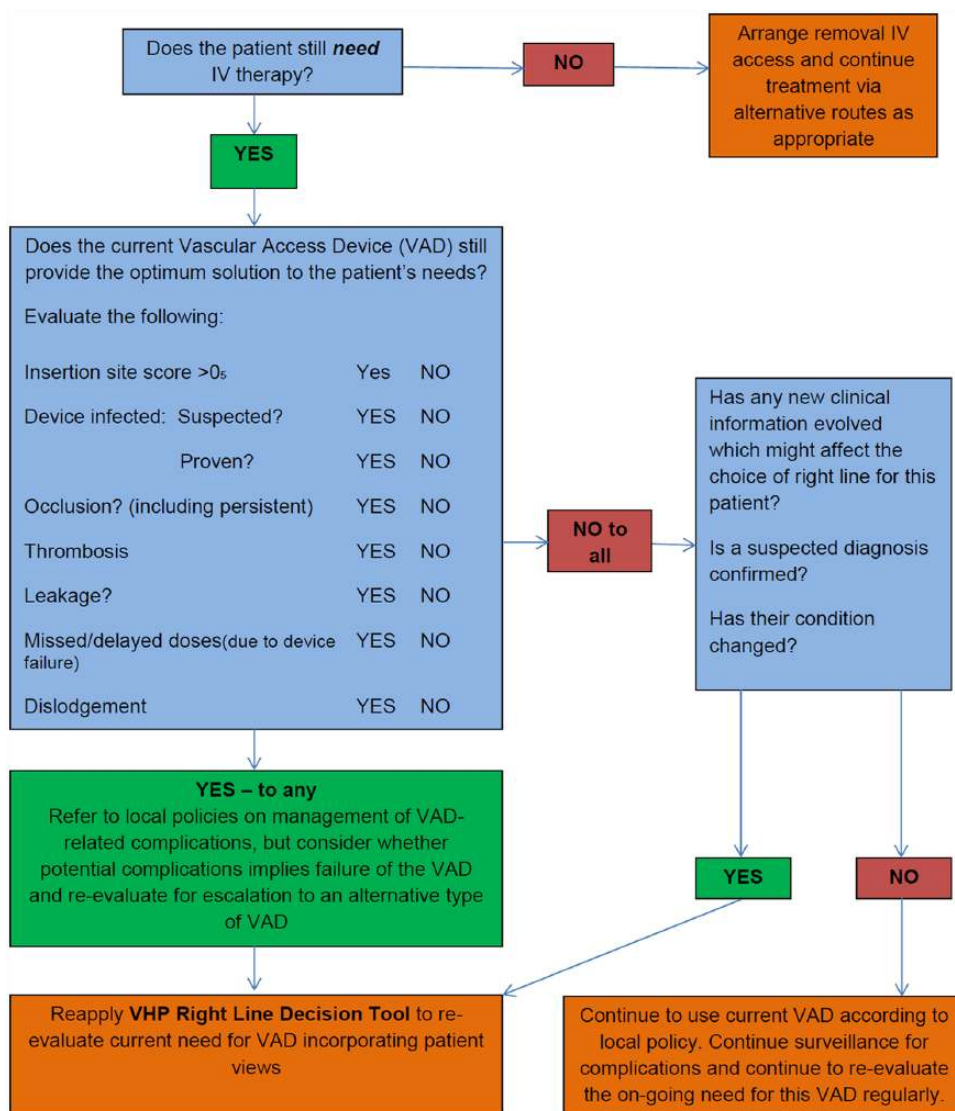


Figure 2. Secondary questions.

**Secondary questions which may refine vascular access device choice in individual patients:**

- Patient preference / Lifestyle issues / Body image
- Known abnormalities of vascular anatomy which limit access site
- Therapy specifics: eg intermittent vs continuous sickness of patient, extreme duration of therapy (months-years) specific indications (eg bone marrow transplant)
- Local availability of vascular competency
- Need for long term dialysis with :AV fistula, avoid vein damage from PICC or Axillary / Subclavian catheters
- Relevant PMH: coagulopathy, severe respiratory dysfunction and other contra-indications to central access
- Patient factors: cognitive function

Figure 3. Re-evaluation of vascular access device.



<sup>6</sup>Use local insertion site score e.g. VIP score for peripheral cannula (Jackson 1998)

framework acknowledges UK-based initiatives such as Saving Lives (Department of Health, 2010) and Matching Michigan (Bion et al., 2012).

Discussion

Preservation of vessels is required to minimise damage and maximise patient safety. The framework assists with clinical decision-making in order to preserve vessels and prevent complications and maximise the patient's positive experience. The literature search undertaken suggests that the framework is unique but the concept has been adapted from the work developed by Moureau et al. (2012).

The decision tree was developed by the VHP Group from existing evidence-based guidelines and modified following testing in clinical areas. The variety of clinical areas where the decision tree underwent early testing includes both urgent care settings and planned care settings such as oncology and outpatient settings. During testing, some clinicians reported that the use of the decision tree convinced managers of the complexity of the process, the potential complications of poor decision-making which helped in establishing and developing vascular access teams. In those

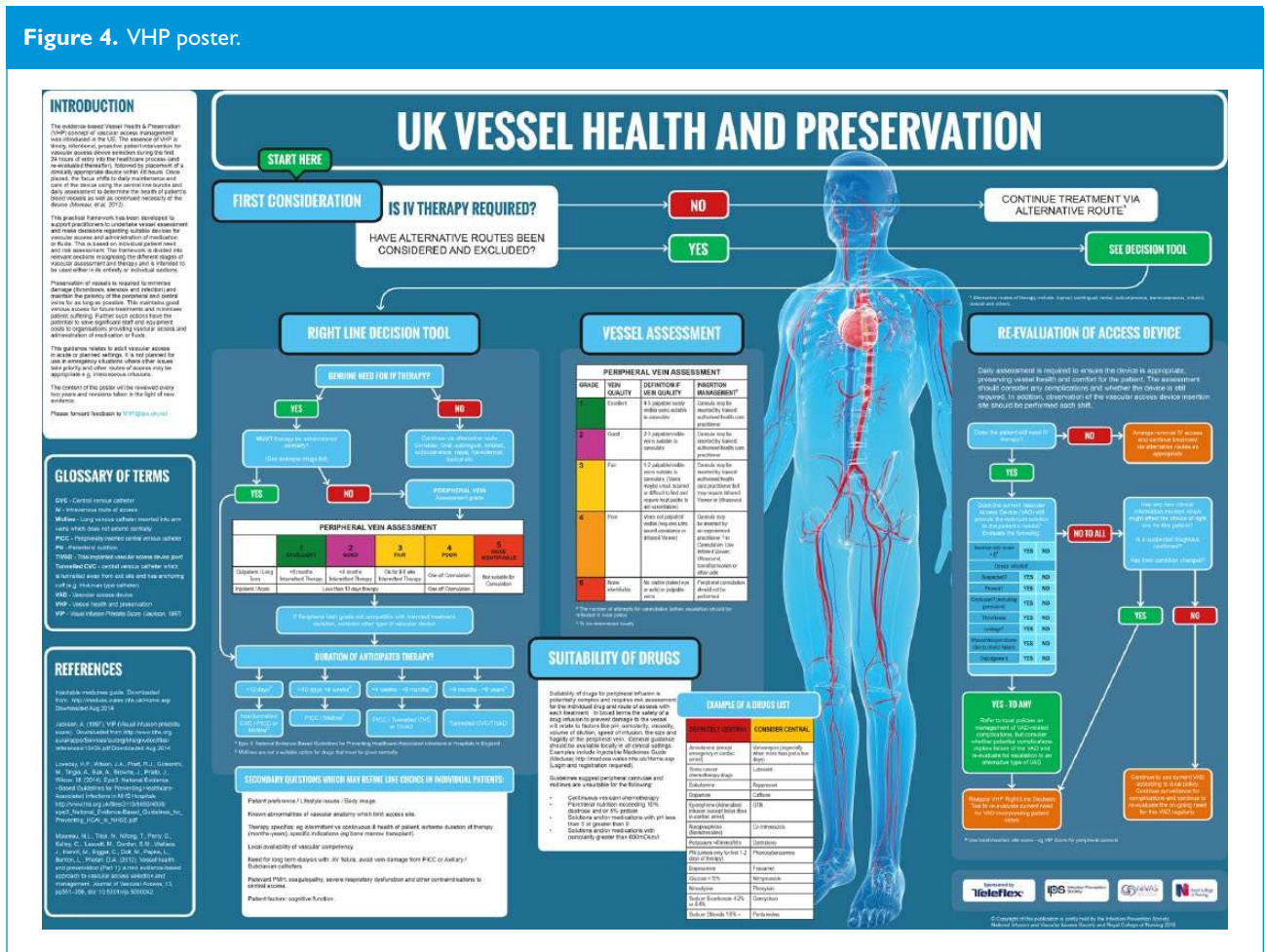
areas where vascular access teams were already in place, the framework is reported to have assisted in highlighting the benefits of providing a selection of options for device selection particularly with the use of midlines.

The framework does not address training and competency requirements for either the insertion or the ongoing management of the vascular access device nor does it provide guidance on site selection for device or promote any particular brand or material of device. These were intentional omissions as this guidance is readily available elsewhere.

Next steps

The VHP framework has been presented at a number of events in the UK and internationally at the World Congress of Vascular Access (WoCoVA) in Berlin with positive feedback and interest from both vascular access teams and infection prevention and control specialists. The VHP framework, however, needs to be formally evaluated in clinical practice in order to evaluate patient experience and outcomes, staff knowledge, skills and attitudes. The VHP group continues in the evaluation phase with a pilot

Figure 4. VHP poster.



**Table 3.** UK VHP working group.

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evaluation being carried out in a teaching hospital in the North of England before moving to a multi-site evaluation in 2016.

The development of a simple training video on how to use the VHP framework is currently being developed. The framework (Figure 4) has been made available on the IPS and NIVAS websites.

We encourage interested individuals and organisations to review and evaluate this pathway and we welcome feedback on the project.

## Conclusion

There is a need to support clinicians and enable them to achieve optimal vessel health preservation for their patients. An approach to VHP in the US did not fit the clinical situation in the UK. Collaboration between specialists working together adapted and modified this approach to suit the UK. The produced framework was considered by professional groups including IPS, NIVAS and the RCN. Evaluation sites will now assist in further testing, evaluation and ongoing development of this framework.

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## Peer review statement

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