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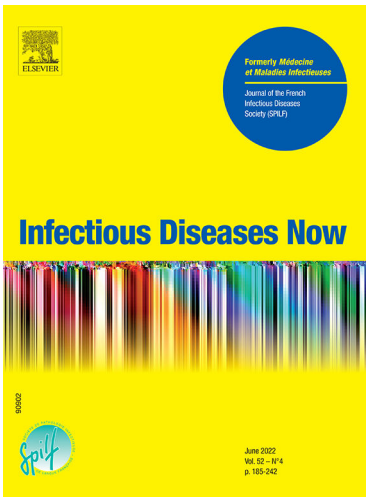

Review

Best practice in the use of peripheral venous catheters: A consensus from French experts

Olivier Mimoz, Anne Debonne, Audrey Glanard, Olivia Keita Perse, Jean-Christophe Lucet

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Best practice in the use of peripheral venous catheters: A consensus from French experts

Olivier Mimoz[a,*], Anne Debonne[b], Audrey Glanard[c], Olivia Keita Perse[d], Jean-Christophe Lucet[e]

[a] Centre Hospitalier Universitaire de Poitiers, Poitiers, France (Olivier.MIMOZ@chu-poitiers.fr)

[b] Centre Hospitalier d'Argenteuil, Argenteuil, France (Anne.debonne@ch-argenteuil.fr)

[c] Centre Hospitalier de Saint-Denis, Saint-Denis, France (audrey.glanard@gmail.com)

[d] Centre Hospitalier Princesse Grâce, Monaco (olivia.keita-perse@chpg.mc)

[e] Infection Control Unit, Bichat-Claude Bernard Hospital, AP-HP, F-75018 Paris, France; Université Paris Cité and Université Sorbonne Paris Nord, Inserm, IAME, F-75018 Paris, France (jean-christophe.lucet@aphp.fr)

***Corresponding Author:**

Olivier Mimoz

Centre Hospitalier Universitaire de Poitiers

2 rue de la Milétrie

CS 90577

86021 Poitiers Cedex

FRANCE

Olivier.MIMOZ@chu-poitiers.fr

+33.5.49.44.46.00

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Declaration of Interest

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Abstract

Background: Peripheral intravenous catheters (PIVCs) are the most commonly used invasive medical devices in healthcare. While they are often perceived as innocuous because they are common, this perception does not match their risk factors. In France, 16% of intravenous device-associated bacteremia are due to PIVCs. This consensus document reports the French experience in PIVC management, issues arising from their complications, and a proposed path toward improved PIVC care.

Methods: A panel of five French experts discussed this topic based on evidence and personal experience. A consensus process was applied to highlight the issues in need of increased awareness and to suggest possible improvements. PIVC topics were organized as General Statements, Indication, Preparation, Insertion, Maintenance, and Removal. An electronic survey was used to record agreement or disagreement; to expand the dataset, five additional French experts also answered the questions.

Results: Out of 67 statements, 62 reached a consensus (the 80% agreement threshold was exceeded). Experts are increasingly aware that PIVCs are a significant source of complications, including local and bloodstream infections. Practices need to progress to improve patient outcomes, which will require better education for all personnel involved with the insertion and maintenance of PIVCs.

Conclusions: Current practice around PIVCs does not always comply with the recommendations issued. A new surveillance network targeting catheter-related healthcare-associated infections is now in place in France. Simplified, standardized, bundled solutions are needed to reduce avoidable harm from PIVCs. Healthcare practice has changed over time and new educational tools are needed to adapt to increased workload and time constraints.

Keywords: best practice, bloodstream infections, complications, peripheral venous catheter, prevention

Abbreviations

BSI: Bloodstream infection

CHG: Chlorhexidine gluconate

CVC: Central venous catheter

CRBSI: Catheter-related bloodstream infection

ERPIUP: European Recommendations for Proper Indication and Use of Peripheral venous Access

ICU: Intensive care unit

INICC: International Nosocomial Infection Control Consortium

IV: Intravenous

PICC: Peripherally-inserted central catheter

PIVC: Peripheral intravenous catheter

SF2H: Société Française d'Hygiène Hospitalière (French Society of Hospital Infection Prevention)

SPIADI: Surveillance et Prévention des Infections Associées aux Dispositifs Invasifs (French national surveillance network for invasive device-associated infections)

1. INTRODUCTION

Peripheral intravenous catheter (PIVC) insertion is the most common invasive hospital procedure performed worldwide [1]. While this routine procedure is covered in guidelines [2, 3], compliance with these guidelines is known to often be inadequate [4]. In a French study by the CleanHand4 Collaboration Group, hand hygiene compliance observed during PIVC placement was reported to be 23.5% [5]. Overall failure rates of 35-50% have been reported for PIVC-related complications [1, 4, 6-8]. A majority of PIVC complications are noninfectious (occlusion, infiltration, phlebitis, displacement), but local site infections or bloodstream infections (BSI) can also occur. The lack of clear, universal definitions for local infection and phlebitis is problematic insofar as the line between infectious and noninfectious complications is blurred. In addition, while noninfectious phlebitis may be a precursor of infection [9], it does not automatically lead to BSI [10].

In 2006, Maki et al [11] published a systematic review of 200 prospective studies (ranging from 1966 to 2005) on the risk of BSI in adults with different intravascular devices. Among these 200 studies, 110 included PIVCs (a total of 10,910 catheters). The reported infection rate for PIVCs was 0.1%, or 0.5 per 1,000 catheter-days. By comparison, the same article reported a rate of 4.4% or 2.7 per 1,000 catheter-days for central venous catheters (CVCs). These authors concluded that all types of intravascular devices pose a risk of device-related BSI. In a more recent systematic review of the literature (63 studies published from 1980 to 2016) carried out to determine the magnitude of BSIs related to the use of PIVCs, the calculated incidence of PIVC-related BSIs was 0.18% among 85,063 PIVCs, and these catheters accounted for 23% of nosocomial catheter-related BSIs [12]. Another study [13] using different units came to a very similar conclusion regarding the overall contribution of PIVCs to catheter-related BSIs: this 7-year retrospective study found the cumulative incidence of catheter-related BSI to be 0.36 per 1,000 patient-days for CVCs (representing 77.2% of the 285 cases) and 0.106 per 1,000 patient-days for PIVCs (22.8% of cases). Mermel et al [12] pointed out that even though their data showed the risk of a CRBSI being greater from a CVC than from a PIVC, the much higher number of PIVCs used may lead to significant numbers of infections caused by these devices every year. Others have also made that argument [9, 10], even stating that the absolute number of PIVC-BSIs is likely as high as and may surpass the number of CVC-BSIs, with significant associated morbidity and mortality [14].

Interestingly, a study from Spain reported comparable rates of BSIs for PIVCs and CVCs [15], suggesting that this could be due to the excessive numbers of PIVCs used in emergency departments, often inserted under poor aseptic conditions by personnel unaware of subsequent complications or overworked. A recent French study followed 9,833 patients with a PIVC inserted in the emergency department who were subsequently hospitalized in a ward and found that 25 (4%) of them developed a BSIs due to a PIVC, some of them with serious complications including one death directly imputed to the PIVC-BSI.[16] To avoid a bias due to the pandemic, patient inclusion was suspended when Covid started; conversely, a Swiss study reported catheter-related or -associated BSIs during the pandemic and observed 90 cases attributable to PIVCs versus 94 cases attributable to short-term CVCs and 74 to long-term CVCs in a total of 179,463 patients.[17] A study from the USA found a PIVC-BSI rate of 0.115 per 1000 line-days (the same rate in ICU and non-ICU settings) compared to CLABSI rates of 0.588 per 1000 line days in ICUs and 0.199 per 1000 line-days outside of ICUs.[18] The authors also observed a greater risk of Staphylococcus aureus bacteremia in PIVC-BSIs. In addition to these data, several studies from various countries have been

published by the International Nosocomial Infection Control Consortium (INICC) reporting rates of complications and infections related to PIVCs throughout the world [19-23]. These articles report rates that are higher in countries with limited resources (ranging from 2.06 to 2.91 PIVC-BSIs per 1,000 catheter-days) than in more economically developed countries, where these infections range from 0.5 [11] to 0.67 [24] PIVC-BSI per 1,000 catheter-days), offering an insight on the impact of adequate resources on prevention.

Duration of PIVC insertion is another topic that remains actively discussed in the literature. The studies advocating for clinically-indicated replacement used phlebitis as a primary outcome and due to the low number of infections were not powered to detect differences in BSI rates.[25-28] A Clinical Care Standard on the management of PIVCs from Australia, published in May 2021, suggests routine replacement at 72h and clinically-indicated replacement only if the institution practices prospective surveillance of PIVC-related BSIs, comprehensive documentation of insertion, maintenance, and removal, and compliance with competency requirements for insertion and management.[29] A large cohort study found, on the other hand, that a significantly increased incidence rate ratio of PIVC-associated BSIs occurred when clinically-indicated replacement was implemented.[30] This topic was not discussed by the French panel.

There is a need to raise awareness that infections caused by PIVCs are a relevant problem that can be reduced by practice change. An initial panel of European experts convened to discuss this topic in 2020, representing Switzerland, Germany, the UK, Spain, and Italy. The resulting consensus statements have been published [31] to propose practice points based on evidence and consensus and to complement existing guidelines. The process has now been replicated with a group of French experts and this article specifically focuses on the French perspective. In 2019, France launched a nationwide surveillance network on invasive device-associated infections with the goal of preventing avoidable infections (SPIADI: *Surveillance et Prévention des Infections Associées aux Dispositifs Invasifs*). The most recent full report was published in 2021.[32] The same year, the French Society for Infection Prevention in Hospitals (SF2H: Société Française d'Hygiène Hospitalière) published an update to its recommendations for the prevention of infections associated with PIVCs and sub-cutaneous catheters.[33] The French panelists also reflected on adoption of these recommendations in their country and the impact of surveillance on quality of care.

2. METHODS

2.1 Literature search focusing on catheter care

The same literature search process described in the publication on the European panel consensus was used.[31] Briefly, a literature search covering the period from 1 Jan 2000 to 31 Oct 2020 was performed using PubMed, Embase, and Medline, with the search terms "PIVC or peripheral intravenous catheters" and "warmth" or "induration" or "phlebitis" or "thrombophlebitis" or "infiltration" or "extravasation" or "dislodgement" or "occlusion" or "bleeding" or "catheter-related bacteremia" or "blood stream infection"

or “dermatitis” or “pus or abscess” or “erythema” or “insertion attempts” or “complications” or “failure” or “adverse effects” or “infection”. A total of 391 articles were identified and reviewed, of which 146 were retained for data extraction: population, sample size, study arms, end points, and risk factors. Data were collected by Microsoft Power BI (https://powerbi.microsoft.com/). Six of the 146 articles were selected for the pre-reading list based on the following criteria:

a. Recent publication (not older than 5 years)

b. Helpful to facilitate the panel discussion on different aspects of PIVC care and maintenance:

- Incidence/prevalence of all PIVC-related complications with focus on PIVC-BSI [1, 12]
- Impact of PIVC replacement [34]
- Impact of a maintenance bundle on PIVC-related complications [35]
- Relevance of compliance of care and maintenance bundles to clinical outcomes [36]
- Costs of PIVC cannulation [37]

2.2 Advisory panel meeting

French panel members (four physicians and one nurse) from different institutions were selected based on their expertise in the utilization of PIVCs and their experience in infection prevention and urgent care. These five experts are the authors of this article. A virtual discussion moderated by the lead author and a representative of the sponsor took place on 16 June 2021. Prior to the live online meeting, panel members were provided with selected documents to read in advance (pre-reading list of articles [1, 12, 34-37], three French regional presentations describing surveillance data to be reported to the SPIADI network, an educational presentation on the process of S. aureus colonization, a review on bacteremia related to catheters, and an educational tool intended for training nurses on the insertion of peripheral catheters) and an agenda focusing on the importance and magnitude of complications related to PIVCs. The video meeting consisted in a panel discussion on interventions designed to best address this topic. The meeting started with each expert delivering a presentation to the others on pre-selected themes:

1. Epidemiology in France based on the 2020 data from the national surveillance network for invasive device-associated infections (SPIADI) and literature review on PIVC complications
2. Health economic impact of PIVC bundles
3. Infection prevention and control strategies for PIVCs
4. Microorganisms responsible for PIVC infections and diagnosis; impact of *Staphylococcus aureus* bacteremia
5. Training in best practices and traceability

Following these presentations, specific questions on the following topics were put forward by the moderators to structure and guide the conversation:

- Clinical consequences of PIVC complications (infectious and non-infectious)
- Diagnostic practices for PIVC infections
- Securement practices
- Possible bundle components
- Standard of care, variability between caregivers and adherence to recommendations
- Surveillance practices
- Antimicrobial solutions and clinical evidence needed
- Health economic impact
- Education and training

2.3 Post-meeting follow-up

A medical writer drafted a list of consensus statements based on a recording of the meeting and on the existing literature pertaining to the topic. These statements were reviewed by all panel members and then sent as an electronic survey to the five panel members and to five additional French experts (listed in Acknowledgements) so as to augment the dataset, recording agreement or disagreement (binary vote). The responses to the survey were compiled and are presented in Supplemental Tables 1-6. A descriptive summary by category is presented in Figure 1. No statistical analysis was performed. Comments by the survey participants were incorporated into the final manuscript, which was reviewed by all authors.

2.4 Consensus agreement

In this process, consensus was defined as 80% or more of the participants agreeing with the statement (at least eight out of 10 survey respondents). If three experts disagreed, no consensus was reached.

3. RESULTS

3.1 Overview

Consensus statements with > 80% agreement are outlined below. All statements (with or without consensus) with the voting results are summarized in the supplement (Supplement tables 1 – 6). Figure 1 summarizes the level of agreement for each category of statements.

3.2 Consensus statements with ≥ 80% agreement

3.2.1 General statements

PIVCs are by far the most frequent invasive procedure on any given day in a hospital

PIVC infection rates are low compared to central lines but infectious complications are still numerous (in absolute numbers) due to the quantity of PIVCs inserted

PIVC infections mostly come from S. aureus and coagulase-negative staphylococci

PIVC infections, especially those due to S. aureus, lead to increased morbidity, mortality, and costs

Major complications of PIVCs include PIVC-associated infectious endocarditis, septic thromboses, prosthetic infections, septic arthritis, and spondylodiscitis (primary infection of an intervertebral disc by a pathogen)

Patients with endovascular devices (cardiac prosthesis, vascular prosthesis, pacemaker, defibrillator) may be more at risk for PIVC-related S. aureus severe bacteremia than patients who do not have such devices

Patients with chronic skin lesions (e.g., psoriasis, eczema) are more at risk for PIVC infections

The vast majority of PIVC infections are identified outside the Intensive Care Unit (ICU)

Infection prevention is essential and must be multi-factorial. The goal is to find the optimal bundle likely to prevent the most complications

Infection risk from PIVCs is perceived by nurses and physicians as low

Microbiological diagnosis of PIVC infection is not done systematically

Diagnosis of PIVC infection should be improved

PIVC contamination comes mostly from the skin

Noninfectious complications leading to catheter failure are much more frequent (40 to 60% of inserted PIVCs) than infectious complications.

The line between infectious and noninfectious complications is not clear because some definitions are not clear or universal (local infection, phlebitis)

Failure is a mix of mechanical, vascular and infectious complications

Catheter failure should not be considered an unavoidable consequence of care. Practice should be improved to reduce these failures

Bundles can help improve PIVC care

Bundles need to be standardized

Bundles should also contain elements to prevent noninfectious complications

Better training is needed (educate at every opportunity and in ongoing fashion)

We need to go back to better care; too much time is now spent on traceability

The implementation of current recommendations can be improved, as current recommendations are not followed adequately (insufficient compliance). Making adherence to national recommendations a part of hospital accreditation through direct examination of insertion sites during certification visits and through nurse interviews regarding practices for managing invasive devices could improve practice

Traceability of PIVC insertion and removal is quite variable between departments

Surveillance should be done for all hospital-acquired bacteremia

The surveillance system of hospital-acquired bacteremia should be nationwide and firmly encouraged through accreditation

The topic of PIVC-associated bacteremia should be raised higher up on the list of concerns for infection prevention teams

PIVCs are known for their overall high rate of complications and failure. A recent large-scale retrospective study of medical records showed a similar rate of PIVC failure just above 53% whether the PIVCs had been inserted in emergency departments or inpatient settings.[38] The panel members discussed the various types of possible infections associated with PIVCs given different patient susceptibilities (patients with prostheses, endovascular devices, chronic skin lesions), and frequent failure to associate the origin of a bacteremia with a PIVC. In agreement with the previous European panel, the French experts concurred that a bundle could help to improve PIVC care. This is also supported by a study (CLEAN-3) in which a bundle (composed of closed integrated catheters, positive displacement needleless connectors, disinfecting caps, and pre-filled flush syringes) extended the complication-free dwell time of PIVCs in patients from the emergency department compared to the use of standard devices.[39] This bundle reduced catheter occlusion and dislodgement, but not infiltration, phlebitis, and local infection. No BSIs were observed in either group. A mathematical model based on observed data from the CLEAN-3 study

was later used to assess the cost-effectiveness of this bundle strategy and demonstrated that it was less costly and more effective than the use of standard devices.[40]

Finally, the French experts emphasized education, as they reported that current recommendations are not followed adequately. They went as far as suggesting that hospital accreditation could be made contingent on auditing practices related to the use of invasive devices. For example, SPIADI offers a tool called OBSERVA 4 for observation of catheter insertion practices.[41] The consensus meeting also highlighted an apparent contradiction between the need to go back to better care with too much time currently spent on traceability, and the need for more consistent and universal surveillance. This may indicate a need for better, easier documentation systems. The experts did not agree on whether the staff often fails to associate the origin of a bacteremia with a PIVC; the level of awareness on this topic may vary from institution to another.

3.2.2 Statements on PIVC indication

Catheters are still inserted even when they are not needed

Catheter failure can be a good opportunity to reconsider if we really need to insert a new catheter

Once again, in agreement with reflections from the previous European panel, the French experts noted that the practice of unneeded PIVC insertion upon admission is problematic because it exposes patients to an unnecessary risk. During the discussion, the experts mentioned the importance to also work on the non-indications for PIVCs because PIVCs are still at times inserted when they are not needed or when a peripherally-inserted central line (PICC) would be preferable. A recent qualitative study aimed to understand the factors impelling the decision of an emergency care clinician to insert a PIVC or not.[42] The authors concluded that this decision often comes from a learnt reflex with little cognitive input, even citing occasions where PIVCs were inserted for practice or skill maintenance. However, different considerations were used for the pediatric population, with clinicians leaning towards avoidance due to the associated stress and trauma for young patients and their parents. Objectively, the clinical need for a PIVC and the risks associated with it are essentially the same for adults and children and unnecessary insertions should be avoided for all patients. Increased awareness of complications would help improve practice in this respect.

3.2.3 Statements on PIVC preparation

Contamination mostly comes from the skin

Skin preparation is an important step and the solution used should be alcohol-based. It should also be applied vigorously with skin contact time of at least 30 sec and the skin should be allowed to dry before inserting the catheter

Skin damage can favor bacterial growth, which may increase the risk of infection

The previous European panel agreed that "*A solution of 2% CHG in alcohol is preferable to a solution of 5% povidone iodine in alcohol*" for skin preparation but the French experts did not reach a consensus on this topic (6 in favor of this statement, and 4 not in agreement). Interestingly, a recent study highlighted the fact that the mode of application (concentric versus back-and-forth) of an antiseptic solution can impact its activity. With the concentric method, the antiseptic solution is applied once whereas the back-and-forth method allows to recoat the same skin area. These authors concluded that significantly greater efficacy was seen with back-and forth friction.[43] Previous studies comparing 2% CHG in alcohol to 5% povidone iodine in alcohol for skin preparation before catheter insertion and concluding in favor of 2% CHG in alcohol used different modes of application for these solutions, i.e. concentric for povidone iodine and back-and-forth for CHG, per manufacturers' instructions [39, 44]. Further studies comparing skin preps and using the same mode of application would be helpful to clarify this topic. However, it is important to note that the products are not always available in the same format; for example, povidone-iodine in alcohol is not available in a single-use applicator in France. There is also a long and strong history in France for the use of povidone iodine as a skin prep and practices can be slow to change despite scientific evidence and guidelines now recommending an alcohol-based chlorhexidine antiseptic for skin preparation.[2, 45] The French experts also discussed how different skin prep practices were observed in their institution, suggesting a need for better training because skin prep quality is an essential component of PIVC success. These observations on various practices are consistent with the results of the SPIADI network for OBSERVA4 2021. This report describes observation of 2152 insertions (PIVCs or midlines), for which an antiseptic was used in 99.9% of cases (2150 insertions). Among these cases, 76% (1644 insertions) followed the recommendation to use an alcohol-based antiseptic (povidone-iodine in alcohol in 977 insertions, CHG 2% in alcohol in 407 insertions, and CHG 0.5% in alcohol in 260 insertions). The recommendation was not followed in 23.1% of cases (497 insertions) in which skin prep was predominantly performed with alcohol 70% (312 insertions).[46]

3.2.4 Statements on PIVC insertion

Insertion technique plays a greater role than patient-related factors in PIVC infections

Emergency catheter insertion leads to a higher risk for PIVC infection

Catheter insertion under poor conditions (less staff, heavier care load, high patient/caregiver ratio) creates a higher risk for PIVC infection

Insertion recommendations have evolved over time but are still not fully implemented. Inadequate practices (recommendations not fully implemented) include skin prep solution used, duration of

skin antisepsis, provision for adequate antiseptic dry time, catheter securement under dressing, type of dressing used, and writing of insertion date on the dressing

The time available to nurses to insert a PIVC is not the same as it was 10 years ago, therefore there is likely less compliance with the procedural steps

Traceability of insertion is important for proper surveillance

The quandary about PIVC insertion is that specific training is necessary to do it properly and minimize the risk of complications, yet there is also a need for all nurses to be able to do it due to the high frequency of this intervention. The French experts agreed that the procedural steps of insertion are important for success, but unfortunately, the recommendations in place are not adequately followed.

From a patient perspective, recent research has shown that patient experience with vascular access management informs satisfaction with overall hospitalization experience. In a study involving over 500 patients, the most important factors for patients were the competency of the health care provider, infection prevention, and pain management. Specifically, multiple PIVC insertion attempts and PIVC-related complications were likely to produce a loss of trust in providers and patient anxiety.[47] This topic is therefore directly related to quality of care and should be considered as a matter of high importance, even though the experts did not reach a consensus on whether re-insertion is more difficult and more costly than initial insertion. In addition, patients could be encouraged to engage in reminding clinicians to practice hand hygiene before starting PIVC insertion and other procedures that would help to improve adherence.

<u>3.2.5 Statements on PIVC maintenance</u>

Maintenance plays a greater role than patient-related factors in PIVC infections

For PIVC securement, a dressing that adheres well is important

For PIVC securement, a dressing that is the right size (adult versus child) is important

For PIVC securement, a bordered dressing increases wear time and allows for less frequent dressing changes

The cost benefit of an antimicrobial dressing for such a rare event (PIVC-related bacteremia) has yet to be determined

Thrombus formation at the catheter can be prevented by pulsed lavage

The experts agreed that adequate dressing is important to protect the insertion site and secure the catheter. It is important to note that reinsertions necessary due to the failure of a previous catheter are technically considered maintenance, and that reinsertions also involve a considerable amount of clinical resources and time.[48] This group of experts did not reach a consensus on whether it is reasonable to assume that antimicrobial dressings would have the same efficacy on PIVCs as on CVCs, which aligns with their assessment that the cost-benefit ratio of an antimicrobial dressing for PIVC-related bacteremia has yet to be determined.

The topic of adequate PIVC securement was covered in a recent literature review.[49] Within the 19 studies (43,683 PIVCs) included, 45 different securement interventions were tested, two thirds of them comprising a combination of multiple products. All in all, nonsterile tape directly over the insertion site was associated with increased PIVC failure and complications, whereas sutureless securement devices appeared comparable to transparent dressings and could potentially reduce failure and complications. The authors concluded that there is a lack of the high-quality evidence required to produce clinical practice recommendations. More research is needed to identify the best securement method, which should then be considered for inclusion in a bundle.

3.2.6 Statements on PIVC removal

Failure is defined as complication developing before planned removal

Traceability of removal is important for proper surveillance

Poor securement can be the cause of some, but not all accidental removals

The French experts discussed the importance, as a means of preventing complications, of removing catheters no longer in use, and of adequately documenting removal for surveillance purposes. A recently published study aiming to determine nursing compliance with proper PIVC documentation describes how removal documentation is the least compliant of the PIVC documentation steps, with only 49.4% compliance.[50] The consequence of poor documentation is inability to reach meaningful conclusions on the causes of PIVC failure and complications. As discussed above under General Statements, better, easier documentation systems are needed to improve PIVC surveillance data and to gather the information needed to make significant improvements. As stated in other documents [2, 3, 29, 31, 51], it remains important and necessary to inspect PIVC lines daily to assess the continuing (or non-continuing) need for the line, and the status of the insertion site.

4. DISCUSSION

Following the panel discussion, 67 statements were developed and the ten experts reached a consensus (defined as at least 80% agreement) on 62 of them. These statements provide general guidance on the use of PIVCs, are based on clinical experience, and corroborate existing guidelines and published evidence. In addition, there was general agreement on the need to increase awareness that the risk from PIVCs should be taken seriously and on the need for better training and education to standardize practices and increase PIVC safety. The five statements for which a consensus was not reached involved the level of staff awareness of the association between PIVCs and bacteremia, the skin prep solution that should be used (2% CHG in alcohol versus 5% povidone iodine in alcohol), the additional burden of re-insertions compared to initial insertions, and the assumption that antimicrobial dressings will have the same efficacy on PIVCs as on CVCs. The possible reasons for the lack of consensus on these statements were covered above (see sections titled General Statements, Statements on PIVC preparation, Statements on PIVC insertion, and Statements on PIVC maintenance, respectively).

The main messages and recommendations that emerged from the interaction between the experts were the following:

- The surveillance data coming out of the new French national network (SPIADI) are very useful to establish a baseline and track progress. The data collected in 2020 showed that 14.2% of catheter-related bacteremia are due to PIVCs.[32] The adult PIVC-BSI rates (per 1,000 patient-days) were 0.14 in ICU, 0.09 in hematology, 0.05 in oncology, 0.03 in surgical units, and 1.04 in other units, indicating that focusing on ICUs for surveillance as is often done does not address the main source of these infections. These rates are comparable to data published by others.[52, 53] A previously published French study[54] compared the prevalence of all healthcare-acquired BSIs in ICU versus acute care settings and rehabilitation centers, as well as the proportion of BSIs that were catheter-related versus not. Even though the prevalence was higher in ICUs (3.2% vs 0.6% in acute care and 0.2% in rehabilitation), 75% of healthcare-acquired BSIs occurred in acute care settings and 10% in rehabilitation centers. The most common cause remained exposure to a catheter (42.0% of BSIs in ICU, 44.7% of BSIs in acute care, and 19.0% if BSIs in rehabilitation centers). This also supports the position that prevention and surveillance efforts should expand beyond the ICU. Other authors also support the inclusion of PIVC-BSIs in nationwide surveillance systems.[17]

- The current recommendations for the insertion and care of PIVCs are not fully observed and better training and education should be implemented to address this. Hand hygiene, skin prep duration, and disinfection of connectors were cited as steps that are frequently skipped over or performed incorrectly. Other authors have also expressed concerns about the lack of adherence to published PIVC care recommendations [50, 55] and cited shortcomings in hand hygiene compliance.[5] On its website, the SPIADI network proposes educational tools dedicated to the improvement of PIVC insertion.[56]

- Major complications are PIVC-associated infectious endocarditis, septic thromboses, prosthetic infections, septic arthritis, spondylodiscitis (primary infection of an intervertebral disc by a pathogen). The financial and human cost of these infections is high and avoidable. Specific data from France on such complications were recently published.[16]

- Training and continuing education are extremely important, especially since the information provided in French nursing schools might not be aligned with recent recommendations. Based on

the panelists' experience, 15-20 minute modules in duration in care units can work well. QR codes leading to short videos provide an attractive way to absorb useful content in real time. The panelists also emphasized that all personnel working with patients need proper training: for example, a nursing assistant helping a patient get dressed and disconnecting and reconnecting the line with bare hands just to pass it through the clothes reflects a real difference between IV team behavior and behavior in the field.

- Bundles should definitely be favored, as they reduce the risk of catheter failure compared to the traditional approach. Published evidence has confirmed this. [39, 57] More research is needed to standardize a PIVC bundle, which should remain simple and practical.

- The cost related to PIVC failure is a complex question; while noninfectious complications may be less costly, they occur much more often, and repeated insertions may become increasingly more expensive to the extent that the vascular network becomes more difficult to access.

The expert consensus process has limitations. The number of French experts involved was small, and the discussion leading to the consensus process can introduce group influence on the opinions of the respondents who were present for the discussion. However, we still observed a lack of consensus on some statements, and the peer-reviewed literature was used in support of the consensus process.

5. CONCLUSIONS

In order to effectively improve care, everyone involved in the care of PIVCs (including the patients themselves) needs to become aware of the risks associated with these invasive devices. The healthcare system tends to focus on treatment instead of prevention and catheters are simply considered as tools needed for treatment. Our thinking must evolve towards considering PIVC-related complications to be unacceptable and working actively to prevent them. A standardized bundle is a promising approach, but basic proper practice must be in place before implementing more sophisticated technological solutions. PIVCs are ubiquitous and healthcare professionals, scientific societies, and all medical specialties must therefore work hand in hand to address this issue and sustainably change their practices.

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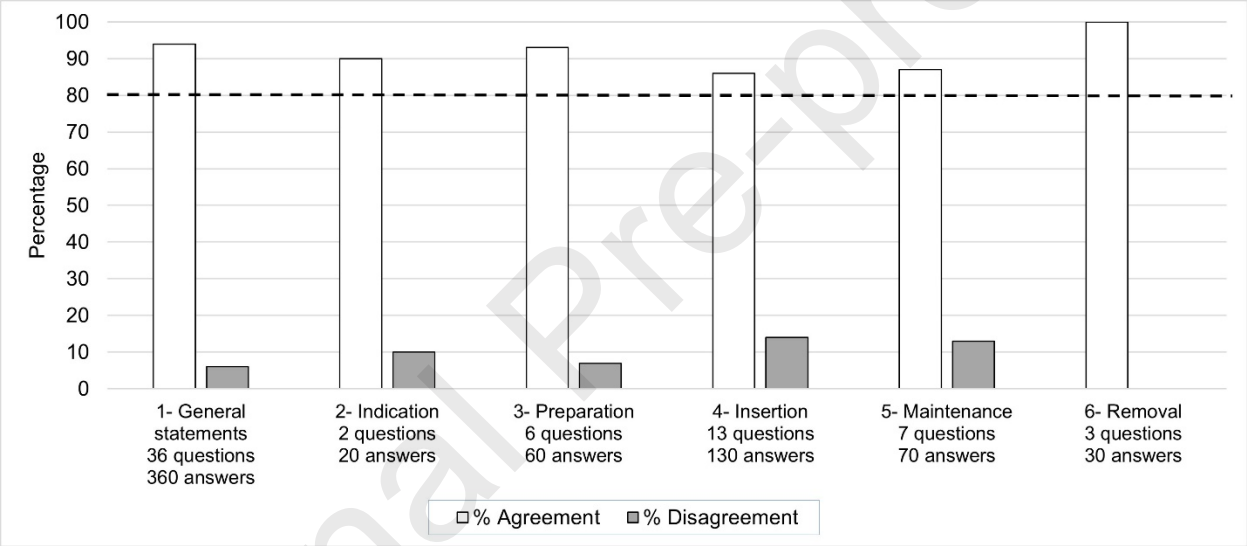
Figure 1. Level of agreement stratified by experts and category.

The dotted line illustrates the 80% agreement level defined for consensus

Highlights

- SPIADI data show that 14.2% of device-associated bacteremia are due to PIVCs
- PIVCs can lead to major avoidable complications (e.g., infectious endocarditis)
- PIVC recommendations are not fully observed. Training and education are needed
- Bundles reduce the risk of catheter failure and should definitely be favored
- PIVC-related complications are unacceptable and can be actively prevented



Author contributions

Prof. Mimoz facilitated the panel meeting discussion during which all authors participated. Prof. Mimoz worked with a medical writer (listed in Acknowledgements) to prepare the manuscript. All authors contributed to the discussion during the panel meeting, reviewed the final draft of the article, and provided input. Prof. Mimoz had the final say in the contents of the publication.