

Safer patient care through better peripheral intravenous catheter management

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Abstract

A surveillance project was undertaken in 3 medical wards of a teaching hospital in Malta, with the aim of introducing standardised peripheral venous catheter (PVC) care and to reduce risk of infections. Data on 285 patients' with peripheral catheters left in situ for more than 12 hours was collected from October 2010 to February 2011 in two separate surveillance periods; pre and post intervention. In the pre-intervention phase 132 observations of PVC were carried out whereas 153 catheters were observed in the post-intervention phase. Each catheter was assessed for documentation of insertion date, quality of dressing, duration of catheter and Visual Infusion Phlebitis (VIP) score. The intervention consisted of introducing the VIP score document for daily cannula assessments and their duration not exceeding 72 hours. Medical doctors and nurses were offered regular training on the new procedure and the post-insertion care of PVC lines. Other measures included daily assessment of PVC line, weekly audit with feedback to nursing and medical staff. The phlebitis rate fell from 22.7% in the pre-intervention to 6.5% in the post-intervention phase. There was also significant improvement in dressing quality and reduction of PVC duration days. The risk of developing phlebitis was 3.47 times higher in the pre-intervention phase than in the post-intervention (95CI: 1.77-6.84) $p=0.0001$.

The results suggest that a significant reduction in the incidence of inflammation associated with peripheral intravenous catheters may be achieved by performing daily cannula assessments and replacing the catheters after 72 hours.

Key words

CATHETERS – standards; CATHETERIZATION, PERIPHERAL – adverse effects; PHLEBITIS; THROMBOPHLEBITIS

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Introduction

Peripheral venous catheterization is the most common procedure in hospitalized patients. Notwithstanding substantial clinical experience with PVC care there is considerable morbidity associated with the use of these catheters.¹ PVC related infections start off with local skin inflammation advancing to cellulitis or even tissue necrosis which may necessitate hospital readmission for surgical treatment.² PVC bacterial colonisation increases when catheters are left in situ for longer than >72 hrs.^{3,4} Infections of the bloodstream can occur in 0-0.2% of cases with resulting morbidity and extended length of hospital stay.^{2,5} In our institution, between January 2010 and April 2011, 30% of all meticillin-resistant *Staphylococcus aureus* bacteraemias were associated with PVCs (unpublished data).

The aims of this study were to assess the post insertion care of peripheral intravenous catheters and identify the phlebitis rate in a before-and-after interventional study. This study reports the assessment results of 285 peripheral intravenous catheters using the Visual Infusion Phlebitis (VIP) score as the measure determining when a peripheral inserted catheter should be removed.

Methodology

The study was undertaken in the acute general hospital in Malta, consisting of 825 beds, in three general medical wards. The bed compliment equals to 24 beds for every ward included in this practice improvement research. The average percentage bed occupancy in the three medical wards is 96.5%. Between October 2010 and February 2011, 285 patients with peripheral cannulas were assessed visually by an infection control nurse to determine the degree of associated erythema, or vein occlusion. The study consisted of a pre-and-post intervention phase.

Pre Intervention Phase

In the pre-intervention phase the audits were conducted weekly and staff was not informed of the purpose of the audit. No patient was audited on more than one occasion unless a new catheter had been inserted in a different peripheral site. Data collection included duration, VIP score and dressing quality. Documentation targeting the insertion and removal of peripheral lines was inexistent at the pre-intervention

stage. Moreover, regular daily assessment of the PVC lines was not a requisite.

Phlebitis was diagnosed by the presence of at least two of the following signs on examination of the catheter insertion site: local pain or tenderness, localised swelling, redness or warmth, or cord induration at the catheter trajectory. The VIP score is widely accepted as a tool of choice for monitoring of PVC sites.⁶ The VIP score provides the practitioner with a tool that can describe the condition of the site. It also promotes an action related to the result of the observation such as cannula removal. The VIP score helps for the assessment and documentation. Healthy sites which show no signs of phlebitis they will be described as 0 on the VIP score. If only pain or redness exists near the cannula site a VIP score of 1 would be documented necessitating vigilance towards the cannula site as the site might be demonstrating early signs of phlebitis. A VIP score of >1 would indicate the development of phlebitis and cannula removal must be completed.⁶ At the pre-intervention stage the peripheral catheters were left in place unless a complication was believed to be present. The duration of PVC could only be approximated following consultation with the medical notes and by questioning nurses, doctors and the patient. Dressing quality was assessed during audits for appropriate adherence to the skin with no loose endings and accessible port beneath the dressing and if dressing were found to be soiled or not. Good quality dressing were scored as 1 whereas compromised quality with any of the above mentioned criteria were scored 0 in Microsoft Excel.

Intervention Phase

The peripheral cannula assessment document was compiled by the hospital's infection control unit and approved by the hospital's infection control committee as a standardized document to be used across all hospital wards. The document consisted of cannula insertion and removal details, the visual infusion phlebitis (VIP) score guide and documentation table for daily assessment during the three days that cannula should be left in situ. The innovative guideline envisaged for peripheral catheters to be removed after 72 hours. PVC could be left up to 5 days only in those cases where ease of cannulation was compromised. Medical doctors had to assess and document a valid rationale for when cannula

duration could be extended for a maximum of 5 days. Phlebitis was defined as a VIP score >1 . This degree of phlebitis should trigger removal of the peripherally inserted intravascular line.^{6,7}

Routine practice in the authors' institution was for junior doctors to perform the procedure of intravenous cannulation. Educational sessions were organized for 80 newly qualified doctors during their induction programme based on practical hands-on workshop on IV cannulation with emphasis on closely monitoring the insertion sites and the continuous assessment of the need for cannula. The peripheral cannula assessment document was also introduced during the educational sessions.

Nursing staff were entrusted the responsibility of conducting the peripheral cannula assessment and documenting the VIP score once daily on a regular basis. Initially, meetings were held with ward managers with educational information of the initiative to prevent intravascular device infections through the implementation of the VIP document and daily cannula assessment from the nursing staff. Objectives were set with approved dates to deliver educational sessions to all nursing staff and initiation of the practice change. Educational sessions were delivered for all staff in the medical wards ($n=45$) to introduce the new system of documentation and daily assessment of PVC lines based on the VIP scale.

Post Intervention Phase

Subsequent to the educational sessions, the implementation of the new set of guidelines took place. The infection control nurse visited the three medical wards on a daily basis during the implementation week so as to facilitate the change process and help clarify any uncertainties. In the post-intervention phase all PVC insertions and removal had to be documented. Nurses were responsible for performing the cannula assessment on a daily basis; however it was not within the scope of this study at that point in time to assess compliance with the new procedure. This improvement of practice pilot study assessed outcomes rather than processes. PVCs were reinserted by medical doctors if intravenous therapy was to be continued for longer than 72 hours. During this pilot period the VIP score documentation forms were handed in to the Infection Control Unit for auditing

purposes once completed. Moreover, from December 2010 to February 2011 regular weekly performance audits were undertaken by infection control nurse, where PVCs were continuously observed and VIP scores compared to the newly introduced cannula assessment document. Dressing quality and cannula duration was also monitored. Continuous reminders and reinforcement from ward managers' and from the infection control team members were necessary to attain ownership of the new practice.

Succeeding the post-intervention phase, feedback sessions were provided for both medical and nursing audience. Collated and analysed data were presented to individual wards and to the three medical wards collectively. Constructive feedback received from ward staff during the pilot period was taken in consideration and necessary improvement modifications to the original VIP score template were completed. Moreover, the meetings organized with ward managers and senior doctors provided strong support to take this initiative forward for its implementation across other hospital wards.

Analysis

The coded data from the observations were entered into Microsoft Excel and analysed using MedCalc. Before and after Student's *t*-test was used to compare the groups for continuous variables. The Chi Square Test was used to determine the existence of a significant association between the groups. The $P < 0.05$ was considered significant.

Results

Data on 285 peripheral catheters left in situ for more than 12 hours was collected from October 2010 to February 2011 in two separate surveillance periods. In the *pre-intervention* phase, October to December 132 observations of PVCs were undertaken in the three general medical wards: Ward 1 ($n=25$), Ward 2 ($n=60$), Ward 3 ($n=47$). In the *post-intervention* 153 catheters were observed: Ward 1 ($n=39$), Ward 2 ($n=91$), Ward 3 ($n=23$).

A significant statistical difference was identified $p < 0.001$ in the comparison of average PVC duration in the pre-intervention phase: Ward 1 = 3.64, Ward 2 = 3.08, Ward 3 = 4.89 days and the post-intervention phase: Ward 1 = 2.43, Ward 2 = 2.09, Ward 3 = 3.08

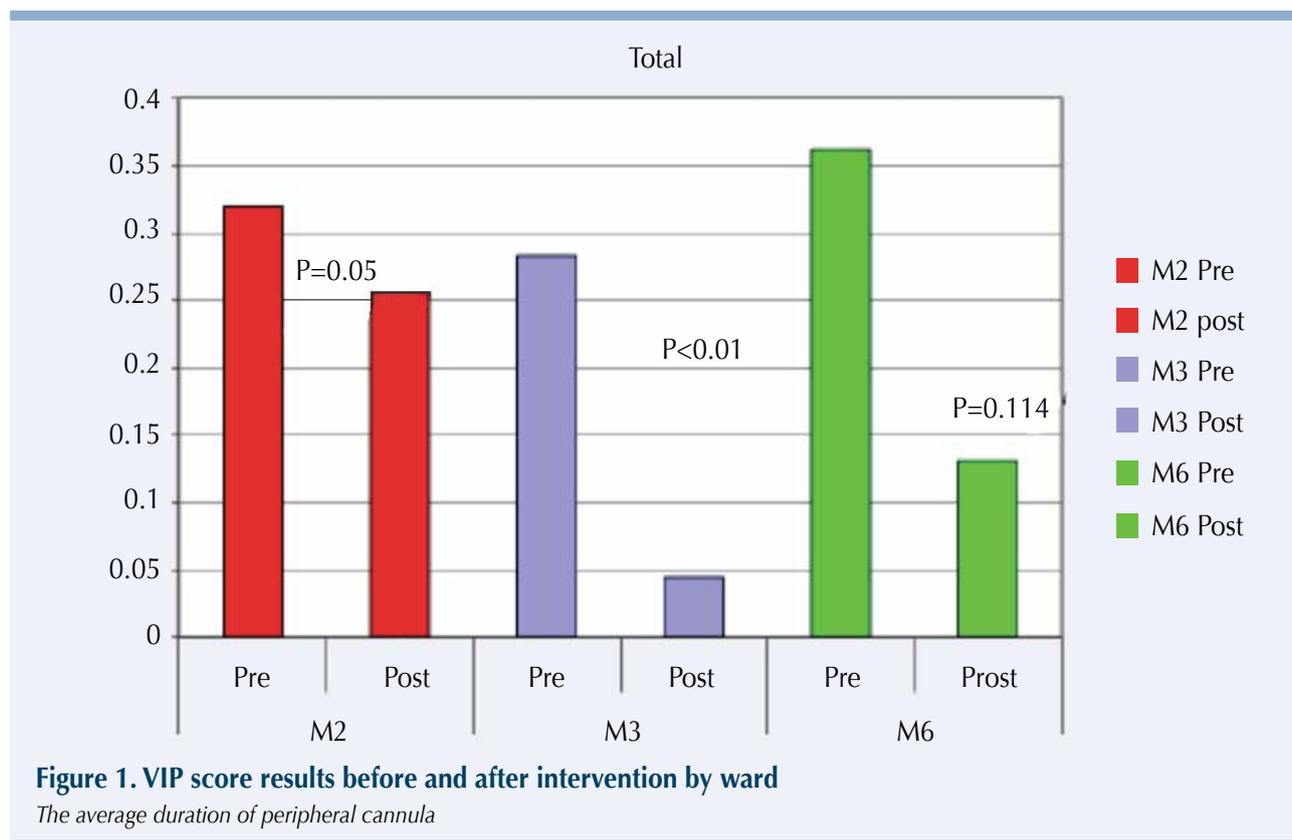
days. The mean for satisfactory dressing quality differed between the two study periods Ward 1= 0.6, Ward 2= 0.5, Ward 3=0.4 whereas after the intervention phase Ward 1=0.82, Ward 2=0.74, Ward 3=0.82 where $p=0.082$. The average of VIP score by ward was significantly different between the 2 study periods, Ward 1 (pre= 0.32, post= 0.24) $p=0.05$; Ward 2 (pre= 0.28, post= 0.04) $p<0.01$; Ward 3 (pre= 0.36, post= 0.13) $p=0.114$ (c 1).

The rate of phlebitis associated with peripheral intravenous catheters decreased significantly throughout the study period (Fig 2). There was significant change in the patient or catheter data between the two surveillance periods. In the pre-intervention phase there was a total of 30 patients' who were identified to have a Visual Infusion Phlebitis score one or greater than one. Nonetheless, in the post-intervention phase where daily cannula assessments were introduced and cannulae were not left in situ for longer than 72 hours VIP score ≥ 1 dropped to 10. The phlebitis rate fell from 22.7% in the pre-intervention to 6.5% in the post-intervention phase $p<0.001$. The risk of developing PVC line infections was 3.47 times more in the pre-intervention phase, as compared to the post-intervention (95CI: 1.77-6.84) $p=0.0001$.

Discussion

As intravascular device-related infections are increasingly prevalent amongst hospitalised patients, the impact they have on patient's outcomes is fundamental necessitating new preventive strategies to emerge.⁸ The use of PVC lines is associated with an underestimated risk of vascular device-related blood stream infections (BSI) which can originate from colonization of the catheter or contamination of the fluid at time of insertion or throughout manipulation of the catheters.⁵

This pilot study undertaken in the acute general teaching hospital in Malta over two periods made possible the identification of phlebitis rate, as well as the introduction of standardized care in the maintenance of peripheral intravenous cannula. The insertion of peripheral IV cannula upon hospital admission is a routine practice at our accident and emergency department. The procedure is carried out for every patient being admitted. There was no standard documentation of peripheral intravenous cannula details and regular cannula site assessment documentation was inexistent. A significant change that has been introduced within Mater Dei Hospital following successful completion of this pilot study with the approval of the hospital's



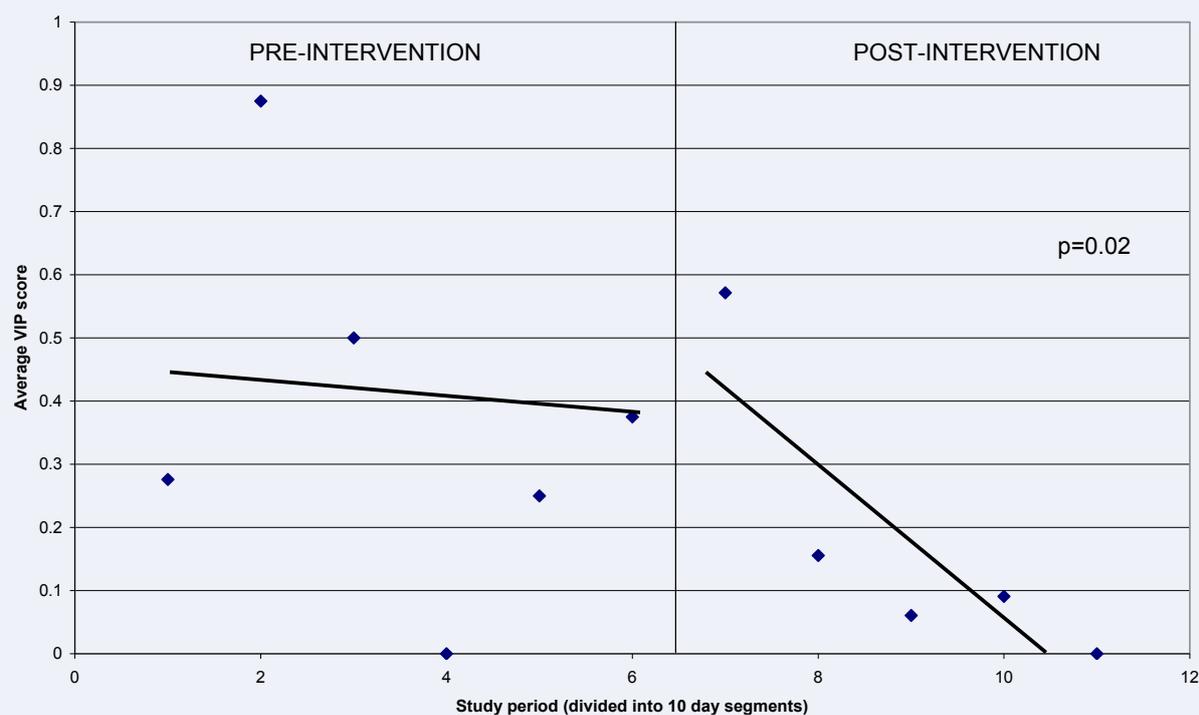


Figure 2. Average VIP Score over study period. Combined results from all the three wards

Infection Control Committee is that of having rolled out across the hospital a standardised document for any PVC insertions with daily VIP score assessments that ultimately aim at improving patient care outcomes. This highlights the importance of having a consistent hospital-based approach towards patient safety such as care of PVC lines so that it can be continued when patients are transferred between wards. VIP score assessment has since been fully implemented in the three medical wards where this study was piloted and further work is currently being done for its successful implementation across the hospital during year 2011.

Similar to other reports the phlebitis rate of 22.7% in the pre-intervention fell to 6.5% in the post-intervention phase.^{4,9} The significant decrease in phlebitis rate and compliance with PVC documentation is linked to various factors; of these, involvement of all ward staff nurses and doctors, regular PVC audits with feedback and ownership of nursing officers of the process. In line with these study findings, a steady improvement in compliance with PVC bundle was documented by Boyd et al by displaying performance feedback results in real time and discussions with staff.¹⁰

Before this pilot study was undertaken, duration of PVC lines left in situ varied across hospital wards from 3 to 14 days. Patent catheters were not being removed unless clinically indicated and many of them were left in situ for the 'just in case' circumstance even if no intravenous therapy was needed, this phenomenon is documented elsewhere in literature.¹² Since PVC were not monitored daily, cannula dressings were left soiled and detached with the entry point left exposed, permitting bacterial migration between from the interface the catheter and the patient's skin. A variety of methods were used to secure the PVC including bandages and adhesive tape.

The findings from a recent systematic review recommend that PVC are changed only if signs of complications are present as there is no decisive evidence of benefit in changing lines routinely every 72-96 hrs.^{10,13} Conversely, some evidence suggests that the incidence of phlebitis (3-5%) and bacterial colonization of PVCs augments for lines left in situ >72 hours.^{3,14} A randomised control trial conducted in the United Kingdom compared outcomes where the PVC was either routinely replaced or changed if clinically indicated. Routine change of PVC resulted

in a significant reduction in the frequency of phlebitis. Nevertheless, the study has been critiqued for the small sample size.¹⁵

Similarly, other authors found a direct relationship between inflammation and PVCs with a duration of longer than 48 hrs ($p < 0.01$).¹² Moreover, changing our hospital policy to replace catheters every 72 hrs would bring the practice in adults in line with recommendations from the Centers for Disease Control and Prevention so as to limit the potential of line infections.¹³

Furthermore, a major barrier to achieving timely removal of PVC during this pilot study was the reluctance by medical doctors to remove lines with no evident signs of infection present. However, in congruence with other study findings a gradual improvement in compliance with PVC management is to be expected.^{10,16}

Conclusions

PVCs should be inspected daily and the findings recorded. With repeated audits, we observed a significant decrease in the monthly prevalence of phlebitis in medical inpatients. Surveillance and regular ward audit with performance feedback was an effective way of determining base line rates and reducing related PVC complications. Educational sessions for all medical and nursing staff and group discussions facilitated the ownership process for introducing new practices. The study findings are suggestive to many PVC related complications such as phlebitis, thrombosis and bacteraemia being preventable and that there is room for improvement in our institution.

The continued need for the cannula should be examined on a daily basis, and catheters should be removed immediately if no intravenous therapy is planned. The new hospital protocol requires that catheters are removed after 72 hours and that a transparent dressing is used to visually assess the insertion site. Catheters should be removed for any VIP score of >1 . Moreover, there is a need to focus on education of healthcare workers and supervision of performance practices concerning the practices of insertion and maintenance of PVC. Further larger

studies are needed to test these findings using phlebitis as a clinically significant outcome.

Limitations

Some limitations of this study are worth mentioning. Weekly auditing of PVC in the medical wards by a single observer poses the threat of observer-related bias. Although a standard definition of phlebitis was used, interpretation of signs and symptoms could still be affected by subjectivity or omission of reporting cases of infection.

The sample size was small, especially when compared between the wards. Nevertheless, we believe that subsequent to this pilot study further research is needed to compare the PVC-associated primary MRSA BSI rates before the cannula policy change in our institution and after the intervention was implemented.

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References

1. Pujol M, Hornero A, Saballs M, *et al.* Clinical epidemiology and outcomes of peripheral venous catheter-related bloodstream infections at a university-affiliated hospital. *J Hosp Infect* 2007; **76**: 22-29. <http://dx.doi.org/10.1016/j.jhin.2007.06.017>
2. Lee WL, Liao SF, Lee WC, Huang CH, Fang CT. Soft tissue infections related to peripheral intravenous catheters in hospitalised patients: a case-control study. *J Hosp Infect* 2010; **76**: 124-129. <http://dx.doi.org/10.1016/j.jhin.2010.05.012>
3. Maki DG, Ringer M. Risk factors for infusion-related phlebitis with small peripheral venous catheters. A randomized controlled trial. *Ann Intern Med* 1991; **114**: 845-854.
4. Malach T, Jerassy Z, Rudensky B, *et al.* Prospective surveillance of phlebitis associated with peripheral intravenous catheters. *Am J Infect Control* 2006; **34**: 308-312. <http://dx.doi.org/10.1016/j.ajic.2005.10.002>
5. Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: A systematic review of 200 published prospective studies. *Mayo Clin Proc* 2006; **81**: 159-71. <http://dx.doi.org/10.4065/81.9.1159>
6. Royal College of Nursing. *Standards for infusion therapy*, 3rd edn. London, 2010. http://www.rcn.org.uk/__data/assets/pdf_file/0005/78593/002179.pdf (Accessed October 18, 2011)
7. Gallant P, S AA. Evaluation of a visual infusion phlebitis scale for determining appropriate discontinuation of peripheral intravenous catheters. *J Infusion Nurs* 2006; **29**: 338-345. <http://dx.doi.org/10.1097/00129804-200611000-00004>

8. Renaud B, Brun-Buisson C, ICU-Bacteraemia Study Group. Outcomes of primary and catheter-related bacteraemia: a cohort and case-control study in critically ill patients. *AM J Respir Crit Care Med*. 2001; **163**: 1584-1590.
9. Webster J, Clarke S, Paterson D. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial. *BMJ* 2008; **337**: a339. <http://dx.doi.org/10.1136/bmj.a339>
10. Boyd S, Aggarwal I, Davey P, Logan M, Nathwani D. Peripheral intravenous catheters: the road to quality improvement and safer patient care. *J Hosp Infect* 2011; **77**: 37-41. <http://dx.doi.org/10.1016/j.jhin.2010.09.011>
11. Webster J, Lloyd S, Hopkins T, Osborne S, Yaxley M. Developing a research base for intravenous peripheral cannula re-sites (DRIP trial). *qA randomised controlled trial of hospital in-patients. Inter J Nurs Studies* 2007; **44**: 664-671. <http://dx.doi.org/10.1016/j.ijnurstu.2006.02.003>
12. Webster J, Osborne S, Rickard C, Hall J. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database SystRev*: 2010; **(3)**: CD007798.
13. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. Centres for disease control and prevention. *MMWR Recomm Rep* 2011; **51(RR-10)**: 1-29.
14. Barker P, Anderson AD, MacFie J. Randomised clinical trial of re-siting of intravenous cannulae. *Ann R Coll Surg Engl* 2004; **86**: 281-283. <http://dx.doi.org/10.1308/147870804317>
15. Safdar N, Fine JP, Maki DG. Meta-Analysis: Methods for diagnosing intravascular device-related bloodstream infection. *Ann Intern Med* 2005; **142**: 451-466.
16. Curran ET, Coia JE, Gilmour H, McNamee S, Hood J. Multi-centre research surveillance project to reduce infections/phlebitis associated with peripheral vascular catheters. *J Hosp Infect* 2000; **46**: 194-202.