Vessel Health and Preservation: an integrative review

Fiorini, Jacopo
Article type: Review

Title: Vessel Health and Preservation: an integrative review

Short title: Vessel Health and Preservation

Authors: MSN Jacopo Fiorini¹, PhD Giulia Venturini², MSN Fabio Conti², RN Emanuele Funaro, PhD Rosario Caruso⁴, PhD Mari Kangasniemi⁵ & PhD Alessandro Sili².

Institutional affiliation:

¹ University of Rome "Tor Vergata", Department of Biomedicine and Prevention, Rome, via Montpellier, 1, Italy 00133
² Policlinico Tor Vergata, Nursing Department, Rome, viale Oxford, 81 Italy 00133
³ Mediterranean Institute of Haematology, viale Oxford, 81 Rome, Italy
⁴ IRCCS Policlinico San Donato, San Donato Milanese, Piazza Edmondo Malan, 2 Italy 20097
⁵ University Lecturer, University of Eastern Finland, Department of Nursing Science, P.O. BOX 167, Kuopio, Finland 70211

Correspondence to J. Fiorini: email: fiorini.jcp@gmail.com; phone 3349864260.

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jocn.14707

This article is protected by copyright. All rights reserved.
Acknowledgements

All authors have agreed on the final version and meet these two following criteria recommended by the IC-MJE (http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html):

- substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work;
- drafting the work or revising it critically for important intellectual content;
- final approval of the version to be published.

Funding Statement: this paper received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest statement

No conflict of interest has been declared by the authors.

Abstract

Aims. To describe and synthesise current knowledge on the maintenance and preservation of vessels in patients who need the placement of a vascular access device (VAD).

Introduction. To administer drugs, blood or intravenous fluids, nurses or doctors insert a peripheral VAD on the arm using the traditional approach. This approach implies that devices are blindly inserted until flow is satisfactory and all possible sites have been exhausted. A proactive approach would ensure at the outset that the best device is used for each patient, eliminating repeated attempts at cannulation.
Design. An integrative review was conducted using data recorded until July 2017. Searches were conducted in PubMed, Cochrane Library, CINAHL and Scopus.

Review method. A modified version of Cooper’s five-stage method and the PRISMA guidelines were used to perform the integrative review.

Results. Nine papers were included in this review. The patients were active participants in a proactive approach to vessel health and preservation (VHP). The involvement of each health care professional (HCP) in VHP improves outcomes and expands the use of a proactive approach to vascular device management. Because nurses are directly involved in the use of such devices and support patients during the decision-making process, they should take the lead in the use of the proactive approach.

Conclusion. Despite the many documented advantages of the proactive approach to preserving vessels in many settings and healthcare systems, it has not been widely tested. Future research is needed to guarantee high-quality VHP care, thus contributing to the development and dissemination of the proactive approach.

Relevance to clinical practice. The proactive approach preserves vessels for future needs, improves the delivery of the treatment plan and reduces length of stay, costs, risk of infection, complications and pain perceived by patients. This approach also ensures better use of nurses’ time and VAD material.

Keywords: vessel health and preservation; proactive approach; vascular access
What does this paper contribute to the wider global clinical community?

- The dissemination of a proactive approach to preserving vessel health, the support of a specialized vascular access team and the involvement of each healthcare professional are necessary to improve patient outcomes and provide high-quality care.
- To ensure patients’ VHP, future research is needed to test the VHP programme in different clinical settings and to design an instrument that includes and evaluates all variables related to this approach.

Introduction

When patients are admitted to the hospital, healthcare professionals (HCPs, e.g., nurses or doctors) often must insert a vascular access device (VAD). Patients perceive VADs as invasive devices that are most frequently used in acute care settings (Wallis et al., 2014). However, patients experience VAD insertion as a ‘necessary evil’ in the care process (Larsen, Keogh, Marsh, & Rickard, 2017).

The vascular device most commonly used in clinical practice is a peripheral cannula, especially in settings such as emergency departments, where VADs are needed for the administration of drugs, blood and intravenous (IV) therapies (Carr et al., 2016; Sebbane et al., 2013; Tiwari, Hermsen, Charlton, Anderson, & Rupp, 2011). HCPs frequently use a traditional approach in which they attempt multiple peripheral blind IV sticks to insert a VAD until the vessels of the lower and upper arms are exhausted. In clinical practice, this approach causes pain for patients, delay in therapy and a prolonged hospital stay (Blackburn, 2014). Moreover, studies found that peripheral VADs are associated with localised complications, such as phlebitis, extravasation, infiltration, occlusion and thrombosis (Armenteros-Yeguas et al., 2017; Grune et al., 2004; Hadaway, 2012; Hamilton, 2006; Maki, Kluger, & Crnich, 2006; Wallis et al., 2014). Peripheral VAD complications often lead to the failure of the device, increased length of stay, morbidity and patient mortality (Alexandrou, 2014). Furthermore, vessel cannulation is often complicated in older patients, who develop...
comorbidities and require the administration of irritant or vesicant IV therapies (Hawes, 2007). The traditional approach to managing VADs may be ineffective when nurses or doctors are no longer able to easily cannulate any of the vessels. The worst outcome of poor VAD management is vein depletion, which could be seriously harmful to the patient.

Knowledge on the preservation of vessels is fragmented. Moreover, a comprehensive review of the literature related to the preservation of vessels has not been published. Considering the importance of this topic, the comprehensive review provided here is very useful for clinicians and researchers because it provides a synthesis of the current evidence regarding vessel health and preservation.

Studies have evaluated the outcomes of the placement of VADs in clinical practice (Armenteros-Yeguas et al., 2017; Burns & Lamberth, 2010), especially in terms of the reduction of the risks associated with IV therapy and the increase in patient safety and well-being. Findings have shown that the proactive approach is more cost-effective than the traditional approach (Armenteros-Yeguas et al., 2017; Caballero, 2006; Kokotis, 2005).

Currently, the implementation of the proactive approach is promoted by the vascular access team, the infusion team or the peripherally intravenous central catheter (PICC) team (Blackburn, 2014; Harrold, Martin, & Scarlett, 2016; Kokotis, 2005). These teams are usually composed of nurses who are specialised in VAD insertion, management and intravenous therapy. The Intravenous Nurses Society (INS) claims that nurses are the most appropriate healthcare providers to select the correct VAD. Furthermore, the INS has recommended that nurses be included in the multidisciplinary vascular access team because they are the principal users of VADs (Intravenous Nurses Society, 2016; Sturtevant, 2002).
Considering the wide variety of IV therapies, patient differences and the complications that may result from using inappropriate infusion devices, a proactive approach is necessary to evaluate and ensure that the best VAD is available for the right patient at the right time (Jackson, Hallam, Corner, & Hill, 2013; Moureau et al., 2012). A proactive approach to preserving vessel health involves the evaluation of the patient’s opinion, treatment characteristics and VAD characteristics (Moureau et al., 2012). This approach also improves the patient’s satisfaction with the treatment (Hawes, 2007; Moureau et al., 2012). An example of patients indicating satisfaction with the use of a specific VAD for a specific purpose appears in a study by Harrold et al. (2016). Patients who underwent chemotherapy treatment after the placement of a PICC were satisfied with their care process because infusion pain was avoided, and their distress was decreased because the entire treatment was simplified (Harrold et al., 2016). In addition, the correct use of materials and resources, the nurses’ time management and the costs associated with complications or length of stay have all been found to benefit from the proactive approach (Armenteros-Yeguas et al., 2017; Hawes, 2007; Moureau et al., 2012).

Inspired by the proactive approach, a multidisciplinary group of experts developed the Vessel Health and Preservation (VHP) Programme (Moureau et al., 2012). The purpose of this programme is to ensure the selection of the correct VAD during the first 24 hours of hospitalisation or when the patient enters the healthcare facility, followed by the placement of an appropriate device within 48 hours. The VAD must then be evaluated daily to determine the health of the patient’s vessels as well as the need to maintain the VAD at the site (Moureau et al., 2012). The VHP programme has been associated with reduced lengths of stay and reduced delays in administration. The programme also encourages the timely removal of any intravenous catheter when it is no longer needed (Moureau et al., 2012).
Moreover, because it is standardised, the VHP programme promotes vessel preservation, particularly through the strategic selection and management of the right VAD. Consequently, consensus has been established among a variety of HCPs, including nurses, doctors, and pharmacists as well as the vascular access team, the infusion team and the PICC team, regarding the use of this approach (Moureau et al., 2012).

Although many advantages are related to the use of the proactive approach, the reason to adopt VHP in clinical practice is not well defined in the published literature. The present review focuses on studies that report the maintenance and preservation of vessel health and provides new information for practice, education and research strategies, helping HCPs improve patient outcomes.

Aims

The aim of this integrative literature review is to describe and synthesise the current knowledge on the maintenance and preservation of vessel health among inpatients who need the placement of central or peripheral devices. Thus, the following research questions are posed:

1. What patient factors are related to VHP?
2. What factors related to IV therapies and devices are linked to the preservation and maintenance of vessels?
3. Which HCPs are involved in vein preservation and maintenance and what are their roles?
4. What outcomes are improved by using the proactive approach instead of the traditional one?
Methods

Design

We conducted the review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (see Supplementary File 1) (Moher, Liberati, Tetzlaff, Altman, & Prisma Group, 2009) and Cooper’s five-stage method (Cooper, 1982, 1998) as modified by Whittemore and Knaf (Whittemore & Knaf, 2005), which includes the following steps: problem identification, data collection, evaluation of data (quality appraisal), analysis and interpretation of data (data abstraction) and presentation of the results (Cooper, 1982, 1998; Russell, 2005; Whittemore & Knaf, 2005). At the beginning of the review process, we identified the research problem by conducting a preliminary literature search using the search term “proactive vascular approach”. We did not undertake a formal meta-analysis because of the heterogeneity of the study methods. We chose to conduct an integrative review to consider studies using a variety of methodologies and to present a comprehensive understanding of the phenomenon of vessel health preservation.

Data collection

We collected data from the electronic databases PubMed, CINAHL, Scopus and Cochrane Library (Figure 1). We formulated the search terms based on the preliminary literature search. The search terms consisted of combinations of free words and indexed terms concerning VADs and vessel health preservation (Figure 1). We limited the search to studies published between 1948 and July 2017 (Figure 1).
We included studies that focused on the preservation of vessels and had as the study population adult patients who required the placement of a central or peripheral access device. We included only peer-reviewed, original empirical and theoretical studies. We excluded studies that analysed the construction of an arteriovenous fistula for haemodialysis and those in which patients who were disabled or had dementia were the primary focus and VAD was the secondary focus (Nguyen & Sidawy, 2017).

**Search outcome**

Our electronic search yielded 588 studies. We selected studies in four stages based on their titles (n = 87), abstracts (n = 48), full texts (n = 9) and by applying the inclusion and exclusion criteria. The search was conducted by three reviewers (JF, GV, FC). Of the 588 studies, nine were selected for the present review.

**Quality appraisal**

We evaluated the quality of the nine studies using six descriptive criteria: clearly described aim and objectives; adequate study design; appropriate research method; explicit theoretical framework; description of limitations; and discussion of implications (Bowling, 2014; Gazarian, 2013). The six criteria were appraised according to a three-point scale: ‘good’, ‘poor’ and ‘not reported’. The results showed that all articles described the aims and objectives, explained the theoretical framework and discussed their implications. The design, research methods and limitations were described in only three articles. One paper reported the design and research method but only briefly discussed the study’s limitations (Table 1).
Data abstraction

The fourth stage was the data analysis and interpretation (Cooper, 1982, 1998). Initially, we read the full texts of the included articles to obtain an overview of the content. The data were then extracted and tabulated according to the author(s), year, country, aim, method, the characteristics evaluated and the main findings (Table 2).

Data synthesis

In the final stage, all results relating to elements of the VHP programme were analysed (Cooper, 1982, 1998; Russell, 2005; Whittemore & Knafl, 2005). The researchers (JF, FB, GV, and EF) conducted a thematic analysis to synthetize and summarize the factors and findings obtained from the literature on the maintenance and preservation of vessel health. The data were categorised into themes according to the research questions and analysed collaboratively by all four researchers.

Results

Characteristics of the selected papers

Eight of the nine papers included in the review were theoretical. The remaining pilot study was conducted in a haematology ward that used the VHP programme (Weston, Nightingale, Loughlin, & Ventura, 2017). All nine studies were published between 1999 and 2017 (Table 2). Four of the studies were conducted in the US (Blackburn, 2014; Hadaway, 1999; Moureau et al., 2012; Moureau & Chopra, 2016), and five were conducted in the UK (Hallam et al., 2016; Jackson et al., 2013; Weston et al., 2017).
Two theoretical papers described the traditional approach to VAD and the new proactive approach (Blackburn, 2014; Hadaway, 1999). Moureau et al. (2012) described the development of the VHP programme as well as the steps taken to ensure, select and manage the right VAD for the right patient at the right time. Jackson et al. (2013) and Hallam et al. (2016) described the adaptation of the VHP programme to the UK healthcare system, in which the original US programme was modified according to the guidelines already published in England. Moureau and Chopra (2016) developed the Michigan Appropriateness Guide for Intravenous Catheters (MAGIC), which includes a practical list of indications, both appropriate and inappropriate, to guide the selection of the right VAD. Weston et al. (2017) conducted a unique study that evaluated the VHP programme, tested the model developed in 2012 and conducted a preliminary pilot study. Shaw (2017a, 2017b) reiterated the benefits of using the VHP programme and described tools that were useful in cases of difficult cannulation, emphasising the importance of HCPs’ knowledge and skills in the assessment and placement of VADs.

The data synthesis revealed four categories related to the VHP programme: patients’ related factors, IV therapies and device factors related to VHP, the HCPs involved in the proactive approach and their roles, and the advantages of using the proactive approach compared to the traditional approach.

**Patient factors related to VHP**

In each study, patients were involved because the purpose of the VHP programme includes the early assessment of patients’ vessels, the limitation of damage and complications, the overall improvement of patient outcomes, safety and satisfaction and the
avoidance of vein depletion (Hadaway, 1999; Hallam et al., 2016; Moureau et al., 2012). In fact, a statement that appropriately synthesises the purpose of the VHP programme is ‘to provide the right line for the right patient at the right time’ (Jackson et al., 2013; Moureau et al., 2012; Weston et al., 2017).

Patient evaluation was the first step in the VHP process (Jackson et al., 2013; Moureau et al., 2012). Using a peripheral vein assessment tool, experienced nurses evaluated vessel quality, thus improving the overall patient outcome and the timing of care delivery (Jackson et al., 2013). A visual inspection, followed by an ultrasound to determine vessel health and integrity, was found to be the best method to evaluate vein quality, especially in patients with poor skin quality, veins difficult to cannulate, or a lack of adequate sites for VAD placement (Blackburn, 2014; Jackson et al., 2013; Shaw, 2017a). In addition, the HCP sometimes used a vacuderm tourniquet, which is a single-use system in which a dome is pumped eight to ten times, improving the tourniquet effect and producing negative pressure in the patient’s vessels (Shaw, 2017a). It was also recommended that the vascular access specialist evaluate the anatomy of the veins (Shaw, 2017b). Many guidelines and recommendations were available from manufacturers and societies. A widely used guideline was developed by the INS and is a valid tool for helping the HCP identify the site of access with the lowest risk of infection and complications. The guideline also provides standards of practice for each device (Intravenous Nurses Society, 2016).

Furthermore, the primary diagnosis of the patient is important because it is related to the type and length of therapy and possible complications, such as the risk factors for catheter-related infection or thrombosis (Hadaway, 1999; Moureau & Chopra, 2016). In addition, the studies emphasised the need to consider relevant diseases and comorbidities,
such as hyper/hypo-coagulopathy states (e.g., antithrombin III deficiency, protein C and S deficiencies and activated protein C resistance), severe respiratory dysfunction, immunosuppression, diabetes, risk of local or bloodstream infections, cancer, mastectomy, trauma, pregnancy, parturition, use of oral contraceptives or steroids, nutritional and fluid imbalances, obesity, kidney disease and congenital conditions (Blackburn, 2014; Hadaway, 1999; Jackson et al., 2013; Shaw, 2017a). Indeed, some allergic reactions should also be considered. Among the allergies, those to iodine or VAD material (polymer or plastic) might produce an immune response. Allergies to tropical fruit (e.g., kiwi, avocado and banana) might indicate cross-sensitivity to latex (Hadaway, 1999). The patient’s history of previous VAD placement could reveal other aspects that should be assessed, such as the previous number and type of VADs (Hadaway, 1999; Shaw, 2017b) and patient preferences, needs, lifestyle, body image and cognitive function (Hadaway, 1999; Hallam et al., 2016; Moureau et al., 2012).

**IV therapies and device factors related to the preservation and maintenance of vessels**

After the patient assessment, the second step in the VHP programme was the selection of the VAD based on the IV therapy. The US VHP programme provides a complete list of IV therapies according to the VAD characteristics (Hallam et al., 2016; Moureau et al., 2012). In contrast, the UK VHP programme includes a list of specific IV therapies that are stratified by clinical setting, but it does not include many drugs sold outside the UK. To adapt the US programme to the UK programme, an English multidisciplinary team recruited pharmacists to provide an updated list of drugs (Hallam et al., 2016; Jackson et al., 2013).
The following characteristics of the infusion therapy were evaluated: pH, osmolality, dose, frequency, indications and contraindications, side effects, effects of the IV therapies on the vessels, solution used for dilution, viscosity, temperature, rate, volume of dilution, speed of infusion, length of treatment and drug compatibility (Hadaway, 1999; Hallam et al., 2016; Moureau et al., 2012; Moureau & Chopra, 2016; Shaw, 2017b). Based on this information, Moureau and Chopra (2016) developed MAGIC, providing a practical list summarising the appropriate and inappropriate indications to guide the choice of the right VAD—a peripheral catheter, midline, PICC, non-tunneled or tunneled catheter or port (Moureau & Chopra, 2016).

Regarding the decision process for placing the right VAD, Hadaway (1999) and Blackburn (2014) identified other aspects for evaluation prior to placement, including the device characteristics, such as material, tip location, diameter, lumen, size, valves and method of insertion. Regarding the material, polyurethane catheters are softened by body heat, allowing the toleration of higher infusion pressure, the use of smaller devices and avoidance of the occlusion of vein flow rate. Silicone catheters soften and show a low risk of irritation and perforation but may complicate the insertion of the device (Blackburn, 2014; Hadaway, 1999).

Regarding the number of VAD lumens, considering the ways in which the same lumens are linked was important to the therapy protocol. Although multiple lumens are related to a higher risk of infection, commercialised VADs with one, two, or three lumens are available, allowing multiple compatible therapies and avoiding the necessity of using multiple insertion sites/devices (Hadaway, 1999; Moureau et al., 2012). Furthermore, some devices have valves in the proximal or distal parts or in both parts, which remain open in

This article is protected by copyright. All rights reserved.
cases of infusion or aspiration and close when no pressure is applied. In Hadaway (1999), these valves decreased the risk of air emboli.

Another important assessment should be performed to evaluate the tip location of VADs, as a central line is appropriate for infusion of vesicant and irritant IV therapies (Blackburn, 2014; Moureau & Chopra, 2016; Weston et al., 2017). Research has demonstrated a lower risk of thrombosis when the tip is situated at the superior vena cava (Hadaway, 1999). When the tip is in the midclavicular location, there is a higher risk of thrombosis than when it is situated in the central VAD. These catheters are a valid choice for patients with poor veins or anatomical and pathophysiologic conditions (i.e., those described in the patient factors related to VHP paragraph) (Hadaway, 1999).

Moreover, the method of insertion could influence some outcomes. According to Hadaway (1999), a break-away needle might damage the catheter during insertion and lead to potential emboli when the VAD is removed. Other considerations included the diameter or internal lumen of the VAD and the size of the device, which is related to the internal catheter volume, flow rate and pressure rating (Blackburn, 2014; Hadaway, 1999). The goals of the VHP programme are to select the device with the smallest suitable size for the specific conditions and the smallest number of lumens to guarantee the best treatment plan (Moureau et al., 2012). These considerations are reflected in MAGIC, in which a small PICC size with a minimal number of lumens is suggested to reduce the risk of deep vein thrombosis (Moureau & Chopra, 2016).
The HCPs involved in vein preservation and their roles

The HCP is directly involved in assessing, placing and managing the VAD that is right for the patient (Blackburn, 2014). The presence of a multidisciplinary team with a high level of knowledge and expertise in vascular access is essential to implement the VHP programme (Hadaway, 1999; Moureau et al., 2012; Shaw, 2017b). HCPs with poor knowledge of VAD and vein anatomy limit the accurate assessment of the patient’s VAD needs and the benefits of the VHP programme (Shaw, 2017b). Under the VHP programme, the vascular access team should be composed of nurses, doctors, pharmacists and even radiologists (Hadaway, 1999; Hallam et al., 2016). These team members should have the knowledge, attitude and skills that are required to guide patients in choosing the right VAD (Hadaway, 1999; Moureau et al., 2012). In the proactive approach, patients are active participants in choosing the device and learning how to live with it (Hadaway, 1999; Jackson et al., 2013).

Hadaway (1999), Jackson et al. (2013) and Weston et al. (2017) reported an increased number of advantages when nurses were directly involved in the proactive approach. The findings indicated that nurses are the appropriate HCP to preserve vessels because they evaluate vein quality at patients’ admission to the hospital and then refer patients to the vascular access specialist for the placement of a VAD (Blackburn, 2014; Hadaway, 1999; Moureau et al., 2012; Weston et al., 2017). Currently, in the UK, there are various models of vascular access provision. However, the VHP programme is the solution to standardising and homologating the approach to placing a device (Jackson et al., 2013). After the placement of the device, nurses re-evaluate the VAD daily for possible complications (Hadaway, 1999; Jackson et al., 2013). Moreover, nurses and other HCPs should educate patients on living with and adapting to the VAD (Hadaway, 1999). For this purpose, they could use
technologies such as videos and teach useful strategies to patients, thus overcoming the learning barriers and improving patients’ perceptions of the device (Hadaway, 1999).

**Advantages of the proactive approach compared to the traditional approach**

The literature review revealed that all the studies considered the inappropriateness of the *traditional approach* when applied in routine healthcare delivery. This approach consists of the cannulation of peripheral veins, which is performed blindly until the procedure is successful. Drugs are then administered through the cannula. Because this approach does not consider patients’ needs, it should be replaced by a new proactive approach (Blackburn, 2014; Hadaway, 1999; Hallam et al., 2016). In fact, the VHP programme offers a standardised approach to resolving this problem by ensuring the proactive assessment of vessel health and the timely placement of the right VAD for the right patient (Jackson et al., 2013; Moureau et al., 2012). Furthermore, this approach is not focused on gaining the best outcome during a single hospital stay; instead, it preserves the vessels for the future needs of the patient (Hallam et al., 2016; Jackson et al., 2013; Moureau et al., 2012; Shaw, 2017b).

Patient outcome and satisfaction are improved by the implementation of the VHP programme. This programme ensures the delivery of all prescribed treatments, the safe management of VADs, the use of specialised vascular access teams, and the application of guidelines and recommendations. Furthermore, it guarantees the assessment of vessel health upon admission, the placement of a VAD within 24 to 48 hours to promote reliability and consistency of access, and daily assessment of the device’s suitability (Moureau et al., 2012). The VHP programme also reduces length of stay, decreases pain during the device’s placement, limits attempts to cannulate a vein, and reduces the risk of infection and other possible complications (Moureau et al., 2012). This approach also reduces time wastage in
nursing delivery of IV therapies and promotes the optimal use of VADs, thus reducing the costs related to unsuccessful attempts at VAD placement (Hadaway, 1999; Hallam et al., 2016; Jackson et al., 2013). The VHP programme also reduces the time before a vascular access specialist is consulted for patients with poor vein quality (Hadaway, 1999; Hallam et al., 2016; Moureau et al., 2012).

The effects of the VHP programme were confirmed in a pilot study conducted by Weston et al. (2017). In their study, the mean number of admission-to-referral days for an alternative VAD was reduced from 9.4 to 6.6 days (Weston et al., 2017). The findings of this study also showed decreased use of a cannula (31.3%) and its related costs by 30.2% (£2273.22), because ward nurses had autonomy to refer patients directly to the IV team in cases of difficult access placement. (Weston et al., 2017).

**Discussion**

This integrative review showed that the VHP programme represents an alternative to the *traditional approach* to selecting and managing a VAD in a healthcare setting, considering that patients often receive multiple sticks to place a peripheral cannula until all arm vessels are exhausted. The findings indicated that the *proactive approach* improved patient outcomes in addition to benefitting HCPs, especially the nurses who used the devices, reducing the number of attempts needed to place a VAD and limiting wasted time in nursing care. The proactive approach was shown to reduce the costs related to the materials used during attempts to cannulate a peripheral vessel. The US VHP programme was improved and adapted by Jackson et al. (2013) and Hallam et al. (2016) to the UK healthcare system to establish a homogenous and standardised approach that is valid in the UK.
This review revealed several relevant findings. The characteristics of the VHP programme were described: patients, IV therapies and device factors related to VHP, the HCPs involved in the preservation and maintenance of vessels and their roles, and the outcomes improved by using the proactive approach. Patients played an essential role in the proactive approach because they were active participants in choosing the device, and the evaluation of patient factors, from their diagnosis to their needs, was the first consideration (Blackburn, 2014; Hadaway, 1999; Jackson et al., 2013). Two types of factors were related to the patients: clinical and individual.

The first category includes medical aspects, such as the primary diagnosis, allergic reactions and the patient’s disease history. Many studies evaluated these aspects and identified the relationship between them and the choice of VAD (Blackburn, 2014; Hadaway, 1999; Jackson et al., 2013). In contrast, some individual aspects were related to patients’ needs or preferences and the ways in which the patient’s lifestyle and body image would be impacted by the placement of a VAD. However, these aspects were only briefly described, and they were not evaluated. Only Jackson et al. (2013) described a tool for investigating and directly asking patients about their habits. Further studies should evaluate the degree to which individual aspects influence a patient’s choice of the best VAD (Jackson et al., 2013).

The second question that arose from the findings of this review concerned the HCPs that should be involved in the VHP programme. The findings confirmed that the proactive approach obtained the best outcomes when each HCP conformed to the same maintenance and preservation of vessel health programme. Hence, nurses, doctors, pharmacists and radiologists should collaborate and communicate to guarantee the early assessment of patients’ vessels and the timely placement of the right VAD within 24 to 48 hours of
hospitalisation (Moureau et al., 2012). Therefore, a multidisciplinary team is a necessary part of the entire VHP programme because the team adheres to the model and team members share knowledge, attitudes and skills with other HCPs, which promotes the dissemination of the proactive approach. The results of Weston et al.’s (2017) pilot study showed that this approach helped nurses in a haematology ward, who became promoters of the VHP programme and referred patients with poor quality veins to a specialised team.

Regarding HCPs, nurses should be considered essential in the implementation of the VHP programme. The role of nurses in the care process is significant because they spend more time with the patients than other HCPs, establishing a relationship and helping them relax, pass the time during the hospital stay and forget their medical problem (McCabe, 2004). In the proactive approach, the role of nurses was significant beginning with the admission of patients to the healthcare system because they assessed vein quality using the tool developed for the VHP programme. Nurses were the principal users of the VAD, and they supported patients in choosing the device based on their needs and preferences (Hadaway, 1999; Jackson et al., 2013; Moureau et al., 2012; Weston et al., 2017). Nurses also supported and guided patients in the process of adapting to the VAD (Hadaway, 1999). Their role and importance in the VHP programme is reflected the guidelines of the INS, which emphasise that nurses are the most appropriate HCP to help the patient select the appropriate VAD. For this reason, the presence of nurses on a multidisciplinary vascular access team is needed.

Despite the many advantages of the VHP programme for patients, the healthcare system and the HCP, it has not been widely implemented. This review revealed that the main difficulty was identifying healthcare habits and attitudes. Future research should evaluate possible strategies for implementing the proactive approach in clinical practice, testing it.
from the HCP and patient perspectives. Several findings showed that the VHP programme was the best choice for patients because it guaranteed the right VAD at the right time and preserved vessel health (Jackson et al., 2013; Moureau et al., 2012). The VHP programme also guided HCPs in the decision process before and after the placement of the VAD and ensured the correct management of the VAD. Nevertheless, no study included in this integrative literature review discussed the reasons for the application of the traditional approach instead of the proactive approach or vice versa. Therefore, future research should be conducted to evaluate these reasons to confirm the true efficacy of applying the proactive approach in clinical practice in terms of optimizing the care process and patient outcomes.

Limitations

The limitations of this integrative review concerned the search strategies used and the heterogeneity of the selected studies (Whittemore & Knafl, 2005). A clear limitation of this review was the small number of included papers, most of which were theoretical, precluding definitive conclusions regarding the proactive approach. To minimise limitations, the authors followed the guidelines for performing an integrative review (Whittemore & Knafl, 2005). To avoid bias, the year and language of publication were not restricted. However, the nine studies included in this integrative review were published and available in English. A further limitation was imposed by the choice to not restrict the study period, because older studies may be less accurate and may have influenced the results of this review.
Conclusions

The VHP programme is a proactive approach to choosing, placing and managing the correct VAD for the right patient at the right time within 24 to 48 hours of hospitalisation. Based on the findings of this review, the proactive approach should replace the traditional approach in which therapies are administered through a peripheral vein until the patient’s vessels are exhausted. The new approach should involve each HCP, especially nurses, because they directly use VADs and support patients in the decision-making process. Nevertheless, an instrument that includes and evaluates all variables of vessel health and preservation is still lacking.

Relevance to clinical practice

Many advantages of the VHP programme, such as its ability to limit possible damage and complications as well as improve patient outcomes, safety and satisfaction, have been identified. In addition, the proactive approach preserves vessels for future needs, improves the delivery of the prescribed treatment plan, ensures the safe management of VADs, reduces the length of hospital stay, and decreases the risk of infection, complications and pain perceived by patients during the device’s placement and the various attempts to cannulate a peripheral vein. The VHP programme also ensures better use of nurses’ time and VAD material, thus reducing the costs related to unsuccessful attempts. These advantages are achieved with the support of specialised vascular access teams and the involvement of each HCP in the VHP programme.
References


of America, 35(1), 63–8.


**Table 1.** Quality appraisal of the included articles.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aims and objectives clearly described</strong></td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>p</td>
<td>p</td>
<td>g</td>
<td>p</td>
<td>p</td>
</tr>
<tr>
<td><strong>Study design adequate</strong></td>
<td>nr</td>
<td>nr</td>
<td>p</td>
<td>nr</td>
<td>g</td>
<td>nr</td>
<td>nr</td>
<td>p</td>
<td>nr</td>
</tr>
<tr>
<td><strong>Research method appropriate</strong></td>
<td>nr</td>
<td>nr</td>
<td>g</td>
<td>nr</td>
<td>g</td>
<td>nr</td>
<td>nr</td>
<td>g</td>
<td>nr</td>
</tr>
<tr>
<td><strong>Explicit theoretical framework</strong></td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>p</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
</tr>
<tr>
<td><strong>Limitations presented</strong></td>
<td>nr</td>
<td>nr</td>
<td>g</td>
<td>g</td>
<td>p</td>
<td>nr</td>
<td>nr</td>
<td>nr</td>
<td>nr</td>
</tr>
<tr>
<td><strong>Implications discussed</strong></td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
<td>g</td>
</tr>
</tbody>
</table>

**Notes**

Legend Table 1. This table reports the quality appraisal conducted by the authors of the articles included in the integrative review. Scale used to evaluate quality: g=good, p=poor, nr= not reported.
Table 2. Synthesis of the articles included in the literature review

<table>
<thead>
<tr>
<th>Author(s), years, country</th>
<th>Aim</th>
<th>Method</th>
<th>Characteristic(s) evaluated by the model/project</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaw (a) (2017a) UK</td>
<td>Increase practitioners’ knowledge of veins in patients that are difficult to cannulate and emphasise the importance of the VHP programme and vein palpation.</td>
<td>Theoretical discussion, literature</td>
<td>Author describes the benefits of using vein location aids, such as an intravenous eye vein imager and vacuderm tourniquet and reports how to use them. In addition, the author iterates the advantages of using an assessment tool, such as the VHP framework.</td>
<td>VHP is a long-term goal. Using an assessment tool and vein location aids can help healthcare professionals assess veins difficult to cannulate and identify subsequent actions. Using vein imagers improves the success rates of peripheral cannulation and reduces the use of central VADs where they are not indicated. In the decision process, vein palpation helps determine whether cannulation should be attempted.</td>
</tr>
<tr>
<td>Shaw (b) (2017) UK</td>
<td>Develop healthcare practitioners’ awareness and knowledge of the VHP framework.</td>
<td>Theoretical discussion, literature</td>
<td>Author reports the classification of different and available VADs and each step of the VHP programme in the decision process for placing the right device. The factors that healthcare professionals should evaluate in the decision process to place a VAD are the following: anatomy of the veins, use of infrared vein imagers or novel tourniquets; veins to cannulate</td>
<td>Lack of healthcare knowledge limits the assessment of the patient’s vascular access needs and the benefits of the VHP programme, so healthcare professionals are not able to select the best VAD for the right patient at the right time.</td>
</tr>
<tr>
<td>Weston et al. (2017) UK</td>
<td>Examine the impact of the framework in a haematology ward in an acute hospital in the Northwest of England during a three-month pilot study</td>
<td>Pilot study</td>
<td>In the first stage, a multidisciplinary team was established that included an anaesthetist, haematologist, nurses and a vascular access specialist team. A pre-implementation questionnaire was distributed to establish the level of knowledge of the ward staff.</td>
<td>The results showed that 44% (52) of patients should have an alternative VAD, have not had the right line at the right time, and are not in line with the VHP programme. The study allowed 50% of evaluators to access the relevant information on the VHP programme, compared to 20% in the pre-intervention. The mean number of admission-to-referral days for an alternative VAD decreased from 9.4 to 6.6 days, with a 45% (20) increased frequency of ward referrals to the vascular access team. Cannula usage decreased by 31.3% (756), and the related cost decreased by 30.2% (£2273.22). During the pilot, 28% (8) of referrals were made by nurses. Before the intervention, 100% of referrals were made</td>
</tr>
<tr>
<td>Authors</td>
<td>Country</td>
<td>Study Description</td>
<td>Methodology</td>
<td>Findings</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------</td>
<td>------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Moureau &amp; Chopra (2016)</td>
<td>US</td>
<td>Summarise the work and the recommendations of the panel for the Michigan Appropriateness Guide for Intravenous Catheters (MAGIC).</td>
<td>Theoretical discussion, literature</td>
<td>The indications refer to a peripheral catheter, ultrasound-guided peripheral catheter, midline catheter, PICC, non-tunnelled and tunnelled catheter and completely implanted subcutaneous port. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC) is a practical list of indications, both appropriate and inappropriate, to guide selection of the right VAD.</td>
</tr>
<tr>
<td>Hallam et al. (2016)</td>
<td>UK</td>
<td>Develop a decision tree to select the best access device according to the existing guidelines of Epic 2, Epic 3 and the Centre for Disease Control and Prevention.</td>
<td>Theoretical discussion, literature</td>
<td>In the first step, peripheral vessels must be assessed using a tool that describes vein quality on a five grade scale. Then, the drug infusion type must be considered (pH, osmolarity, viscosity, volume of dilution, speed of infusion, and size and fragility of peripheral veins). Other aspects that need to be considered are the patient’s preferences and lifestyle. Finally, re-evaluation of the inserted VAD is performed to determine if the device is still required and identify possible complications. The UK Infection Prevention Society, inspired by the US work of Moureau et al. (2012), produced a VHP framework as a resource to evaluate and choose the best VAD that meets the patient’s needs and preserves veins.</td>
</tr>
<tr>
<td>Blackburn (2014)</td>
<td>US</td>
<td>Describe a new method for selecting a VAD and choosing a proactive approach.</td>
<td>Theoretical discussion, literature</td>
<td>In the first step, the therapy and its characteristics (drug pH, drug osmolarity) are considered. Next, the duration and frequency of therapy and the patient’s condition are rated: clinical conditions, The proactive approach to VHP requires a multidisciplinary team evaluation of the patient, his/her vessels and drug treatment. This approach guarantees vessel preservation.</td>
</tr>
<tr>
<td>Jackson et al. (2013) UK</td>
<td>Describe the reasons for adopting the VHP model in UK healthcare settings.</td>
<td>Theoretical discussion, literature</td>
<td>In the UK, many of the declared aims of the VHP programme are being addressed by the National Institute for Clinical Excellence guidance and the Epic 2 process. The authors plan to develop a toolkit-style approach so that trusts and units will be able to adapt the VHP protocol to the existing service and adopt elements to develop the use of support services.</td>
<td>The UK authors recommend the involvement of various healthcare professionals in the VHP programme because it is most useful in a shared format developed in general units and trusts. Each VHP programme must be adapted and personalised to the infusion therapies used in a country by a multidisciplinary team.</td>
</tr>
<tr>
<td>Moureau et al. (2012) USA</td>
<td>Develop the Vessel Health and Preservation (VHP) programme, which is a standardised approach to vascular access care, to provide the right line for the right patient at the right time. Provide a well-timed and reliable VAD that is individualised for each patient as needed.</td>
<td>The VHP programme is based on a multidisciplinary approach that involves a doctor, nurse, vascular access specialist and radiologist. The programme includes placement and daily assessment of patient’s needs and clinical condition, according to the guidelines published by various organisations. The programme The VHP programme and improves patient outcomes.</td>
<td>The effects of the VHP programme are as follows: effective administration of the treatment plan; vessel health assessment at admission; daily assessment of device suitability and requirement; discontinuation of any intravenous catheter when treatment is complete; reduced length of stay; reduced risks associated with the use of VAD materials.</td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Title</td>
<td>Methodology</td>
<td>Main Findings</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Hadaway</td>
<td>Describe the traditional approach to VAD, which involves several peripheral venepunctures until all veins are exhausted and propose a proactive approach to the insertion of the most appropriate VAD.</td>
<td>Theoretical discussion, literature</td>
<td>The proactive approach ensures that patients experience decreased pain, discomfort, and complications and ensures the better use of human resources and products by healthcare providers. Nurses are the most qualified professionals to select the best VAD for each patient.</td>
<td></td>
</tr>
</tbody>
</table>

Notes

Legend Table 2. This table summarises the articles included in the review according to the author, year, country, aim, method, characteristic(s) evaluated by the model/project and the main findings.

Figure Legends: Figure 1 summarises the integrative review process.
Figure 1: flow diagram of literature searches and selection.

Limitations: Years
Cinahl 1981-2017
Pubmed 1948-2017
Scopus 1960-2017
Cochrane 1993-2017
Search words:
(vascular access device, peripheral OR central/venous/intravenous access/catheter/cannula) AND (vessel health and preservation, proactive approach).

Inclusion criteria:
- Peer-reviewed, scientific paper, original empirical research with a qualitative or quantitative design methodology and theoretical paper;
- focused on VHP;
- adult patients;
- sample of patients needing a central/peripheral access device’s placement.

Electronic searches
(N=588)
Pubmed = 216
Cochrane = 5
Cinahl = 18
Scopus = 349

Excluded based on titles N = 501

Accepted on titles
(N=87)
Pubmed = 30
Cochrane = 1
Cinahl = 10
Scopus = 46

Excluded based on abstract N = 24
Duplicate removed N = 15

Accepted on abstract
(N=48)
Pubmed = 19
Cochrane = 1
Cinahl = 5
Scopus = 23

Excluded based on full texts N = 39

Accepted on full-text
(N=9)
Pubmed = 4
Cochrane = 0
Cinahl = 2
Scopus = 3

Selected full texts N = 9