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Compliance with good practice **guidelines for the prevention of vascular access infections: The multicentre PHYDEL survey in French haemodialysis units.**

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ABSTRACT

Background: French guidelines for the prevention of vascular access infections in a haemodialysis setting were released in 2005. Compliance with these guidelines is currently unknown. Our aim was to assess compliance with guidelines for vascular access infection prevention in French haemodialysis units, and to describe the difficulties reported.

Methods: A cross-sectional survey was conducted between March and December 2019 in 200 haemodialysis units randomly selected in France. Data were collected via questionnaire, completed by telephone interview with an infection control practitioner. A practice was deemed compliant when > 85% of units declared always complying with guidelines.

Results: A total of 103 units (51.5%) agreed to participate. Most practices complied with guidelines, however some of them (working in pairs when connecting central venous catheter (CVC) lines, performing hand hygiene before disconnecting lines, rinsing antiseptic soap before painting CVC exit site or arteriovenous fistula (AVF) puncture site, allowing antiseptic paint to dry, handling CVC branches with antiseptic impregnated gauze, performing hand hygiene after AVF compression with gloves, wearing protective eyewear when connecting/disconnecting CVC or when puncturing AVF, wearing a gown when puncturing AVF) did not reach the 85% compliance threshold. Most frequently reported difficulties were understaffing, difficulties with skin preparation because of exit site skin damage, and lack of buttonhole technical expertise.

Conclusions: Despite good overall compliance, this survey highlights some shortcomings in complying with infection prevention guidelines, which could be associated with either higher vascular access infection risk or with increased blood-borne virus transmission.

Key words: Bacteraemia; vascular access; infection control; haemodialysis units; guidelines; compliance

INTRODUCTION

The incidence of bacteraemia in patients on haemodialysis is extremely high (13.7 per 100 person-year) [1]. Infection is the most common morbidity and the second leading cause of hospitalization and death in adults receiving haemodialysis [2-3] and generates a large use of healthcare resources and related costs [4-5].

Vascular access (VA) is implicated in 48 to 73% of cases of bacteraemia in haemodialysis patients [6-7]. Among VA, a central venous catheter (CVC) is associated with an increased risk of bacteraemia compared to an arteriovenous fistula (AVF) [8]. The latter is therefore recognized as the gold-standard VA for chronic haemodialysis [9] although about 20% of chronic haemodialysis patients in France have a CVC for VA according to The French Renal Epidemiology and Information Network (REIN) registry [10].

The French Society for Hospital Hygiene (SF2H) together with the French Society for Nephrology, Dialysis and Transplantation (SFNDT) released guidelines in 2005 to prevent VA-related infections in French haemodialysis patients [11]. In addition, the National Kidney Foundation (NKF) releases regularly updated guidelines, with a last update dealing with vascular access in 2019 [12].

Few surveys have been performed regarding the compliance of haemodialysis teams with guidelines. One survey investigated acute short-term haemodialysis in an intensive care unit (ICU) setting [13]. Three large surveys were performed in a haemodialysis setting between 1996 and 2014 in the United Kingdom, Ireland, and Quebec, and retrieved a heterogeneous level of compliance with guidelines [14-16]. To the best of our knowledge, no study has assessed compliance with guidelines for the prevention of vascular access infections in French haemodialysis units. Furthermore, the context has changed since the release of these guidelines: other French guidelines (not specific to haemodialysis) regarding skin preparation before vascular access were released in 2016 [17], and new devices (such as alcohol-impregnated caps) and techniques (catheter locks, AVF buttonhole cannulation techniques) have been proposed.

Therefore, we performed a nationwide survey to describe compliance with vascular access guidelines in French haemodialysis units and the diffusion of newer practices for which an agreement has emerged in the literature since the release of guidelines, and to highlight difficulties and unanswered practical questions related to VA-related infection control.

METHODS

Study design

The survey was a nationwide, descriptive survey including a random sample of units performing haemodialysis all over France. It was conducted from March 2019 to December 2019, in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) requirements.

Study population and Sample selection

In France, since 2001, the REIN registry exhaustively lists all French haemodialysis units, 1189 at the time of our survey. The REIN registry provided a list of eligible units (providing either in-centre haemodialysis, or supervised haemodialysis, or auto-dialysis) and 200 units were randomly selected from this list.

Data collection

A questionnaire was designed covering 2005 SF2H-SFNDDT guidelines for infection prevention in haemodialysis, and 2016 SF2H guidelines for skin preparation between invasive procedures [11,17]. In addition, a literature search for relevant English language articles between 2005 and April 2019 was performed on Pubmed to identify practices where a consensus seemed to appear since the release of French guidelines. Fifty-seven potentially relevant papers according to their title were retrieved and analysed. A steering committee comprising physicians and nurses with expertise either in haemodialysis or hospital hygiene or epidemiology, endorsed and validated the questionnaire, which was then pre-tested in five dialysis units.

The questionnaire collected data regarding haemodialysis unit funding status (public/associative/private), unit type (in-centre haemodialysis/ dialysis under medical supervision/auto-dialysis), declared practices, and difficulties encountered.

The current paper focuses on VA care practices: CVC/AVF connection, CVC/AVF disconnection, CVC/AVF care including catheter/blood line manipulation, caregivers' and patients' protective equipment, CVC exit site and AVF site skin preparation. Although our topic of interest was mainly infection risk for patients, we also assessed practices regarding caregivers' protection against exposure to bloodborne viruses during VA care.

For each theme, haemodialysis teams were asked if their usual practices for VA care complied with French SF2H-SFNDDT 2005 guidelines, or with agreement regarding best practices in the literature, for practices outside the scope of French guidelines, and to explain, if necessary, the difficulties they experienced complying with guidelines. According to our search, an agreement appeared in the literature for the following practices: availability of procedures (a document for patients with information regarding precautions for CVC or AVF, a protocol for patients' arm hygiene for AVF, a specific skin preparation procedure for patients with vascular access site damaged skin, a procedure describing the technique for buttonhole AVF access), and the need to independently fix the lines during dialysis care, to prepare injections extemporaneously, to use single use heparin vials, to place a new sterile plug on

the access port of the line after each access port use, to use an antimicrobial catheter lock (although it is not clear whether this should be an antibiotic lock, a heparin lock, or a taurolidine or citrate lock), to access the AVF using the buttonhole technique.

Data collection was carried out in two steps. First, the questionnaire was sent by e-mail to all haemodialysis units agreeing to participate, to be filled by a representative of each unit, together with their infection control team when available. In an attempt to maximize the response rate, follow-up e-mails and telephone calls to encourage participation were made to all units that had not responded in the two weeks following receipt of the questionnaire.

In a second step we conducted rounds of telephone interviews with **respondents** to review the specific issues—which the participating units wished to discuss. Data collection was completed in December 2019.

Analysis

Statistical analysis was performed using Statistical software SAS 9.4 (SAS institute Cary, North Carolina). Descriptive statistics were used to present the description of the characteristics of the dialysis units, and the responses for the primary and secondary endpoints. The categorical variables were expressed as percentages with 95% confidence interval (95% CI) and continuous variables as mean values \pm standard deviation. Characteristics of participating haemodialysis units regarding funding status and type of haemodialysis practice were compared to characteristics of non-participating haemodialysis units. Regarding compliance with guidelines, we arbitrarily estimated that 90% of units declaring **that they** always **complied with** a guideline was an adequate threshold to consider that a practice was indeed correctly implemented in haemodialysis in France. To allow for imprecision in estimate in our sample of 103 units, we therefore chose 85% (i.e. lower limit of 95% CI of a proportion of 90% observed in a 103-unit sample) as the threshold to consider that a practice was **compliant with** guidelines.

Ethical considerations

The local Institutional Review Board approved this survey. No information was collected about individual patients and therefore the approval of the French Electronic Data Protection Authority was not required. We pledged to maintain the confidentiality of the data collected in haemodialysis units.

RESULTS

A total of 103 units in France (see additional online material) agreed to participate in the current study and returned a questionnaire, giving a total response rate of 51.5%. No variable with more than 5% of missing values was observed. The characteristics of haemodialysis units participating in our survey are reported in Table I and compared with those of non-participating units as regards funding status, and haemodialysis type. Participating units differed from non-participating units by their funding (they were more likely to be associatively run, and less likely to be run private-for-profit), and by a lower proportion of units performing “in-centre” haemodialysis.

Declared practices complying with SF2H-SFDTN 2005 guidelines on haemodialysis [11] and SF2H 2016 guidelines on skin preparation before invasive procedure [17], as regards CVC care and AVF care, are described respectively in Table II and Table III.

Declared practices regarding topics outside the scope of current guidelines but where an agreement was observed in the literature, are described in Table IV. Most units preferred using heparin lock rather than **antibiotic lock** or **alcohol lock** therapy as antimicrobial catheter lock solutions. No unit in our sample used alcohol-impregnated caps. When a unit had a written skin preparation procedure specific to patients with damaged skin, 61.2% (95%CI [28.8 to 54.3]) of these procedures recommended to seek advice from a dermatologist.

The most frequently reported difficulties reported by haemodialysis units were understaffing (reported by 30 units out of 103), **difficulties** with skin preparation because of patient allergies to antiseptics (reported by 15 units), and a lack of expertise in the buttonhole technique (reported by 12 units).

DISCUSSION

This survey suggests a high level of compliance with French guidelines for haemodialysis vascular access. In particular, haemodialysis units declared compliance with guidelines regarding mask wearing by patients and by caregivers, sterile glove wearing during CVC exit or AVF puncture, gown wearing when connecting and disconnecting CVCs, caregivers' hand hygiene before connecting lines, antiseptic cleaning of the CVC exit site or the AVF puncture site, and use of a sterile drape to cover the CVC exit site or the AVF puncture site.

However, there was room for improvement as regards working in pairs when connecting CVC lines, performing hand hygiene before gloving when disconnecting the CVC, rinsing antiseptic soap before painting the CVC exit site or the AVF puncture site with antiseptics, allowing antiseptic paint to dry, and handling CVC branches with antiseptic impregnated gauze. These non-compliant practices are of concern because they could be associated with an increased risk of VA-related infection.

In addition, some other non-compliant practices could be associated with an increased risk of exposure to blood-borne viruses for patients or caregivers: not performing hand hygiene after AVF compression with gloves, not wearing protective eyewear when connecting/disconnecting the CVC, during restitution, or when puncturing the AVF, and not wearing a gown when puncturing the AVF.

Our results also suggest that haemodialysis units encounter difficulties outside the scope of guidelines: reports of understaffing, difficulties in the choice of a strategy for skin preparation in patients with skin allergies or irritation, and a reported lack of expertise in the buttonhole technique for AVF access, a technique which has developed since the publication of guidelines.

Few surveys in the literature have assessed infection control practices in the haemodialysis setting. Kumwenda *et al.* surveyed 66 dialysis units in the UK [14]. However, their survey was performed in 1996, before the release of current guidelines and studied only CVC and not AVF. Another survey, published in 2014, assessed the CVC and AVF practices of 36 Quebec dialysis units [16]. Compared to their results, we observed a higher level of compliance for the use of an alcohol antiseptic product for CVC site care (76% vs. 67%), for pair working when connecting the CVC (63% vs. 50%), and for performing forearm hygiene in patients with an AVF (87% vs. 61%), but a lower level of compliance for the use of an alcohol antiseptic product for AVF site care (71% vs. 97%).

Some of the non-compliant practices in our survey, such as wearing gloves without prior hand hygiene, and not wearing protective eyewear, although reported here during VA care, fall within the more general scope of standard precautions. Non-compliance with standard precautions by caregivers despite a good knowledge of these precautions has been widely reported in the literature [18- 23].

However, this is the first time they are described in French haemodialysis units, and via a large national survey. In addition, one would expect haemodialysis caregivers to be aware of the particularly high risk associated with non-compliance with standard precautions in the "bloody" environment of the haemodialysis setting [21], and therefore to comply more carefully with standard precautions.

Organisational difficulties could be one possible explanation for some declared non-compliance with standard precautions. Understaffing, which was frequently reported by haemodialysis units in our survey, is indeed a mechanism frequently put forward in other settings to explain non-compliant practices [22-23]. For example, performing hand hygiene before gloving might be difficult if a lack of time makes it difficult to wait for alcohol hand rub to dry before donning gloves, and time may also be lacking to complete the successive steps of skin preparation [22-23]. In addition, understaffing could explain some non-compliant practices outside the scope of standard precautions: working in pairs indeed requires adequate staffing. However, understaffing may not be the only explanation for a lack of compliance with standard precautions. Some surveys [24-25] reported that compliance with standard precautions was sometimes sustained by feelings of fear and/or disgust regarding the care of an individual patient. One study also suggested that familiarity with patients could overcome this feeling of fear and disgust [22]. Haemodialysis caregivers, who perform care for the same patients usually three times a week, for months and sometimes years, probably experience a great familiarity with patients, which could in part lower the perception of risk and compliance with standard precautions. Previous surveys suggested that the trivialisation of risk associated with the repetition of dangerous procedures may also explain some at-risk non-compliant practices in some settings [22,26]. The fact that caregivers in haemodialysis units care for different patients, thereby multiplying the frequency of precautionary measures including hand hygiene, could explain the lack of declared compliance with standard precautions. Baloh *et al.* reported that performing hand hygiene frequently was sometimes perceived by caregivers as a reason not to perform hand hygiene just before gloving because they had already performed hand hygiene just before [19].

Beyond standard precautions, we observed non-compliant practices regarding specifically VA care. Such non-compliant VA care practices have been described in other settings than haemodialysis, even in recent surveys [13, 27-30]. However, this non-compliance is perhaps more surprising here given the particular burden represented by VA-related bacteraemia in haemodialysis patients [31-33], which is well known by haemodialysis caregivers. However, the mechanism described above of risk trivialisation when a dangerous procedure is performed frequently, also applies to VA care in haemodialysis units.

The hypothesis of an underestimation / misperception of risk may also be evoked to explain that hand hygiene is more rarely performed when disconnecting the CVC than when connecting the CVC. Another explanation for the lack of hand hygiene when disconnecting the CVC could be a higher care load at the time of disconnecting, due to the fact that caregivers have to manage a large number of CVCs, some of them malfunctioning. Previous surveys in the literature have demonstrated a correlation between activity level and compliance with hand hygiene [34-35].

Another issue is the low compliance declared by 65% of units with the guidelines requesting the handling of catheter branches with antiseptic impregnated gauzes, despite the evidence-based character of this recommendation [36] and the fact that it has been strongly enforced both in older and in recent French recommendations [11,17].

Regarding skin preparation, our survey showed that skin cleaning of the AVF site with-soap before antiseptics was reported to be always performed by only 37% of haemodialysis units. This low compliance is probably explained by the fact that, although skin cleaning-was part of the 2005 guidelines, it is **no longer** required by more recent French guidelines when skin is clean [17]. The fact that 60% of haemodialysis units declared that they performed skin cleaning when it was-not already **done** by the patient or when the skin was found dirty is consistent with this hypothesis. Therefore, a low compliance with this procedure is both understandable and acceptable. Another important result of our survey is the difficulty **of skin preparation** that is quite specific to chronic haemodialysis reported by haemodialysis caregivers. Indeed, haemodialysis patients, who require skin preparation of a VA exit site **three** times a week, for months and sometimes years, are exposed to the occurrence of skin damage, as has been described for CVC exit sites in various settings [37]. This damage was described by caregivers in our survey as “skin allergy” or “skin irritation” related to frequent skin antiseptics. In this situation therefore, caregivers may be tempted to avoid **skin** cleaning with antiseptic products by either skipping antiseptics steps or avoiding alcohol products if no adequate skin preparation procedure is available.

Our survey also highlights difficulties regarding some practices that have evolved since the release of French guidelines. First, although antimicrobial lock is strongly advised by CDC [38] and NHS [39] **guidelines**, only about 13% of haemodialysis units in our survey **declared** that they routinely used such locks [40]. Second, only 69% of haemodialysis units reported that they had a procedure for the buttonhole technique, and 12% reported a lack of expertise in the buttonhole technique in their **unit**. Taken together, these points suggest **a need to** update French guidelines.

Our survey has some **limitations**. First although we randomly selected our study population, only one selected haemodialysis unit out of two agreed to participate, which may have overestimated compliance with **guidelines**. However, participating **units** were keen on discussing their practices with infection control practitioners, and willing to improve patients’ safety. Second, we studied declared practices, which may also have overestimated compliance with **guidelines**. However, we were careful to obtain the adherence of haemodialysis caregivers to the survey by guaranteeing anonymity and associating haemodialysis professionals in the steering committee. We made sure that respondents had enough time to discuss the questionnaire both with field professionals and with infection control professionals so that their responses truly reflected their practices. We obtained the **collaboration** of the REIN registry, which allowed us to randomly select haemodialysis units and to compare responding and non-responding units which allowed us to avoid a selection bias.

Overall, a haemodialysis setting combines an extremely high risk of VA-related infection, together with **some** characteristics (high frequency of access, familiarity with patients) that contribute to the minimization of this risk by caregivers, and other characteristics (skin damage, understaffing) that **contribute to non-compliance** with guidelines even when there is a **desire** to do so. Our work suggests

that some actions are necessary to improve the safety of haemodialysis patients. **First**, we suggest that it would be useful to assess whether haemodialysis staffing ratios are adequate given the current characteristics of haemodialysis patients and the care practice guidelines. **Second**, the suspected mechanisms suggested above for non-compliance make it difficult to rely only on training and voluntary audit and feedback to improve practices. We suggest that a national policy with accreditation criteria requiring documented compliance and mandatory training for caregivers could help maintain caregivers' vigilance and adequate care standards. **Third**, we suggest that French guidelines should be updated, providing recommendations regarding antimicrobial locks and the buttonhole technique, and that training in the buttonhole technique should be made easily available for haemodialysis caregivers, via simulation and/or online training.

In conclusion, despite an overall good level of compliance with guidelines, our survey highlights some difficulties **in** topics **central to the safety of** both patients and healthcare workers. Future guidelines should address these difficulties and their possible mechanisms.

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CONFLICTS OF INTEREST

One of the authors (V.M.) is a member of the French Society for Hospital Hygiene (SF2H) board but this paper does not necessarily reflect the position of the SF2H. V. Merle was previously a corresponding local epidemiologist for REIN registry. H. Marini is currently the corresponding local epidemiologist for REIN registry. S. Edet is the corresponding local nephrologist for REIN registry

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Table I. Characteristics of the participating dialysis units (N=103) and comparison with available characteristics of all French haemodialysis units

| | Participating units (n=103) | Non participating units (n=1086) | P-value |
|---|-----------------------------|----------------------------------|-----------------|
| Administrative status, n (%) | | | .0015 |
| Public | 14 (13.6) | 175 (16.1) | |
| Association ^b | 76 (73.8) | 608 (56.0) | |
| Private for profit | 13 (12.6) | 293 (27.0) | |
| Unknown | 0 | 10 (0.9) | |
| Units performing auto dialysis ^a , n (%) | 56 (54.4) | 654 (60.2) | .24 |
| Units performing dialysis under nurse supervision, n (%) | 43 (41.7) | 495 (45.6) | .56 |
| Units performing in-centre haemodialysis ^c , n (%) | 30 (29.1) | 594 (54.7) | .0000007 |
| Unit belonging to a haemodialysis network | 63 (61.2) | | |
| Time since unit creation, years (SD) | 20.5 (12.2) | | |
| Number of dialysis stations, mean (SD) | 17.8 (13.8) | | |
| Number of nephrologists, mean (SD) | 4.3 (3.1) | | |
| Number of nephrologists present, mean (SD) | 2.3 (8.1) | | |
| Training of nurses in VA procedures, n (%) | 91 (89.2) | | |
| Training of nephrologists in VA procedures, n (%) | 44 (42.7) | | |
| Infection control team available, n (%) | 100 (97.1) | | |
| Epidemiological surveillance of infections (n, %) | 86 (83.5) | | |
| Via local surveillance | 66 (64.1) | | |
| Via participation in a National surveillance network | 37 (35.9) | | |

^a Dialysis unit treating patients trained in dialysis procedures, with the presence of a nurse only to monitor haemodialysis sessions

^b Dialysis unit treating patients requiring care from nurses but not necessarily nephrologists during haemodialysis sessions.

^c Dialysis unit treating patients requiring the constant presence of a nephrologist during haemodialysis sessions.

SD: Standard Deviation, VA, vascular access

Table II. Proportion of haemodialysis units (n=103) declaring that their usual practices comply with CVC access care SF2H-SFDTN 2005 guidelines. “Conform practices” according to our threshold are highlighted in bold.

| | % (95CI) |
|--|----------------------------|
| Patient always wears a surgical mask during the connection and restitution phases | 89.1 [87.1 to 98.9] |
| Cleaning of skin around CVC puncture site is always performed | 94.2 [91.1 to 99.9] |
| Rinsing is always performed after cleaning | 81.5 [75.1 to 94.3] |
| Antiseptic paint is always allowed to dry | 52.8 [39.3 to 65.5] |
| Caregivers always work in pairs when connecting or disconnecting the CVC | 61.7 [54.3 to 74.8] |
| Caregivers always perform hand hygiene and change gloves between skin prep and connecting lines to catheter | 96.8 [88.6 to 99.4] |
| Caregivers always perform hand hygiene before disconnecting lines from the catheter | 65.1 [57.3 to 80.4] |
| Caregivers always wear a sterile gown and sterile gloves when connecting/ disconnecting the CVC and during restitution | 98.4 [91.1 to 99.9] |
| Caregivers always wear a surgical mask when connecting/disconnecting the CVC and during restitution | 95.3 [87.2 to 98.9] |
| Caregivers always wear protective eyewear when connecting/ disconnecting the CVC and during restitution | 31.7 [58.7 to 81.2] |
| Caregivers always wear charlotte clips when connecting/ disconnecting the CVC and during restitution | 87.5 [87.2 to 99.8] |
| Sterile drapes are always used on CVC puncture site | 95.5 [88.1 to 99.6] |
| Caregivers always handle catheter branches with antiseptic impregnated gauzes | 64.9 [31.3 to 50.9] |
| An occlusive dressing always covers the CVC puncture site at the end of haemodialysis | 78.6 [62.7 to 84.7] |

95CI, 95% Confidence Interval CVC, Central Venous Catheter

* Alcohol antiseptic: included either chlorhexidine 0.5%, chlorhexidine 2% or alcohol 70% solution

Table III. Proportion of haemodialysis units (n=103) declaring that their usual practices comply with AVF access care SF2H-SFDTN 2005 guidelines. “Conform practices” according to our threshold are highlighted in bold.

| | % (95CI) |
|---|----------------------------|
| Patient’s arm where the fistula is located is always washed before the dialysis session using a foaming antiseptic solution | 86.5 [79.2 to 93.2] |
| Caregivers always wear a surgical mask during AVF puncture | 87.1 [84.7 to 96.3] |
| Caregivers always wear gloves during AVF skin antiseptis and puncture | 99.9 [4.3 to 16.3] |
| Caregivers always wear protective eyewear during AVF skin antiseptis and puncture | 22.3 [70.3 to 86.6] |
| Caregivers always wear a non-sterile gown during AVF skin antiseptis and puncture | 41.6 [49.2 to 68.9] |
| Cleaning of skin around AVF puncture site is performed | |
| Systematically | 37.3 [28.1 to 47.4] |
| if skin cleaning has not been performed by the patient | 41.2 [3.16 to 51.4] |
| If skin is visually dirty | 19.4 [14.3 to 31.1] |
| Rinsing is performed after cleaning | 65.8 [58.5 to 78.5] |
| Antiseptic paint is always allowed to dry | 48.8 [44.7 to 65.7] |
| Sterile drapes are always used on AVF puncture site | 91.2 [83.6 to 95.7] |
| AVF compression is always followed by hand hygiene after removing gloves | 7.5 [85.8 to 96.9] |

95CI, 95% Confidence Interval

AVF: Arteriovenous Fistula

*Alcohol antiseptic: included either chlorhexidine 0.5%, chlorhexidine 2% or alcohol 70% solution

Table IV. Description of declared practices of haemodialysis units regarding topics beyond the scope of French SF2H^a-SFNDT^b 2005 guidelines on haemodialysis and SF2H 2016 guidelines on skin preparation (N=103)

| Other practices going beyond the national recommendations | %(95CI) |
|--|---------------------|
| CVC and AVF | |
| A document providing patients with information regarding precautions for CVC or AVF is available | 97.1 [91.1 to 99.2] |
| A specific skin preparation procedure for patients with vascular access site damaged skin is available | 34.6 [30.4 to 49.9] |
| A protocol for patients' arm hygiene for AVF is available | 97.1 [93.8 to 100] |
| A procedure describing the technique for buttonhole AVF access is available | 69.1 [55.3 to 80.1] |
| The lines are independently attached during dialysis care | 80.7 [73.1 to 89.1] |
| Drug injections are prepared extemporaneously | 95.7 [89.6 to 98.7] |
| Single use heparin vials are used | 81.1 [73.4 to 89.2] |
| A new sterile plug is placed on the access port of the line after each access port use | 62.9 [33 to 53.2] |
| A CVC antimicrobial prophylaxis lock is used between dialysis sessions | 83.3 [75.9 to 92.1] |
| Antibiotic lock | 12.7 [10.4-26.7] |
| Heparinized lock | 43.7 [40.1-60.6] |
| Taurolidine lock | 31.6 [37.5-58.2] |
| Citrate lock | 12.5[27.3-47.8] |

SF2H, French Society for Hospital Hygiene

SFNDT, French Society for Nephrology, Dialysis and Transplantation

95CI, 95% Confidence Interval

CVC, Central Venous Catheter

AVF, Arteriovenous Fistula

Supplementary data

Figure A : Map of France showing haemodialysis units included in the survey