



FRENCH SOCIETY FOR HOSPITAL HYGIENE

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Prevention of peripheral venous catheter-related infections

Guidelines for clinical practice

Reference committee
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for Health



FOREWORD

The French Society for Hospital Hygiene (SFHH) took the initiative of editing this document in the context of a call for tenders, opened in 2003 by the French National Authority for Health (HAS), which subsidized the publication of the present guidelines concerning the **“Prevention of infections related to the use of peripheral venous catheters”**.

These guidelines have been elaborated, whilst taking into due account the method described in the compilation: “Guidelines for clinical practice – Methodological basis for their implementation in France”, published by the ANAES [1].

The SFHH solicited contributions from the following learned societies, federations and professional associations:

- Association for Hospital Pharmacy of Ile de France (APHIF);
- National Federation of Cancer Centers (FNCLCC);
- National Nursing Federation (FNI);
- French Emergency Medical Service (SAMU);
- French Society of Hospital Hygiene Nurses (SIIHHF);
- French Society for Anesthesia- Critical Care (SFAR);
- French Society for Microbiology (SFM);
- French Speaking Society for Infectious Diseases (SPILF);
- French speaking Intensive Care Society (SRLF).

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Summary of recommendations

Peripheral venous catheterization is a very common act in health care, since it is estimated that 25 million such catheters are used every year in France. This type of catheter can lead to potentially severe local, or systemic infections. However, a comparison between the risk of infections related to different types of catheter (central or peripheral) shows that the risk associated with peripheral venous catheters is the smallest.

The prevention of intravascular catheter-related infections has received recommendations mainly for the case of central venous catheters. The present document proposes specific recommendations for the prevention of infectious risks related to peripheral venous catheters during the various phases of their use. These are intended for all health-care workers involved in the insertion, maintenance, monitoring and removal of such devices.

“Choice of Catheter”

MATERIAL

- ✓ **R1** – In order to prevent the risk of infection, it is recommended to use polyurethane or fluorinated polymer catheters, or cannulae (**B1**).
- ✓ **R2** – It is recommended not to use steel cannulae in the case of the administration of products able to induce cutaneous necrosis, because of the risk of extravasation (**D3**).

EQUIPMENT

- ✓ **R3** – It is strongly recommended to use equipment provided with safety systems (peripheral venous catheters or steel cannula devices) in the context of the protection of health-care workers from the risk of infection, and to train professionals in the use of such equipment (**A - Statutory**).
- ✓ **R4** – It is possible to use catheters with an injection port on the hub. Due to the lack of relevant studies, no recommendation other than those proposed for all catheters can be made. (**C3**).

“Catheterization”

SITE SELECTION

- ✓ **R5** – In adults, it is recommended to select an insertion site on an upper limb rather than on a lower limb (**B1**). It is recommended not to insert a catheter next to a joint (**D2**).
- ✓ **R6** – In pediatric patients, it is also possible to use the hand, instep, or scalp (**C2**).
- ✓ **R7** – It is strongly recommended not to insert a catheter into a limb on which lymph node dissection or radiotherapy has been carried out, or on which a malignant tumor has been diagnosed (**E3**).
- ✓ **R8** – It is strongly recommended not to insert a catheter into a limb with an arteriovenous fistula (**E3**).
- ✓ **R9** – It is strongly recommended not to insert a catheter in the vicinity of cutaneous weeping infectious lesions (**E3**).
- ✓ **R10** – It is strongly recommended not to insert a catheter into a limb with an orthopedic prosthesis, or into a paralyzed limb (**D3**).

OPERATOR’S GARMENTS

- ✓ **R11** – It is recommended not to adopt specific measures relative to the operator’s garments (in particular the wearing of a sterile gown, a mask and cap), since the present document deals specifically with the prevention of the risk of infection arising from peripheral venous catheters (**D3**).

HAND HYGIENE AND WEARING OF GLOVES

- ✓ **R12** – It is strongly recommended, before insertion of the catheter, to undertake hand disinfection, either by means of hygienic washing of the hands with an antiseptic soap (or antiseptic washing), or by disinfectant rubbing with an alcohol-based gel or solution (**A1**).
- ✓ **R13** – It is recommended to wear gloves in order to protect the user from accidental exposure to blood (standard precautions) (**A-Statutory**).
- ✓ **R14** – It is recommended to wear sterile gloves if the insertion site needs to be palpated following skin antiseptics (**B3**).

ANTISEPSIS OF THE SKIN

- ✓ **R15** – It is recommended not to remove hair from the insertion area (**D3**); if hair removal is indispensable, it is recommended to prefer clipper use (**B3**).
- ✓ **R16** – It is recommended to proceed with detergative cleaning (with an antiseptic soap, followed by rinsing and drying) before applying any antiseptic (**B2**). It is recommended, in the absence of antiseptic soap from the same family as the antiseptic, to use a mild liquid soap for the detergative cleaning phase (**B3**).
- ✓ **R17** – It is strongly recommended to carry out cutaneous antiseptics before inserting a peripheral venous catheter (**A1**).
- ✓ **R18** – It is recommended, for the antiseptics, to use chlorhexidine-alcohol (**B1**) or alcoholic povidone-iodine (**B3**).
- ✓ **R19** – An aqueous povidone-iodine solution may be used (**C1**). Chlorinated solutes and 70% alcohol may be used (**C3**); however no study has compared the efficacy of these products in the prevention of infections related to peripheral venous catheters.
- ✓ **R20** – It is recommended not to use an aqueous (0.05%) chlorhexidine solution, or iodine tincture (**D1**).
- ✓ **R21** – It is recommended to wait for spontaneous drying of the antiseptic after use (**B3**).
- ✓ **R22** – It is recommended to use the same family of antiseptic, for the same patient, at the time of catheterization or maintenance of the delivery system (**B3**).
- ✓ **R23** – It is recommended not to use acetone (**D2**).
- ✓ **R24** – In neonates it is strongly recommended not to use iodine compounds (**E1**).
- ✓ **R25** – In infants younger than 30 months, it is recommended to refer to the product characteristic summaries pertaining to their precautions for use (**A-Statutory**).
- ✓ **R26** – It is recommended to ensure there is traceability of catheter insertion in the patient's file: date of insertion, date of removal, size of catheter, insertion site, operator (**B3**).

USE OF LOCAL ANESTHETICS

✓ **R27** – It is recommended, when applying a topical anesthetic, to use single-dose or single-patient packaging (**B3**); in such a situation, during catheterization, it is strongly recommended to carry out a detergic cleaning phase prior to antisepsis (**A3**).

CONFIGURATION OF THE DELIVERY SYSTEM

✓ **R28** – It is recommended to select the simplest possible configuration (minimum number of lumens, connectors and ports) for the intended purpose of the catheter (**B3**).

✓ **R29** – It is recommended to prefer a delivery system configuration designed for minimal manipulation of the catheter hub, in particular through the use of an extension tube (**B3**).

DRESSING

✓ **R30** – It is recommended to cover the catheter injection site and to secure the catheter by using a transparent, semipermeable, sterile dressing made of polyurethane (**B1**), to allow visual inspection of the insertion site (**B3**).

✓ **R31** – It is recommended to use a sterile adhesive gauze dressing, in the case of bleeding or exudation (**B3**).

✓ **R32** – It is recommended to use adhesive sterile strips to attach the catheter, provided asepsis is maintained (**C3**).

✓ **R33** – It is recommended not to apply antiseptic or antibiotic ointments to the insertion site.

✓ **R34** – It is recommended to temporarily protect the dressing with an impermeable material whenever a shower is taken or it is exposed to water (**B3**).

“Utilization”

MANIPULATION OF THE CATHETER, TUBING AND STOPCOCKS

- ✓ **R35** – It is recommended, before any manipulation of the catheter or any of the delivery system components, to disinfect the hands, either by means of hand disinfection with an antiseptic soap (or antiseptic washing), or by hand rubbing disinfection with an alcohol-based gel or solution (**B2**).
- ✓ **R36** – It is recommended to disinfect the tips and stopcocks before they are manipulated, with the help of a sterile gauze pad dipped in alcoholic chlorhexidine, alcoholic povidone-iodine, or 70% alcohol (**B2**).
- ✓ **R37** – It is recommended to install a new sterile stopper each time the access or the stopcock is opened (**B3**).
- ✓ **R38** – It is recommended to keep the stopcock ramps at a good distance from any source of contamination (for example bed linen, wounds, stoma) (**B3**). In the absence of bibliographic evidence, it is not possible to make recommendations concerning the use of protection devices for junctions and stopcock ramps, for the purpose of preventing the risk of peripheral venous catheter-related infection.
- ✓ **R39** – It is possible to use needleless connectors as long as they are disinfected before the system is accessed in any way (**C2**).

LOCKS (HEPARIN AND ANTIBIOTIC LOCKS) - STOPPERS

- ✓ **R40** – It is recommended not to make use of an antibiotic lock to prevent venous catheter-related infections (**D3**).
- ✓ **R41** – In the absence of bibliographic arguments, it is not possible to propose a recommendation concerning the use of a heparin lock, of continuous heparinization, of a saline lock, or of a stopper, to maintain the catheter’s permeability.
- ✓ **R42** – It is recommended to abide by the antisepsis rules when using a heparin lock, continuous heparinization, a saline lock, or a stopper to maintain the catheter's permeability (**B3**).
- ✓ **R43** – When using a stopper, it is recommended to install a new sterile stopper every time the catheter has been accessed (**B3**).

“Maintenance”

FREQUENCY OF CATHETER REPLACEMENT

- ✓ **R44** – It is strongly recommended to remove the peripheral venous catheter as soon as it is of no further use **(A3)**.
- ✓ **R45** – It is strongly recommended to examine the insertion site at least once a day, for local signs of infection **(A3)**.
- ✓ **R46** – It is strongly recommended to remove the catheter in the case of a local complication or suspected catheter-related systemic infection **(A3)**.
- ✓ **R47** – In case of a suspected infection, it is strongly recommended to proceed with the aseptic removal of the distal cannula of the catheter and to communicate this item to the laboratory for a microbiological examination **(A3)**.
- ✓ **R48** – It is recommended to replace a catheter as soon as possible, if non-aseptic insertion is suspected **(B2)**.
- ✓ **R49** – In adults, it is recommended not to leave a catheter inserted for more than 96 hours **(B2)**. In a patient with limited venous access, provided the insertion site is carefully monitored, and in the absence of complications, it is possible to leave the catheter in place for a longer period of time **(C3)**.
- ✓ **R50** – It is recommended, in infants, not to change a catheter on a routine basis. Catheter changes are recommended only in the case of signs of complication **(B2)**.

DRESSING REPLACEMENT

- ✓ **R51** – It is strongly recommended, before handling the dressing, to disinfect the hands, either by means of hand washing with an antiseptic soap (or antiseptic washing), or by hand rubbing disinfection with an alcohol-based gel or solution. **(A3)**.
- ✓ **R52** – It is recommended to proceed with dressing replacement only when it becomes loosened or soiled, or when inspection of the site is necessary, under the same conditions as during dressing application. **(B2)**.

DELIVERY SYSTEM REPLACEMENT

- ✓ **R53** – It is recommended to replace the tubing after each administration of blood products, and within 24 hours following the administration of lipid emulsions (**B1**).
- ✓ **R54** – It is recommended to change the delivery system (tubing and accessories) whenever the catheter is changed (**B3**).
- ✓ **R55** – It is recommended to change the delivery system (tubing and accessories) every 96 hours if the catheter is to be left in place for longer than such a period (**B3**).

“Monitoring - Education - Evaluation”

- ✓ **R56** – It is strongly recommended to draft written procedures concerning the insertion, maintenance, monitoring and removal of peripheral venous catheters (**A2**).
- ✓ **R57** – It is strongly recommended to inform the patient of the infectious risk associated with peripheral venous catheters (**A - Statutory**).
- ✓ **R58** – It is recommended to involve the patient or close family and friends with the prevention and detection of an infection related to peripheral venous catheters, by means of a suitable educational approach (**B3**).
- ✓ **R59** – It is strongly recommended to clinically monitor the condition of the patient and the insertion site, on an at least daily basis (**A3**).
- ✓ **R60** – It is recommended to introduce an infectious risk surveillance program related to peripheral venous catheters; the surveillance strategy* should be drawn up by the CLIN (French Nosocomial Infection Control Committee) and the infection control team, in collaboration with the clinical units (**B2**).
- ✓ **R61** – It is recommended, in the context of a program for preventing peripheral venous catheter-related infections, to routinely evaluate** the methods applied by professionals in charge of the insertion and maintenance of peripheral venous catheters (**B3**).

1-1 Context

Short peripheral venous catheters are sterile medical devices, which are percutaneously inserted into a superficial vein. They are used for diagnostic or therapeutic purposes. They allow the parenteral administration of solutes, blood products, nutrient solutions, and medications. They are very commonly used, and are relevant in all fields of care. The annual number of peripheral venous catheters used in France is estimated to be 25 million. Catheters can be the source of potentially severe local or systemic infections. A comparison of infectious risks associated with the use of different types of catheter (central or peripheral, venous or arterial) shows that these decrease in the case of peripheral venous catheters. In the case of blood stream infections, short peripheral venous catheters are thus responsible for 4% to 8% of nosocomial bacteremias [2, 3], and 5% of iatrogenic bacteremias in ambulatory care [3]. An English study has shown that, in non-teaching hospitals, such catheters are the cause of nearly 20% of bacteremias associated with a medical device [2]. Local infections are more common.

The prevention of the intravascular catheter-related infection risk has already been dealt with by a set of recommendations, but these do not always deal specifically with peripheral venous catheters, and the proposed measures are frequently based on studies related to the use of central venous catheters [4-6].

The present document proposes specific recommendations for the prevention of the risk of infection associated with short peripheral venous catheters, during the various phases of their utilization. These recommendations are relevant for all professionals involved in the insertion, utilization, maintenance, monitoring and removal of this type of device. The use of short peripheral venous catheters for subcutaneous infusion is not dealt with in this document.

A summary of these recommendations is provided at the beginning of this document. They are also proposed to professionals in the form of a practical and operational summary card.

1-2 General methodology

The method used for drafting these recommendations is that of the “Recommendations for clinical practice” (RPC) proposed by the HAS (French National Authority for Health) [7], and described in Appendix 1, which also includes the bibliographical search strategy. In this document, for each aspect which is treated, the proposed recommendations are formulated in accordance with an assessment scale for the levels of evidence and ranking of recommendations, adapted from Kish: [8]

Ranking of recommendations

A = It is strongly recommended to ...

B = It is recommended to ...

C = It is possible to, or not to ...

D = It is recommended not to ...

E = It is strongly recommended not to ...

Levels of evidence

1 = At least one randomized trial of good quality.

2 = At least one trial without randomization or one case/control study, or one multi-center study, or one historical series, or at least the indisputable outcome of uncontrolled experiments.

3 = Expert opinion, results of a clinical study, or a descriptive study, or results of a professional consensus.

Each recommendation is preceded in the text by a reminder of the existing recommendations, with their bibliographic references, their evidence levels, and a critical analysis of recent literature.

All of the bibliographic references, ranked according to the order of their appearance in the text, are grouped together in the *Bibliography* chapter.

2-1 Definitions

2-1.1 The catheter and the delivery system

According to the AFNOR NF S 90-040 norm, short peripheral venous catheters are “tubes made of a plastic or elastomer material, of a length less than or equal to 80 mm, introduced by breaking into the vascular system for a limited period of time”. The catheter (see drawing in Appendix 2) comprises a flexible or rigid element, which is introduced into the vein, and a hub onto which the delivery system or “venous line” is connected. There are catheters of different lengths and diameters (Table in Appendix 2). Catheter hubs may or may not contain flexible plastic wings or an injection port.

Metallic devices or “needles” are also used to allow intermittent blood sampling or the repeated injection of medications; these cannula devices (drawing in Annex 2), intended for insertion into a vein, are non-reusable. The intravenous drip delivery system is comprised of the drip tubing and its accessories: extension tube, stopcock and ramp of stopcocks.

2-1.2 Infections associated with catheters

It is not the aim of this document to discuss the definitions of infections associated with catheters; the existing types of infection are complex and are not specific to short peripheral venous catheters [4, 5, 9]. However, for the purposes of the clinical or epidemiological monitoring of these infections, it is proposed here to make a simple distinction between local infections and systemic infections related to the catheter:

- Local infections include at least one clinical sign of infection at the insertion site (erythema, tenderness, collection or presence of pus) and a positive microbiological sample (sample taken from the catheter or the injection port).
- Systemic infections include at least one clinical sign of general infection and a positive microbiological sample (sample taken from the catheter or the injection port, or a positive hemoculture in the absence of any other recognized etiology).

In the absence of a clinical sign of infection, the growth of microorganisms, when the catheter tip is cultured, is considered to reveal colonization of the catheter. This simplification is linked to the on-going debate at the National Technical Committee for Nosocomial and Healthcare-Associated Infections (CTINILS), on the topic of the definitions to be used to describe the location of different infections.

2-2 Physiopathology

The occurrence of an infection related to a peripheral venous catheter can result from one of the following mechanisms:

A - Contamination of the catheter

- During catheter placement, from the patient's or the professional's cutaneous flora, from a contaminated antiseptic product, or from a catheter whose packaging integrity has not been respected (storage under unsuitable conditions, for example);
- During manipulations of the catheter or dressing, through contamination of the insertion site by the patient's or the professional's cutaneous flora;
- During manipulations of the delivery system.

B - Contamination of the injected products

This can occur during the production, storage or preparation of products.

C - Hematogenous contamination of the catheter from a remote infectious site.

2-3 Epidemiology

Peripheral venous catheters are very frequently utilized. The national survey concerning the prevalence of nosocomial infections in healthcare institutions, carried out in France in 2001, thus revealed that 18% of patients hospitalized for more than 24 hours had been catheterized with a peripheral catheter; in this survey 90% of vascular catheters were peripheral venous catheters [\[10\]](#).

Various studies, of which some are described below, show that the risk of systemic infection

resulting from the use of peripheral venous catheters is lower than that related to the use of central catheters. A study of infections related to catheter use was carried out by the inter-regional Paris North Coordinating Centre for nosocomial infection control (CCLIN Paris Nord), based on the data collected in the above-mentioned survey [10]: the prevalence of infections related to the use of catheters was 0.67% in patients with peripheral venous catheters, and 2.18% in patients with central catheters. The English *Nosocomial Infection National Surveillance Scheme*, in which 17 teaching and 56 non-teaching hospitals participated from 1997 to 2001, paid specific attention to medical device-related bacteremia [2]. In the teaching hospitals, peripheral venous catheters were responsible for 7.4% and central catheters were responsible for 73.1%, of device-related nosocomial bacteremia; in non-teaching hospitals, these numbers were respectively 19.2% and 51.7%. A French prospective multi-center study of nosocomial infections related to anesthesia found an infection rate, relevant to peripheral venous catheters, of 1 per 1000 patients [11]. The study included 7339 adults receiving general anesthesia, anesthesia of the spine or a peripheral nerve group, or a combination of the two forms of anesthesia, for a clean or clean-contaminated contamination class of operation. Among the 25 observed nosocomial infections, 7 were related to peripheral venous catheters [11]. In the nosocomial bacteremia surveillance scheme organized in France, the results for the year 2002, supplied by the *national program for early warning, investigation and surveillance of healthcare-associated infection* in France (RAISIN), was based on 268 participating hospitals, including 120,154 beds and 12,640,959 hospital days [3]; 6269 nosocomial bacteremias, and 580 ambulatory iatrogenic bacteremias were noted, of which respectively 4.8% and 4.3% were related to short peripheral venous catheters. Nearly half of these infections were microbiologically recorded [3].

The microorganisms most frequently involved are those found in the skin flora, mainly coagulase-negative *staphylococci* and *staphylococcus aureus*, followed by enterobacteriaceae. In the study made by Coello [2], staphylococci are identified in 71.4% of bacteremias related to peripheral catheters; in the RAISIN program [3], staphylococci are involved in 70% of nosocomial bacteremias related to a central or peripheral catheter.

3-1 Material

3-1.1 Literature review

A – Existing recommendations

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC - 2002 [4]

The CDC references include four studies, comparing peripheral venous catheters with each other, and with steel cannula devices:

- two randomized studies 2002 [12, 13], one comparing tetrafluoroethylene (Teflon®) and polyurethane (Vialon®), and the other a steel cannula device with a Teflon® catheter: no difference was found in terms of infections;
- one non-randomized study [14], comparing polyvinylchloride (PVC) with Teflon®: this revealed a lower colonization rate (≥ 15 colonies per box) with Teflon® (24.6% vs 6.9%; $p < 0.001$);
- one descriptive study of complications related to steel cannula devices [15]. The CDC recommendations did not deal with the material, but with the non-utilization of steel cannula devices for the administration of products capable of producing necrosis in the case of extravasation **(IA)** [13, 15].

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

Apart from the studies already cited, the bibliography includes an *in vitro* study of material adherence [16], which has revealed a lesser adherence of *staphylococcus aureus* to silicon steel ($9.9 \pm 0.9 \times 10^5$ bacteria/cm²), when compared with Teflon® ($37.2 \pm 2.8 \times 10^5$ bacteria/cm²) and polyethylene ($168.4 \pm 15.6 \times 10^5$ bacteria/cm²).

The following recommendations were made:

“The selection of polyurethane, silicone or Teflon® catheters, or cannula devices, should be

based on the operating instructions for these catheters or cannula devices **(BII)** [14, 16].

There is no data indicating that steel cannula devices are superior or inferior to catheters in terms of the prevention of infections **(C)**.

There is insufficient data available for a recommendation to be made for or against the use of catheters impregnated with antimicrobial or antiseptic products **(C)**.”

> “**100 recommendations for the surveillance and prevention of nosocomial infections**” – CTIN - 1999 [5]

Recommendation No 85 was as follows: “steel needles appear to be less irritating than Teflon or polyurethane catheters, but expose the patient to the risk of extravasation of intravenous drip solutions and to an increased risk of injury”.

> “**Good practice guidelines for the prevention of infections associated with healthcare dispensed outside health facilities**” – CTIN – 2004 (2005 edition) [17]

The following recommendation was expressed: “Prefer catheters with Teflon® or polyurethane cannulae to steel needle cannulae, which expose the patient to the risk of extravasation of intravenous drip solutions and to an increased risk of injury”.

B – Critical analysis of recent literature

At the present time there are no short peripheral venous catheters, impregnated with heparin, antiseptics or antibiotics. The literature search found one randomized trial comparing polyurethane and tetrafluoroethylene [12] and one *in vitro* study of the adherence of microorganisms as a function of the material [18]: PVC, silicone elastomer, polyurethane, or tetrafluoroethylene. In a randomized trial, complications (phlebitis, infection) were searched for by means of daily inspections of the insertion site, and catheter culturing was carried out at the time of removal. The study was performed on 1054 short peripheral venous catheters. It demonstrated the better efficacy of Vialon® (polyurethane) when compared to Teflon® (tetrafluoroethylene) in the prevention of phlebitis (multivariate analysis: RR = 0.73; 95% CI [0.59 – 0.90]; p < 0.003); the local catheter-related infection rates were not statistically different in the 2 groups (Vialon®: 6.9%; IC₉₅ [4.9% – 9.6%] versus Teflon®: 5.4%; 95% CI [3.8% – 7.6%]; p < 0.05); no catheter-related bacteremia was observed in this study. The *in vitro* study of the kinetic adherence of the germs most commonly found in infections associated with peripheral venous catheters [18] (*S. aureus*, *S. epidermidis*, *P. aeruginosa*, *E. coli*), as a

function of material, showed that PVC or silicone elastomer catheters provided greater adherence for bacteria (2 to 6 times greater; $p < 0.05$) than those made from Vialon® (polyurethane) or Teflon® (tetrafluoroethylene). Vialon® (polyurethane) offered the lowest adherence for *staphylococci*, whereas Teflon® (tetrafluoroethylene) offered the lowest adherence for *E. coli* and *Pseudomonas*. None of these two studies observed a significant difference in favor of polyurethane or tetrafluoroethylene.

3-1.2 Recommendations

- ✓ **R1** – In order to prevent the risk of infection, it is recommended to use polyurethane or fluoropolymer catheters, or steel cannula devices (**B1**).
- ✓ **R2** – It is recommended not to use steel cannula devices in the case of the administration of products able to induce skin necrosis, because of the risk of extravasation (**D3**).

3-2 Equipment

3-2.1 Literature review

A – Existing recommendations

> **DGS/DH Circular – No 98/249 of April 20, 1998**, concerning the prevention of the transmission of infectious agents carried by the blood or by biological fluids, during hospital care [19].

This circular states that “So-called medical safety devices – sampling needles, catheters, containers, etc. – permit the risk of blood and body fluid exposure (BBFE) accidents to be reduced”. They must be considered as an additional means of precaution, with respect to general hygiene precautions. According to the recommendations of the French Working Group on the Risk of Blood Exposure (GERES), medical devices used for surgical operations must be selected from those whose safety has been demonstrated, and which (in order of preference) have:

- an integrated safety mechanism,
- the earliest possible (with respect to the intended act) automatic safety action,
- an irreversible single-handed activation, with a safety action indicator for devices requiring operator activation.

Before installing this equipment in health care units and technical units, it is imperative to ensure its compatibility with the pre-existing equipment. Operating instructions for such medical devices must be prepared by the Committee for nosocomial infection control (CLIN), and practical training in their manipulation must be given to the users. Finally, their correct use in health care units must be regularly assessed. Among these safety devices, containers for sharp objects represent a demonstrated and indispensable means of preventing BBFEs. The choice of equipment must be made according to safety criteria (suitable volume, visible maximum filling level, stability, leak-tightness, etc.). In order to optimize their use, the paramedical staff in charge of the safety of each unit must ensure that such equipment is rigorously managed: permanent supply, positioning as close as possible to care areas, container disposal as soon as the maximum filling level is reached”.

> **”Safety equipment guide: GERES”** Ministry for health, family and physically or mentally challenged persons - 2004 [20]. This guide recommends the use of:

- short protected catheters, safety butterfly needles (flash infusion), and needle-less connection systems;
- short protected catheters for subcutaneous intravenous drips (plastic cannula).

B – Critical analysis of recent literature

A randomized trial [20] compared the risks of BBFE between a protected and an unprotected catheter under anesthesia. The influence of the use of this equipment in terms of risk of infection for the patient was not evaluated. The difficulty in attaining the venous access, the number of catheters used, the presence of blood on the skin, the operating table preparation and the operator’s garments were evaluated in this study, including 473 catheter placements in 330 patients; no needle-related injury was observed; blood splash occurrences were 4 times more frequent with safety catheters than with non-safety catheters (a total of 77 blood splash incidents were observed in 42 patients). This difference was significant when the catheter was inserted by a skilled operator (40.2% for safety catheters, 9.4% for non-safety catheters), whereas it was non-significant in the case of trainees (10.8% for safety catheters, 10.8% for non-safety catheters). The results of this study confirm the impression that the utilization of safety equipment by professionals must be accompanied by training and assessment actions. The authors conclude that professionals must select the device allowing them to achieve the best venous access as well as the least risk of exposure to blood. No study was found dealing with catheters equipped with a hub injection port.

3-2.2 Recommendations

- ✓ **R3** – It is strongly recommended to use equipment provided with safety systems (peripheral venous catheters or steel cannula devices) in the context of the protection of health-care workers from the risk of infection, and to train professionals in the use of such equipment (**A - Statutory**).
- ✓ **R4** – It is possible to use catheters with an injection port on the hub. Due to the lack of relevant studies, no recommendation other than those proposed for all catheters can be made. (**C3**).

4-1 Choice of insertion site

4-1.1 Literature review

A – Existing recommendations

The following bibliographic references deal mainly with central venous catheters or arterial catheters [15, 22-28].

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC – 2002 [4].

This CDC document indicates that: “The site at which the catheter is placed influences the risk of catheter-related infection and phlebitis. The influence of the site on the risk of catheter infections is related both to the risk of thrombophlebitis, and to the density of local skin flora. Phlebitis has long been recognized as an infection risk factor. For adults, the lower limbs are associated with a higher risk for infection than the upper limbs [23, 25]. In addition, hand veins have a lower risk of phlebitis than wrist or forearm veins [26]”.

The following recommendations were made:

- In adults, the catheter should preferentially be inserted in one of the upper limbs. A catheter inserted in a lower limb must be removed as soon as possible, and be replaced by another catheter in an upper limb **(IA)** [15, 22].
- In pediatric patients, the hand, the instep and the scalp can be used **(II)**”.

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

This Health Canada document specifies that: “It was previously recommended to avoid selecting an insertion site in the lower body, under the assumption that the high microbial density in regions below the groin was likely to compromise maintaining asepsis at the insertion site, and augmenting the risk of infection. Neither observational studies, nor a

randomized prospective study have allowed this hypothesis to be confirmed [27, 28]”.

The following recommendations were made:

- In adults, it may be preferable, for reasons of convenience, to choose an insertion site in the upper extremities. There is no evidence of any increased risk of infection in lower extremity sites.
- In pediatric patients, the hand, the instep, or the scalp may also be used **(BIII)**”.

> “**Good practice guide for venous catheterism**” – CCLIN Paris North – 2006 [6].

The following recommendations were made:

“Prefer an upper limb, the hands and forearm, starting from the distal part of the limb and avoiding folds: basal vein, cephalic vein, vein of the *cubital fossa*, dorsal vein of the hand **(BI)**”.

- Absolute contra-indications:

- The catheter must not be inserted:
- > where an axillary lymph node dissection has been carried out,
 - > where there is an orthopedic or vascular apparatus,
 - > where there has been a cancer or a medical history,
 - > where there is an arteriovenous fistula.

- Relative contra-indications:

- The catheter must not be inserted:
- > on the hemiplegic side,
 - > in infectious or weeping skin lesions.

B – Critical analysis of recent literature

The influence of the position of the insertion site on the risk of colonization or infection, related to peripheral venous catheters, has been taken into account in three prospective, non-randomized studies [29-31].

The main purpose of the prospective observational study of Bregenzler [31], dealing with 609 peripheral venous catheters placed on adults, was to evaluate the influence of the duration of catheterization on the risk of infection. Positioning of the catheter on the wrist, compared with

the forearm, is an independent catheter obstruction risk factor (RR = 3.626; $p < 0.001$); the risk of catheter colonization, analyzed by systematic culturing of the catheter using Maki's semi-quantitative method, is independent of the insertion site. During the course of this study, no catheter related infection was observed.

The main purpose of the prospective, non-randomized and non-contemporary comparative study of Garland [29], carried out in neonatology, was to compare povidone-iodine versus tincture of chlorhexidine for insertion site antiseptics for the prevention of peripheral venous catheter colonization. During the first 6 months, the antiseptic used was povidone-iodine; 408 peripheral venous catheters were placed, of which 38 (9.3%) became colonized. During the 6 following months, the antiseptic used was tincture of chlorhexidine; 418 catheters were placed, of which 20 (4.7%) became colonized ($p = 0.01$). Although the position of the catheter insertion site (on the hand, foot, or ankle) is a risk factor in univariate analysis (RR = 1.2; 95% CI = [1.1-1.3]; $p = 0.02$), multivariate analysis shows that this position is not a significantly independent risk factor for catheter colonization. Substantial skin colonization before catheter insertion is, on the other hand, an independent risk factor for catheter colonization (RR = 3.0; 95% CI [1.8-4.8]; $p = 0.001$).

Barbut[30] carried out a prospective observational study of complication risk factors related to peripheral venous catheters, based on the use of 525 catheters corresponding to 1036 days of catheterism. The catheters were all cultured according to the semi-quantitative methods described by Brun-Buisson. Multivariate analysis shows that the articular positioning of catheters (wrist, elbow and ankle versus hand and forearm) is an independent factor for catheter colonization (OR = 2.94; $p = 0.01$). Only the latter study [30] showed that positioning at an articular site was an independent risk factor for catheter colonization.

4-1.2 Recommendations

- ✓ **R5** – In adults, it is recommended to select an insertion site on an upper limb rather than on a lower limb (**B1**). It is recommended not to insert a catheter next to a joint (**D2**).
- ✓ **R6** – In pediatric patients, it is also possible to use the hand, instep, or scalp (**C2**).
- ✓ **R7** – It is strongly recommended not to insert a catheter into a limb on which lymph node dissection or radiotherapy has been carried out, or on which a malignant tumor has been diagnosed (**E3**).
- ✓ **R8** – It is strongly recommended not to insert a catheter into a limb with an arteriovenous fistula (**E3**).
- ✓ **R9** – It is strongly recommended not to insert a catheter in the vicinity of cutaneous weeping infectious lesions (**E3**).
- ✓ **R10** – It is strongly recommended not to insert a catheter into a limb with an orthopedic prosthesis, or into a paralyzed limb (**D3**).

4-2 Operator's garments

4-2.1 Literature review

A – Existing recommendations

No recommendation was found concerning the operator's garments for the insertion of a peripheral venous catheter, other than the CCLIN Paris North Guide, which recommends the wearing of clean garments [6].

B – Critical analysis of recent literature

A systematic review of the literature found no study dealing with the operator's garments for the prevention of the risk of infections related to peripheral venous catheters. However, a randomized trial compared the infectious risk related to peripheral arterial catheters, between a group in which the maximal sterile barrier precautions (SBP) were used (sterile gown, cap, mask, sterile sheet, sterile gloves) and a control group in which the measures included the wearing of sterile gloves [32]. The SBP and control groups included 129 and 143 patients, corresponding to 1141 and 1202 catheter-days, respectively. The author was able to reveal a

significant reduction, neither in the rate of local infection (0.9 per 1000 days, versus 4.2; $p > 0.1$), nor in the rates of incidence of systemic infection (1.8 per 1000 days versus 1.7; $p > 0.1$), nor in the rates of catheter colonization (17.8% versus 13.3%; $p > 0.1$).

4-2.2 Recommendations

✓ **R11** – It is recommended not to adopt specific measures relative to the operator’s garments (in particular the wearing of a sterile gown, a mask and cap), since the present document deals specifically with the prevention of the risk of infection arising from peripheral venous catheters (**D3**).

4-3 Hand hygiene and sterile gloves

4-3.1 Literature review

A – Existing recommendations

The recommendations given below are related mainly to central venous catheters or arterial catheters [15, 22-28].

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC – 2002 [4].

The CDC bibliography includes 5 references relating to hand-washing techniques [33, 37], an observational study relating to all types of catheter [36], and two studies relating to all types of infection acquired in critical care [33, 38]. CDC’s analysis indicates that for peripheral catheters, correct hand hygiene before insertion or manipulation of the catheters, associated with adherence to an aseptic technique during manipulations of the catheter, prevented infection. Correct hand hygiene can be ensured through the use of: either alcohol-based solutions [39], or an antiseptic soap [36]. Observance of an aseptic technique does not imply the use of sterile gloves. A non-sterile pair of gloves can be associated with a “contactless” (or “no touch”) technique for the insertion of peripheral venous catheters. The wearing of gloves is part of the standard precautions for the prevention of blood and body fluid exposure.

The CDC recommendations, common to all types of catheter, were the following: “Observe proper hand-hygiene procedures either by using an alcohol-based handrub gel or solution, or by hygienic hand washing with a conventional antiseptic liquid soap. These hand hygiene

procedures must be carried out before and after palpation of the insertion site, before and after catheter insertion, and before and after application or replacement of a dressing. The catheter insertion site must not be palpated following skin asepsis, unless an aseptic technique is maintained **(IA)** [33, 34-38, 40]. The use of gloves does not obviate the need for hand hygiene **(IA)**” [37, 38, 40].

> **“Preventing infections associated with indwelling intravascular access devices”** – Federal Ministry of Health, Canada – 1997 [5]

In addition to the CDC references, this document includes a study dealing with the full range of infections acquired in critical care [41].

The Health Canada recommendations were as follows: “The personnel must wash their hands before inserting or manipulating intravascular catheters. Meticulous hand washing is the most important measure; the optimal hand-washing duration is however not known **(BIII)**. The quality of hand washing may be more important than the choice of cleansing agent [36, 41]. However, it may be prudent to use an antiseptic formulation for hand washing prior to insertion of any intravascular catheter **(C)**.”

B – Critical analysis of recent literature

A systematic review of the literature led to the identification of one prospective, multi-center, observational study measuring the influence, on infectious complications related to peripheral venous catheters, of the application of hand hygiene techniques before catheter insertion [42]. This study was carried out in 3 Austrian hospitals and concerned the use of 1132 peripheral venous catheters. These results do not contribute much information, since the evaluation criterion was the appearance of at least one clinical sign of local inflammation, purulence at the insertion site, or the occurrence of an unexplained fever, but no microbiological examination was required to confirm the infection. Signs of inflammation were more frequent, and two cases of suppuration and unexplained fever were observed. In addition, the wearing of gloves was recognized as a hand hygiene measure, as shown by a comparison between the following four groups: no hand disinfection measure at all (reference group), simple hand washing, wearing of gloves, disinfection with an alcohol-based solution. The occurrence of at least one complication was less frequent in the glove-wearing group (RR = 0.52; 95% CI: [0.33-0.85]) and in the hydro-alcoholic solution disinfection group (RR = 0.65; 95% CI: [0.47-0.91]). In this study, we note that the wearing of gloves was observed in only 16% of catheterizations, and that, in more than one quarter of cases (27%), no hand hygiene measure was applied at all.

In France, in a prospective, observational, monocentric study, related to the observation of recommendations for the insertion of peripheral venous catheters in pre-hospital emergency medicine, Lapostole [43] observed that in 41% (273 / 664) of cases the use of gloves, and in 44% of cases, hand disinfection (antiseptic), were not performed. In this study, alcohol-based products were not used.

4-3.2 Recommendations

- ✓ **R12** – It is strongly recommended, before insertion of the catheter, to undertake hand disinfection, either by means of hygienic washing of the hands with an antiseptic soap (or antiseptic washing), or by disinfectant rubbing with an alcohol-based gel or solution (**A1**).
- ✓ **R13** – It is recommended to wear gloves in order to protect the user from accidental exposure to blood (standard precautions) (**A-Statutory**).
- ✓ **R14** – It is recommended to wear sterile gloves if the insertion site needs to be palpated following skin antisepsis (**B3**).

4-4 Skin antisepsis

4-4.1 Literature review

A – Existing recommendations

The recommendations cited by the 2 following documents include studies specific to peripheral venous catheters, of which one was a non-randomized trial carried out in neonatology[29], revealing a lesser rate of catheter colonization when skin asepsis was performed with alcoholic chlorhexidine, versus povidone-iodine. The other studies dealt with central or arterial catheters [44-48], antisepsis before hemoculture [49], and the type of antiseptic used for hand washing [50, 51] or dressings [52].

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC - 2002 [4].

In the United States, povidone-iodine is the most commonly used antiseptic for the preparation of insertion sites for arterial or central venous catheters [44]. In one study, the preparation of insertion sites for arterial and central venous catheters, with a 2% aqueous chlorhexidine solution, reduced the rate of systemic infection when compared with a cutaneous preparation using 10% povidone-iodine or 70% alcohol [45]. Products containing chlorhexidine at this concentration have been available on the market only since July 2000, at which date the FDA authorized 2% tincture of chlorhexidine gluconate for cutaneous antiseptics. Other chlorhexidine preparations turned out to be less efficient. A study carried out in adults [46] has shown that a 0.5% chlorhexidine gluconate solution was not more efficient than 10% povidone-iodine, neither for the prevention of catheter-related bacteremias, nor for the prevention of the colonization of central venous catheters. In a study carried out in neonates, the use of 0.5% chlorhexidine reduced the rate of peripheral venous catheter colonization, when compared with 10% povidone-iodine (20/418 versus 38/408 catheters; $p = 0.01$) [29]. This study, which did not include central catheters, included a sufficient number of subjects to reveal a difference in bacteremia rates. A 1% chlorhexidine solution is available in Canada and Australia, but not yet in the United States. No published trial has compared 1% chlorhexidine with povidone-iodine.

The recommendations, common to all types of catheter, were as follows: “Disinfect clean skin with a suitable antiseptic before catheter insertion, and whenever dressings are changed. Although a 2% chlorhexidine-based preparation is preferred, tincture of iodine, an iodophor, or 70% alcohol can also be used **(IA)** [29, 45, 47, 49]. No recommendation can be made for the use of chlorhexidine before the age of 2 months (unresolved issue). Allow the antiseptic to remain long enough for it to take effect, and air dry before catheter insertion. Allow povidone-iodine to remain on the skin for at least 2 minutes, or longer if it is not yet dry before the catheter is inserted **(IB)**. Organic solvents (e.g., acetone) should not be applied before insertion or during dressing changes **(IA)**” [52].

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

An analysis made by Health Canada indicated that, when compared with the use of a 10% povidone-iodine solution or 70% alcohol, infection rates are lower when a 2% aqueous chlorhexidine gluconate solution is used for cutaneous asepsis, before the insertion of central

venous and arterial catheters [45]. 70% isopropyl alcohol, associated with a 0.5% solution of chlorhexidine gluconate, has been found to be efficient under laboratory conditions [50, 51], and a non-randomized, sequential prospective study has shown that it gave better results than a 10% povidone-iodine solution, in the prevention of colonization of peripheral intravenous catheters in neonates [29]. An observational study relating to “Broviac” catheters used for parenteral nutrition revealed a lower rate of infection with chlorhexidine gluconate than with a 10% povidone-iodine solution [48].

The recommendations of Health Canada were as follows: “Disinfect the insertion point with an antiseptic of proven efficacy. Chlorhexidine gluconate preparations (2% aqueous solution or 0.5% solution in 70% isopropyl alcohol) may provide good results [29, 45, 48]. Although the efficacy of 0.5% alcoholic chlorhexidine gluconate preparations has not yet been confirmed by randomized prospective studies, *in vitro* and observational studies suggest that it could be greater than that of iodophors [29, 48]. Other suitable agents include 10% povidone-iodine, 1% tincture of iodine, and 70% isopropyl alcohol. It is advisable to refer to the manufacturer’s instructions as some products can be incompatible with alcohol-based preparations. Whatever agent is used, the skin must be disinfected for at least 30 seconds (there is no known optimal duration for the preparation of the point of insertion) and allowed to dry. Benzalkonium chloride [53] or hexachlorophene should not be used to disinfect the point of insertion of an intravascular catheter **(AII)**. We do not have sufficient data to recommend or advise against the removal of an iodophor after its application. Removal may reduce skin irritation, but does not halt the continuous release of iodine. Tincture of iodine should be removed **(C)**. Acetone must not be used to ‘defat’ the skin **(EII)** [52].”

B – Critical analysis of recent literature

The literature analysis paid particular attention to the choice of antiseptic, and to the choice of its method of application, in particular the use of a four-step (detergent cleaning, rinsing, drying, antiseptics), or a single-step (antiseptics) procedure.

Concerning the choice of antiseptic, povidone-iodine or chlorhexidine based antiseptics are the most commonly used. The *in vitro* spectrum and antimicrobial activity of povidone-iodine are greater than those of chlorhexidine. These two active ingredients currently exist in either aqueous or alcoholic solutions. Alcohol-based antiseptics have the advantage of a better efficacy with respect to cutaneous flora and reduce the drying time with respect to aqueous solutions. Several trials have been carried out in order to compare the risk of catheter-related infection, or the risk of catheter colonization, depending on the nature of the antiseptic. Most of

these trials were based on the use of central venous or arterial catheters [45-47]. Analysis of the literature has enabled a meta-analysis [54] to be retained, and a non-randomized trial in neonatology [29] to be identified, comparing 10% aqueous solutions of povidone-iodine with 0.5% chlorhexidine solutions in isopropyl alcohol (a formulation not available in France). These two studies are described below; their results favor the use of chlorhexidine. 70% alcohol and chlorine-based products were not studied in the context of peripheral venous catheters, but have a recognized antimicrobial activity. No trial was identified, in which alcoholic povidone-iodine and an alcoholic solution of chlorhexidine were compared, in terms of a reduction in the risk of infection associated with peripheral venous catheters; however, one trial compared chlorhexidine and povidone-iodine in an alcoholic solution in terms of a reduction in cutaneous colonization following antisepsis [55].

In a meta-analysis, Chaiyakuaprok [54] included 8 randomized trials comparing chlorhexidine and povidone-iodine. In the case of chlorhexidine, either a solution of 0.5% chlorhexidine in 70% alcohol, or an alcoholic solution of 1% chlorhexidine (3 trials), or a solution combining 0.25% chlorhexidine, 0.025% benzalkonium chloride and 4% benzyl alcohol (1 trial), was used. In all trials, the povidone-iodine was in a 10% aqueous solution. The results indicate better efficacy of chlorhexidine for all types of catheter in terms of preventing catheter colonization (global RR = 0.49; 95% CI [0.31-0.78]) and catheter-related bacteremias (global RR = 0.50; 95% CI [0.28-0.91]). When only peripheral catheters are considered, only the risk of catheter colonization is significantly decreased (colonization RR = 0.39; 95% CI [0.21-0.71]); the RR of catheter-related bacteremia is 0.45, with a 95% CI of [0.23-1.17]. The analysis involving only those trials in which chlorhexidine was in an alcoholic solution indicates a significant reduction in the rates of catheter colonization and catheter-related septicemia. The analysis including only those trials in which chlorhexidine was in an aqueous solution indicate a significant reduction in the rates of colonization, but not in the rates of catheter-related bacteremia. The study power was not indicated.

Among the studies included in this analysis, one was specific to peripheral venous catheters [56]. It found a significant difference in terms of catheter colonization in favor of an alcoholic chlorhexidine solution (568 catheters), when compared with povidone-iodine (549 catheters) (RR = 0.40; 95% CI [0.18-0.85]); the difference was not significant in terms of bacteremia (0.5% in each group, RR = 0.97; 95% CI [0.20-4.77]).

Garland carried out a non-randomized trial on peripheral venous catheters in neonates [29]. This trial indicates lower catheter colonization rates for an alcoholic chlorhexidine solution, than for an aqueous povidone-iodine solution (9.3% versus 4.7%; $p = 0.01$). The difference in terms of bacteremia was not analyzed, since only two bacteremias occurred during the study.

A randomized trial, carried out on 22 voluntary subjects, did not reveal any difference in terms of a reduction in cutaneous flora, 30 seconds, 3 minutes, and two hours after application of cutaneous antiseptics, when comparing an alcoholic povidone-iodine solution with an alcoholic chlorhexidine solution [55]. This trial involved a four-step antiseptics procedure. The power was 90% for a 0.25 Log₁₀ difference in cutaneous flora reduction.

Concerning single-step or four-step antiseptics, no trial was found comparing these two techniques. Nevertheless, Garland's study shows that significant colonization of the skin before antiseptic application is an independent risk factor for catheter colonization (RR = 3.6; 95% CI [1.9-7.0]), and these results provide indirect support for the 4-step antiseptics technique [29].

In the context of cutaneous preparation before catheter insertion, depilation may be necessary, in order to simplify catheterization. The only study to have taken this factor into account is that of Barbut [30]. Shaving was not an independent risk factor for catheter colonization in this study. In other domains, in particular the prevention of infections on an operating site, this question has been more widely studied. The consensus conference concerning the preoperative management of infectious risk [57] reached the following conclusions: 1) it has been demonstrated that mechanical shaving, the day before an operation, is a risk factor to be formally prohibited; 2) the absence of depilation around the operating site, compared with depilation, no matter what method is used, is the simplest and safest method, provided this does not affect pre- and post- operative requirements; 3) if depilation is judged to be unavoidable, the retained technique must be non-aggressive, adapted to the type of operation, the hairiness of the patient, and must be well tolerated. Clipper based or chemical removal of the hair are reasonable choices, provided these techniques are perfectly mastered.

4-4.2 Recommendations

- ✓ **R15** – It is recommended not to remove hair from the insertion area (**D3**); if hair removal is indispensable, it is recommended to prefer clipper use (**B3**).
- ✓ **R16** – It is recommended to proceed with deterative cleaning (with an antiseptic soap, followed by rinsing and drying) before applying any antiseptic (**B2**). It is recommended, in the absence of antiseptic soap from the same family as the antiseptic, to use a mild liquid soap for the deterative cleaning phase (**B3**).
- ✓ **R17** – It is strongly recommended to carry out cutaneous antiseptics before inserting a peripheral venous catheter (**A1**).
- ✓ **R18** – It is recommended, for the antiseptics, to use chlorhexidine-alcohol (**B1**) or alcoholic povidone-iodine (**B3**).
- ✓ **R19** – An aqueous povidone-iodine solution may be used (**C1**). Chlorinated solutes and 70% alcohol may be used (**C3**); however no study has compared the efficacy of these products in the prevention of infections related to peripheral venous catheters.
- ✓ **R20** – It is recommended not to use an aqueous (0.05%) chlorhexidine solution, or iodine tincture (**D1**).
- ✓ **R21** – It is recommended to wait for spontaneous drying of the antiseptic after use (**B3**).
- ✓ **R22** – It is recommended to use the same family of antiseptic, for the same patient, at the time of catheterization or maintenance of the delivery system (**B3**).
- ✓ **R23** – It is recommended not to use acetone (**D2**).
- ✓ **R24** – In neonates it is strongly recommended not to use iodine compounds (**E1**).
- ✓ **R25** – In infants younger than 30 months, it is recommended to refer to the product characteristic summaries pertaining to their precautions for use (**A-Statutory**).
- ✓ **R26** – It is recommended to ensure there is traceability of catheter insertion in the patient's file: date of insertion, date of removal, size of catheter, insertion site, operator (**B3**).

Important remark

For children (from birth, including premature births, and up until the age of 15 years), professionals may consult the “Good practice guidelines for antiseptics with children” drafted by the SFHH, to be published in the near future.

4-5 Use of local anesthetics:

4.5.1 Literature review

A – Existing recommendations

No recommendation was found in the previously mentioned documents.

B - Critical analysis of recent literature

A systematic review of the literature did not reveal any studies relating to the possible consequences of applying topical anesthetics when inserting central or peripheral catheters, on the catheter-related risk of infection, or on the effectiveness of antisepsis.

4.5.2 Recommendations

✓ **R27** – It is recommended, when applying a topical anesthetic, to use a single-dose or a single-patient presentation (**B3**); in such a situation, during catheterizing, it is strongly recommended to carry out a detergic cleaning phase prior to antisepsis (**A3**).

4-6 Configuration of the infusion device

4.6.1 Literature review

A - Existing recommendations

> "[Guidelines for the prevention of Intravascular Catheter-Related Infections](#)" - CDC – 2002 [4]

No recommendation is made on this topic.

> "[Preventing Infections associated with Indwelling Intravascular access devices](#)" - Public Health Agency of Canada – 1997 [5]

Health Canada's recommendations stated that: "The simplest possible configuration (minimum number of lumens, connectors and ports) should be selected for the intended purpose of the line (BII)". This recommendation applies to all types of catheter.

B - Critical analysis of recent literature

No trial was made comparing the consequences of the infusion device configuration and the infectious risks associated with peripheral venous catheters.

4.6.2 Recommendations

- ✓ **R28** – It is recommended to select the simplest possible configuration (minimum number of lumens, connectors and ports) for the intended purpose of the catheter **(B3)**.
- ✓ **R29** – It is recommended to prefer a delivery system configuration designed for minimal manipulation of the catheter hub, in particular through the use of an extension tube **(B3)**.

4-7 Dressing

Two types of dressing are presently used: transparent semipermeable polyurethane dressings and adhesive dressings comprising a pad (made from "gauze") on a non-woven or polyurethane adhesive substrate. The transparent, semipermeable dressing makes it possible to continuously inspect the catheter insertion point; it is more waterproof than adhesive gauze dressings during normal washing, but is not appropriate for bathing. When blood is seeping from the insertion site, a "gauze" dressing is preferred to a transparent semipermeable polyurethane dressing. There are specific dressings for the maintenance of catheters whose injection site is located near to the hub. Sterile adhesive strips may be used for securing the catheter.

4.7.1 Literature review

A - Existing recommendations

Type of dressing

From the references listed below, few relate to peripheral venous catheters [58-74].

> **"Guidelines for the prevention of Intravascular Catheter-Related Infections"** - CDC – 2002 [4].

The review carried out by CDC showed that in the most relevant controlled trial on peripheral catheter dressings, the infectious risk associated with the use of transparent dressings was evaluated on approximately 2000 catheters [75]. The data provided by this study showed that the colonization rates of catheters are comparable for transparent dressings (5.7%) and adhesive gauze dressings (4.6%), and that there was no significant clinical difference in frequency of insertion point colonization or phlebitis. A meta-analysis combined studies which compared the catheter-related bacteremia risk for groups with transparent dressings *versus* groups with "gauze" dressings [76]: no difference was observed between the groups. The infection or phlebitis rates were equivalent for the two types of dressing. The CDC recommendations, which are not specific to peripheral venous catheters, were as follows: "Use sterile gauze or a sterile, transparent, semipermeable dressing to cover the catheter site **(IA)** [77-80]. In case of profuse perspiration or if the insertion site is bleeding or weeping, sterile gauze is preferable to a transparent, semipermeable dressing **(II)** [77-80]. The dressing should be changed if it becomes damp, loosened, or visibly soiled **(IB)** [77, 78]. In adults and adolescents, the dressing must be replaced at least once per week or according to individual circumstances **(IA)**.^[79] It should not be exposed to water. Showering may be permitted if precautions can be taken to reduce the likelihood of introducing organisms into the catheter (impermeable cover) **(II)**" [81, 82].

> **"Preventing infections associated with indwelling intravascular access devices"** - Public Health Agency of Canada – 1997 [5]

Analysis of the Health Canada document showed that heavy colonization of insertion sites is a well-documented risk factor for infections associated with indwelling devices [83]. It is recommended to cover the insertion site with a dressing in order to protect the open wound from contamination. One study found 10-fold more bacteria colonizing uncovered skin, and 100-fold more bacteria colonizing skin occluded by an impermeable dressing, as compared with skin covered by any of several types of transparent semipermeable or gauze dressings [84]. Few studies have specifically addressed the optimal frequency of dressing changes for catheters. Several studies, among which a meta-analysis, have addressed the issue of the type of dressing and its influence on cutaneous flora, and some of these have found increased bacterial colonization in the case of warm, moist insertion points occluded by transparent, semipermeable (both conventional and the newer, highly permeable)

dressings [75, 77, 85]. These studies must be interpreted carefully with respect to potentially confusing variables, such as dampness persisting under the dressing and differences in the relative permeability of the dressings [76, 77]. Certain transparent semipermeable dressings have been associated with an increased risk of infection [76, 86]. Compared with simple gauze dressings, transparent semipermeable dressings are more expensive but permit easy inspection of the site, stabilization of the catheter, and may offer an advantage for patients who are mobile.

The recommendations of Health Canada were as follows: "A sterile gauze dressing should be used and, unless the dressing or the skin surrounding the entry site becomes wet or soiled, may be left in place until the catheter is removed. Alternatively, a transparent semipermeable dressing (low or high permeability) may be used since the risk of bacteremia is extremely low with peripheral venous catheters (AI)" [75].

Antibiotic or antiseptic ointments at the insertion site under the dressing

None of the aforementioned references relates to peripheral venous catheters [58-74].

> "Guidelines for the Prevention of Intravascular Catheter-Related Infections" - CDC - 2002^[4]

The CDC analysis stated that the application of povidone-iodine when inserting hemodialysis catheters has been studied as a prophylactic measure to reduce the incidence of catheter-related infections. One randomized study of 129 hemodialysis catheters compared the routine use of a povidone-iodine ointment (n=63), *versus* no treatment (n=66). It has demonstrated a reduction in the incidence of infection of the insertion site (5% *versus* 18%, p<0.02), of catheter colonization (17% *versus* 36%, p<0.01) and of bacteremia (2% *versus* 17%, p<0.01) in the group that received a povidone-iodine ointment [59]. Several studies have evaluated the effectiveness of mupirocin ointment applied at the insertion sites of central venous catheters as a means of preventing catheter-related bacteremia [60, 61, 67]; although it reduces the risk of catheter-related bacteremia [61], mupirocin ointment also has been associated with the onset of mupirocin resistance [68, 70], and might adversely affect the integrity of polyurethane catheters [71, 72]. Other antibiotic ointments have also been studied and have yielded conflicting results [62, 63, 65]. The rates of catheter colonization with *Candida spp.* have been increased with the use of antibiotic ointments that have no fungicidal activity [62, 65]. To avoid compromising the integrity of the catheter, any ointment that is applied to the catheter insertion site should be checked against the manufacturer's recommendations concerning their

compatibility.

The CDC's recommendations specify that "the use of topical antibiotic ointments or creams on insertion sites is not recommended because of their potential to promote fungal infections and antimicrobial resistance **(IA)** [64, 70].

> **"Preventing infections associated with indwelling intravascular access devices"** - Federal Ministry of Health, Canada – 1997 [5]

Analysis of this Health Canada document demonstrated that although antimicrobial or antiseptic ointments may have been recommended for the maintenance of the insertion site, due to the theoretical advantage they provide because of their ability to suppress microbial growth at the insertion point, their application did not allow proper protection of peripheral venous catheter sites against infections. The trials carried out on topical antiseptics (povidone-iodine) at the insertion site of central venous catheters have yielded conflicting results. According to one study, the catheter-related bacteremia would be 4 times less frequent with this type of ointment [65]. The increased costs and the risk of promoting the occurrence of antibiotic-resistant microorganisms, as well as colonization by yeasts are other factors suggesting that the use of these ointments should not be recommended. Health Canada's recommendations, which are not specific to peripheral venous catheters, specified that "antimicrobial ointments are of no proven benefit and should not be applied as a routine infection prevention measure, and these ointments should not be applied at the time of dressing changes **(DII)**".

Important remark

Nasal carriage of *Staphylococcus aureus* is a central catheter-related bacteremia risk factor [59, 73]. Mupirocin ointment has been used intranasally to decrease nasal carriage and lessen the risk for catheter-related bacteremia. However, resistance to mupirocin has developed in both *S. aureus* and coagulase-negative *staphylococci* soon after it was put into routine use [68, 70]. For these reasons, it is recommended not to administer intranasal or systemic antimicrobial prophylaxis as a routine practice, before insertion or during use of a peripheral venous catheter, to prevent catheter colonization or catheter-related bacteremia **(IA)** [58, 66, 68, 69].

B - Critical analysis of recent literature

Hoffmann performed a controlled randomized comparative prospective study which compared

the incidence of phlebitis, catheter colonization (defined by the presence of more than 15 UFC after a semi-quantitative growth), skin colonization and secondary bacteremias, according to the type of dressing used to protect the peripheral venous catheter insertion site; the study dealt either with a transparent polyurethane occlusive dressing or a gauze dressing [76]. The study involved 598 patients hospitalized for 4 months; each patient was included only once. There was no significant difference in the catheter colonization rate (5.7% *versus* 4.4%), nor in the phlebitis rate (9.8% *versus* 7.6%) between both types of dressing. No bacteremia was observed. A correlation was found between catheter colonization and phlebitis ($p = 0.02$).

Hoffmann also carried out a meta-analysis, with a sub-group analysis for peripheral venous catheters [85]. It included 12 non-randomized prospective studies and compared polyurethane and gauze dressings. The use of transparent dressings is associated with an elevated risk of catheter colonization (RR = 1.53; 95% CI: [1.18 - 1.99]) but not phlebitis (RR = 1.02; 95% CI: [0.86 - 1.20]), extravasation (RR = 1.12; 95% CI: [0.92 - 1.37]), or skin colonization (RR = 0.99; 95% CI: [0.90 - 1.09]).

VandenBosch's study included a literature search, a transformation of research-based knowledge into a clinical protocol for the use of adhesive bandages, and an evaluation of the proportion of phlebitis between semi-permeable transparent dressings and gauze dressings [87]. The study contributed little knowledge since the catheter-related infection risk was not evaluated. The rate of phlebitis was not significantly different as a function of the type of dressing.

Tripepi-Bova's randomized prospective trial compared the effects of using transparent polyurethane (108 patients) or gauze (121 patients) dressings to protect the insertion site of peripheral venous catheters on the frequency of phlebitis, extravasation and catheter dislodgment, which are infection risk factors [88]. The frequency of catheter dislodgement was much smaller with transparent dressings (6%) than with the gauze dressings (15%) ($p < 0.05$); the difference was not significant for the frequencies of phlebitis (1.8% *versus* 3.3%) and extravasation (17.6% *versus* 20.7%). The infectious risk was not directly assessed. A polyurethane transparent dressing should be preferred to an adhesive gauze dressing (fewer complications such as dislodgement, extravasation, phlebitis, infection risk factors), aside from very short catheterization durations for which both types of dressing show an equivalent complication rate.

Finally, the comparative and non-randomized prospective study carried out by Callaghan compared the effects of polyurethane transparent dressings *versus* the gauze adhesive dressing on the incidence of peripheral venous catheter-related complications in children and

adolescents [89]. A total of 407 catheter dressings were studied: 195 in the study group (transparent dressing) and 212 in the control group (adhesive tape). In children with transparent dressings, visual inspection is easier and adherence is stronger (the dressing needs less reinforcement) than with gauze adhesive dressings. The difference in extravasation or phlebitis incidence was not significant.

No study was found pertaining to the use of sterile adhesive strips to secure the catheter.

4-7.2 Recommendations

- ✓ **R30** – It is recommended to cover the catheter injection site and to secure the catheter by using a transparent, semipermeable, sterile dressing made of polyurethane (**B1**), to allow visual inspection of the insertion site (**B3**).
- ✓ **R31** – It is recommended to use a sterile adhesive gauze dressing, in the case of bleeding or exudation (**B3**).
- ✓ **R32** – It is recommended to use adhesive sterile strips to attach the catheter, provided asepsis is maintained (**C3**).
- ✓ **R33** – It is recommended not to apply antiseptic or antibiotic ointments to the insertion site (**D2**).
- ✓ **R34** – It is recommended to temporarily protect the dressing with an impermeable material whenever a shower is taken or it is exposed to water (**B3**).

5-1 Manipulating the catheter, tubing and stopcocks

5-1.1 Literature review

A – Existing recommendations

The following recommendations are suggested:

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC – 2002 [4]

"Wash the hands with an antiseptic-containing soap or rub the hands with an alcohol-based solution before and after palpating the catheter **(IA)**.

- Maintain an aseptic technique during catheter-related care **(IA)**.
- Disinfect injection ports with 70% alcohol or povidone-iodine before accessing the system **(IA)**.
- Cap stop cocks when not in use **(IA)**.
- Minimize contamination risk by wiping the access ports with an appropriate antiseptic, and by using an aseptic technique **(IB)**".

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

- "Staff who have exudative dermatitis or other open lesions should wear gloves when manipulating catheters and junctions.
- The frequency of handling and manipulation of the cap should be minimized to reduce the risk of contamination. The optimal timing for changing the cap is not known **(C)**.
- Any open injection port or stopcock should be protected with an appropriate cover **(BIII)**.
- Injection ports and stoppers should be decontaminated with 70% isopropyl alcohol or another appropriate disinfectant. If iodophors are selected, a disinfectant rather than an antiseptic formulation should be used. Swabs used for skin cleaning should not be

used".

> **“Venous catheterization, the good practice guidelines”** – CCLIN Paris North – 2001 [6]

- "Disinfect the hands either by hand hygiene (antiseptic) washing, or by rubbing the hands with an alcohol-based product before and after palpating the insertion site and manipulating the venous line **(BI)**.
- Minimize the number of manipulations and protect the injection ports.
- Disinfect junctions with antiseptic-impregnated pads and cap with a new sterile stopper. The latter recommendation applies to central catheters".

> **“100 recommendations for the surveillance and prevention of nosocomial infections”**
– CTIN – 1999 [1]

"The maintenance of the venous line should be rigorously aseptic, with observance of the closed system concept whenever this is possible, and by reducing the number of manipulations as far as possible:

- the delivery line should only be manipulated after antiseptic hand washing; wearing of a gown, gloves or a mask is not required. In all cases, operating protocols validated by the CLIN should specify hygiene rules, clothing and operating procedures for any manipulation;
- hubs and connectors should be disinfected before any injection. Permanently protecting tubing junctions may be useful, especially when these remain in contact with the patient's bed, although the effectiveness of the various proposed systems is not clearly established".

> **“Good practice guidelines for the prevention of infections associated with healthcare provided outside health facilities”** – CTIN – 2004 [17]

- "Hand disinfection or alcohol-based hand rubbing should be performed before any manipulation of the venous line.
- Disinfect junctions with antiseptic-impregnated pads before any injection, followed by capping with a new sterile cap (NB: direct injection into the tubing is not recommended, from the hygienic perspective and to avoid needlestick injuries).
- Restrict the number of venous line openings by performing manipulations at the same

time. Do not leave closed lines unattended".

B – Critical analysis of recent literature

A systematic review of recent literature identified only one controlled randomized *in vitro* experimental study of catheter manipulation [90]. This study evaluated the efficacy of using disinfecting solutions after experimentally contaminating catheter hubs. Catheters were incubated in suspensions of *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, or *Candida parapsilosis*. After incubation, the catheter was wiped with a cotton swab dipped in 1% chlorhexidine in water, or 1% chlorhexidine in 70% ethanol, 97% ethanol, or normal saline (control group). Each catheter hub was then cultured quantitatively. The chlorhexidine alcohol solution was more effective than a normal saline solution on *Staphylococcus epidermidis*, *Pseudomonas aeruginosa*, and *Candida parapsilosis* ($p < 0.0001$; $p = 0.05$; $p = 0.0008$, respectively); similarly, the ethanol solution was more effective than a normal saline solution ($p < 0.0001$; $p = 0.05$; $p = 0.0002$). However, the chlorhexidine aqueous solution was not more effective than the normal saline solution ($p = 0.57$; $p = 0.16$; $p = 0.09$).

Concerning the use of safety connectors, the study carried out by Bouza is the only one found to include peripheral catheters [91]. This randomized prospective study compared the catheter-related infection rate with the colonization rate of the hub, catheter and skin when using a closed-needleless hub or a conventional open system. The study involved patients who underwent heart surgery and included 1774 catheters (865 with a closed-needleless hub device and 909 with a conventional system, 249 and 274 of which were peripheral catheters, respectively). No catheter-related infection occurred for peripheral catheters, and the difference in the infection rates for all catheters was not significant (the cumulated incidence for 100 catheters was 0.72 for closed-needleless connectors *versus* 1.21 for conventional systems). The catheter colonization rates (incidence density per 1000 catheter-days: 59.2 *versus* 83.6; $p = 0.003$), of hubs (incidence density per 1000 catheter-days: 7.5 *versus* 24.6; $p = 58.9$; $p = 0.04$), and skin (incidence density per 1000 catheter-days: 41.5 *versus* 58.9; $p = 58.9$; $p = 0.04$) were smaller with needleless connectors. No sub-analysis was carried out for peripheral catheters.

5-1.2 Recommendations

- ✓ **R35** – It is recommended, before any manipulation of the catheter or any of the delivery system components, to disinfect the hands, either by means of hand disinfection with an antiseptic soap (or antiseptic washing), or by hand rubbing disinfection with an alcohol-based gel or solution (**B2**).
- ✓ **R36** – It is recommended to disinfect the tips and stopcocks before they are manipulated, with the help of a sterile gauze pad dipped in alcoholic chlorhexidine, alcoholic povidone-iodine, or 70% alcohol (**B2**).
- ✓ **R37** – It is recommended to install a new sterile stopper each time the access or the stopcock is opened (**B3**).
- ✓ **R38** – It is recommended to keep the stopcock ramps at a good distance from any source of contamination (for example bed linen, wounds, stoma) (**B3**). In the absence of bibliographic evidence, it is not possible to make recommendations concerning the use of protection devices for junctions and stopcock ramps, for the purpose of preventing the risk of peripheral venous catheter-related infection.
- ✓ **R39** – It is possible to use needleless connectors as long as they are disinfected before the system is accessed in any way (**C2**).

5-2 Locks (heparin and antibiotic) - Stoppers

5-2.1 Literature review

A – Existing recommendations

No recommendation has been proposed in the published documents.

B – Critical analysis of recent literature

Two meta-analyses relating to catheter heparinization were found. In these works, the infectious risk itself is not taken into account. The first meta-analysis studied the benefits of using heparin in venous and arterial peripheral catheters [92]. It involved 10 randomized trials; heparin was either administered by flushing (7 trials) or continuously (5 trials). Results for peripheral venous catheters showed that a heparin lock at a concentration of 10 U/ml does not efficiently prevent catheter-related phlebitis (RR = 1.09; 95% CI: [0.77-1.52]); conversely, locks

at a concentration of 100 U/ml are effective (RR = 0.61; 95% CI: [0.42-0.88]), but their side effects are not well understood. Continuous heparin administration is effective in preventing the risk of phlebitis (RR = 0.39; 95% CI: [0.39-0.77]). The second meta-analysis involved 8 trials carried out on peripheral venous catheters in neonates [93]. Heparin was administered either as a flush solution, or continuously. The risk of thrombosis, extravasation, or intracranial hemorrhage did not differ when the heparin group was compared with the placebo group. Five randomized trials compared the duration of catheter use according to whether heparin was used or not, but because of their heterogeneity, the results could not be combined: two trials showed a significant increase in the duration of catheter use, two did not show any significant difference, and the last one showed a decrease in this duration. The infectious risk was not used as an assessment criterion. The side effects of heparinization are not well known and there is a high risk of dosing error [94].

No study was found on the use of antibiotic locks for peripheral venous catheters.

No study was found relating to stoppers.

5-2.2 Recommendations

- ✓ **R40** – It is recommended not to make use of an antibiotic lock to prevent venous catheter-related infections (**D3**).
- ✓ **R41** – In the absence of bibliographic arguments, it is not possible to propose a recommendation concerning the use of a heparin lock, continuous heparinization, a saline lock, or a stopper, to maintain the catheter's permeability.
- ✓ **R42** – It is recommended to abide by the antisepsis rules when using a heparin lock, continuous heparinization, a saline lock, or a stopper (**B3**).
- ✓ **R43** – When using a stopper, it is recommended to install a new sterile stopper whenever the catheter has been accessed (**B3**).

6-1 Frequency of catheter replacement

6-1.1 Literature review

A – Existing recommendations

The CDC and Health Canada recommendations rely on one non-randomized trial, the main criterion of which is the catheter replacement frequency, with two trials pertaining to the catheter material, of which one was randomized [12] and the other was not [96], six descriptive studies taking into account the frequency of catheter replacement [15, 97-101], two descriptive studies [97, 98] and one trial pertaining essentially to the type of dressing [84]. All of these studies relate to peripheral venous catheters. The other seven studies mentioned above relate to central venous catheters or arterial catheters [102-108].

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC – 2002 [4].

The CDC document stated that the scheduled replacement of intravascular catheters was suggested as a method for the prevention of phlebitis and catheter-related infections. Various studies of peripheral venous catheters show that the incidence of thrombophlebitis and bacterial colonization of catheters increases when the catheters are left in place for more than 72 hours [12, 15, 96]. However, rates of phlebitis are not substantially different when the duration of catheter use changes from 72 hours to 96 hours [95]. Because phlebitis and catheter colonization are risk factors that have been associated with an increased risk of catheter-related infection, short catheters are commonly rotated at 72-96 hour intervals to reduce both the risk of infection and patient discomfort associated with phlebitis. CDC's recommendations were as follows: "Evaluate the catheter insertion site daily, by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs of infection. If the patient has local tenderness or other signs of possible catheter-related infection, an opaque dressing should be removed and the site should be inspected visually (II).

The peripheral venous catheter should be removed if the patient develops signs of phlebitis (e.g. warmth, tenderness, erythema, or a palpable venous cord), infection, or a malfunctioning catheter (IB) [12]. In adults, peripheral venous catheters should be replaced at least every 72-96 hours to reduce the risk of phlebitis. If venous access sites are limited and no evidence of phlebitis or infection is present, the catheter may be left in place for longer periods, provided the patient and the insertion site are closely monitored (IB) [12, 95, 101]. In pediatric patients, the peripheral venous catheters should be left in place until the intravenous therapy is completed, unless complications (e.g. phlebitis, infiltration) occur (IB) [97-100]. Whenever it has not been possible to adhere to an aseptic technique, the catheter should be replaced as soon as possible and after no longer than 48 hours (II) [109-112]. Clinical judgment should be used to determine when to replace a catheter that could be a source of infection, and a catheter should not be replaced routinely in patients who are bacteremic, if the source of infection is unlikely to be the catheter (II)" [113].

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

The Health Canada document indicated that the cumulated incidence of infection increases with time. In a study of peripheral venous catheters in adults, the risk related to each additional 24-hour period of use (incidence density) increases with time; therefore, it is possible to reduce the risk by moving the catheter to a different location every 48 to 72 hours [102]. No similar increase was documented with peripheral venous or arterial catheters in children [97, 98, 103], or with central venous catheters [104, 105]. Therefore, it is not indicated to routinely replace these catheters. It has been proposed to replace pulmonary artery catheters every 4 days in intensive care units because of the increased risk of infection [84], however a prospective study does not support this practice [105]. Studies suggest that the incidence density may increase in the first days, but that it decreases and thereafter remains at a low value. In contrast with a comparative study performed over time [106], it has been shown in prospective studies that the routine replacement of catheters using a guide did not lead to a reduction in the risk of infection [105, 107, 108].

Health Canada's recommendations, which apply to all catheters, were as follows: "Patients with intravascular catheters should be evaluated at least daily for evidence of infectious complications. This evaluation may include gentle palpation of the insertion site through the intact dressing or direct observation, as appropriate for the type of dressing (BIII). If a patient has unexplained fever, or pain or tenderness at the insertion site, or if a patient cannot

communicate, then the insertion site should be carefully inspected **(BIII)**. The two following recommendations are specific to peripheral venous catheters. For adults in hospital settings, steel cannula devices or plastic catheters may be left in place for up to 72 hours [102]. Unless there are signs of inflammation, peripheral venous catheters in children need not necessarily be changed as long as they remain functional **(AII)** [97, 98]".

B – Critical analysis of recent literature

The studies described below were carried out with currently used catheter materials.

Maki and Bregenzler's studies, already described in this document, have demonstrated a significant increase in the cumulated risk of phlebitis when the period of use of the catheter exceeds 24 hours (RR: 1.79; 95% CI: [1.45-1.22]) [12, 31]. It has also been found that the specific risk of phlebitis on each additional day of catheter use remained nearly constant with time. This suggests that the total catheterization duration influences the risk of thrombosis independently of the frequency of catheter replacement. In Maki's study, the specific risk of phlebitis was even greater between the 24th and 48th hour periods than afterwards [31]. According to this study, there was no difference between the cumulated risk of phlebitis on the 4th day, whether the catheter was left in place during the 4 day period or was changed on the 2nd day. In Bregenzler's prospective observational study, in which the catheters were left in place until they were no longer needed or a complication occurred, the specific risk of phlebitis, on each infusion day, appeared to be constant during the first 5 days and even appeared to decrease between the 6th and 9th days [31]. In this study, the daily specific risk of catheter-related infection appears to be constant until day 8. This was not a comparative study and there was no control group allowing the specific risks to be evaluated on each infusion day, if the catheters were routinely replaced after a given period of time.

Grune carried out a prospective observational study to describe the time kinetics of thrombosis complications when a short peripheral venous catheter is inserted [114]. In this study, when there was no clinical evidence of phlebitis or if no catheter malfunction occurred, the venous catheters were left in place until the intravenous treatment had been completed. Just as in Maki and Bregenzler's studies, the specific risk of phlebitis appeared to be constant with time. This tends to prove that the daily risk of phlebitis on any given day is no higher when the catheter is routinely replaced, than when it is left in place.

Cornely's study, which included 412 catheters on 175 patients, did not show any difference between the cumulated rates of phlebitis when the duration of catheter use exceeded 48 hours, although the daily specific risks of thrombosis or infection were not computed [115].

Barker's study is the only randomized trial, and compares a group of patients for whom the catheter was routinely changed every 48 hours and a group for which the catheter was replaced only if the patient developed signs of phlebitis, pain, or catheter dislodging [116]. This trial involved 47 surgical or general medical inpatients. The total duration of the infusion did not significantly differ from one group to the next. The cumulated phlebitis rate per patient on existing or prior insertion sites was significantly higher in the control group (without any systematic change) (11/21 *versus* 1/21; $p=0.003$). This study did not investigate catheter-related infectious complications. An analysis bias was present because the results were expressed in numbers of phlebitis episodes per person-time (days of infusion). In addition, this trial was not performed as a blind test, which could lead to another bias, all the more so since the average time until the occurrence of phlebitis in the control group (with no catheter change) was 2.4 days, this time being very similar to the 2-day period of catheter use in the second group.

Barbut's observational prospective study, already mentioned above, involved 525 catheters and 1036 catheter-days, and showed, through multivariate analysis, that the cumulated risks of phlebitis and catheter colonization increased when the duration of catheter use exceeded 3 days (adjusted OR, of 2.38; $p = 0.009$ and 4.74; $p=0.0003$, respectively) [30]. Here again, the specific risk factors per day were not computed, and the complication rates were not assessed as a function of the infusion duration.

In total, these studies do not show any difference for a 72-hour *versus* a 96-hour duration of catheter use, in terms of preventing phlebitis or catheter colonization. However, it should be stressed that the data cited in this literature are rather conflicting and that the methods used are different.

6-1.2 Recommendations

- ✓ **R44** – It is strongly recommended to remove the peripheral venous catheter as soon as it is of no further use (**A3**).
- ✓ **R45** – It is strongly recommended to examine the insertion site at least once a day, for local signs of infection (**A3**).
- ✓ **R46** – It is strongly recommended to remove the catheter in the case of a local complication or suspected catheter-related systemic infection (**A3**).
- ✓ **R47** – In case of a suspected infection, it is strongly recommended to proceed with the aseptic removal of the distal cannula of the catheter and to communicate this item to the laboratory for a microbiological examination (**A3**).
- ✓ **R48** – It is recommended to replace a catheter as soon as possible, if non-aseptic insertion is suspected (**B2**).
- ✓ **R49** – In adults, it is recommended not to leave a catheter inserted for more than 96 hours (**B2**). In a patient with limited venous access, provided the insertion site is carefully monitored, and in the absence of complications, it is possible to leave the catheter in place for a longer period of time (**C3**).
- ✓ **R50** – It is recommended, in infants, not to change a catheter on a routine basis. Catheter changes are recommended only in the case of signs of complication (**B2**).

6-2 Dressing replacement

6-2.1 Literature review

A – Existing recommendations

CDC's bibliography includes three studies involving central catheters [77-79].

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC - 2002 [4].

- "Hand washing is recommended before and after changing the dressing.
- Wear sterile or non-sterile clean gloves when changing the dressing (**IA**).
- Replace the dressing if it becomes damp, loosened or visibly soiled (**IB**) [77-78].

- Change the dressing at least weekly for adult and adolescent patients, depending on the circumstances of the individual patient **(II)** [79].
- If the dressing is not transparent, remove it in order to allow inspection of the insertion site in case of tenderness or pain when palpating".

> **“Preventing infections associated with indwelling intravascular access devices”** – Federal Ministry of Health, Canada – 1997 [5]

This Health Canada document specifies that only a few studies are available, which are specifically devoted to the optimal frequency of dressing replacement for catheters. Health Canada's recommendations were as follows: "A sterile gauze dressing should be used and may be left in place until the catheter is removed, unless the dressing or the skin surrounding the entry site becomes wet or soiled. Alternatively, a transparent semipermeable dressing may be used".

B – Critical Analysis of recent literature

A systematic review of the recent literature did not allow new aspects to be identified.

6-2.2 Recommendations

- ✓ **R51** – It is strongly recommended, before handling the dressing, to disinfect the hands, either by means of hand washing with an antiseptic soap (or antiseptic washing), or by hand rubbing disinfection with an alcohol-based gel or solution. **(A3)**.
- ✓ **R52** – It is recommended to proceed with dressing replacement only when it becomes loosened or soiled, or when inspection of the site is necessary, under the same conditions as during dressing application. **(B2)**.

6-3 Replacement of the administration set

6-3.1 Literature review

A – Existing recommendations

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC – 2002 [4].

The CDC document states that the optimal interval for replacement of venous lines has been examined in three well-controlled trials. Data from each of these three studies revealed that replacing administration sets at a frequency of more than 72 hours is cost effective [117-119]. Data from a more recent study demonstrate that rates of phlebitis are not substantially different if administration sets are left in place for 96 hours, when compared with 72 hours [95]. When a fluid that enhances microbial growth is infused (e.g. lipid emulsions and labile blood products), more frequent changes of administration sets are indicated, because these products have been identified as independent risk factors for catheter-related systemic infections [120-126].

CDC's recommendations, which apply to all catheter types, were as follows:

- “Replace the administration sets used for administering products no more frequently than at 72-hour intervals, unless catheter-related infection is suspected or documented **(IA)** [117-119, 127].
- Replace tubing used to administer labile blood products or lipid emulsions within 24 hours of initiating the infusion **(IB)** [126,128-131].
- Replace tubing used to administer propofol every 6 or 12 hours, according to the manufacturer's recommendations [132].
- Complete the administration of lipid-containing products within 24 hours of their preparation **(IB)** [124-126, 128, 131].
- Complete the administration of lipid emulsions within 12 hours of their preparation. If volume considerations require more time, the infusion should be completed within 24 hours **(IB)** [124-126].
- Complete infusions of labile blood products within 4 hours **(II)** [133-136].
- No recommendation can be made for the delay within which other products should be administered (unresolved issue).
- Change caps no more frequently than every 72 hours according to the manufacturer's

recommendations **(II)** [137-140].”

> “Preventing infections associated with indwelling intravascular access devices” – Federal Ministry of Health, Canada – 1997 [5]

The Health Canada document specified that it may happen that components of the delivery systems become contaminated, leading to growth of potential pathogens on the system's inner surfaces [74]. Measures to prevent contamination (asepsis), to prevent growth of contaminants (antisepsis), and to prevent microbial growth from reaching dangerous levels are proven methods for the prevention of intravascular device-associated infections.

Health Canada's recommendations specified that: "All intravascular delivery system components up to the hub should be changed at 72 hour intervals [117, 118, 141, 142] with the following exceptions:

- when administering labile blood products (tubing and administration sets should be changed as soon as possible after administration) **(C)**;
- when administering lipid emulsions (the total system must be changed within 24 hours) **(BIII)**;
- upon suspicion of an epidemic of infusion-related septicemia (the total system must be changed within 24 hours) **(BIII)**;
- for on-site compounded solutions of admixtures with a high rate of contamination (the total system must be changed within 24 hours) **(BIII)**;
- for monitoring arterial pressure for which the device may be used for an acceptable period of 96 hours **(BII)**;
- when administering commercially prepared solutions (the manufacturers' recommendations are to be observed) **(C)**.

This rule applies to all intravascular lines, including those used for parenteral nutrition. Scheduled changes should be planned to minimize the number of times that the fluid path is opened **(AI)**. Solutions other than blood, blood components, lipids, or solutions with time-limited stability should either be completely used or discarded at the time of delivery system change (72 hours). If excessive infection rates appear to be associated with solution contamination, then all solutions should either be completely used or discarded within 24 hours of starting the infusion **(AIII)**.

Blood specimens should not be drawn through peripheral (or central single-lumen) venous lines intended for infusions except when it is essential to obtain a specimen or when catheter-

associated bacteremia is suspected. A specific lumen from a multi-lumen catheter should be dedicated to blood-letting **(BIII)**.

The entire infusion device (catheter, administration set, and fluid) should be changed immediately if purulent thrombophlebitis, cellulitis or intravascular device-related bacteremia is diagnosed or is strongly suspected in a patient with a peripheral catheter or a central catheter. If the use of the delivery system is to be discontinued because of a suspected catheter-related infection, appropriate cultures of the fluid and catheters should be obtained. If infection is suspected or documented in a patient with a central venous line, depending on the involved microorganism an attempt may be made to treat the infection with antibiotics without removing the catheter, provided that the patient remains hemodynamically stable **(AIII)**.

Ideally, sterile components should not be assembled in advance ^[143]. The sterile delivery system should be stored in a clean, dry and secure environment **(BIII)**".

B – Critical Analysis of recent literature

A literature review has been carried out recently ^[144]. For non-central catheters, which include peripheral venous and arterial catheters, there is no evidence that the risk of infusion colonization or catheter colonization is increased when the frequency of administration set replacements is decreased from 24 hours to a shorter period (OR = 1.21; 95% CI: [0.44-4.49] and OR = 1.04; 95% CI: [0.63-1.72], respectively). A similar observation is made when comparing the replacement of administration sets every 48 hours with a lower frequency (OR = 1.11; 95% CI: [0.06-8.06] and OR = 1.71; 95% CI: [0.96-3.05], respectively). The risk of infection itself was not evaluated for peripheral catheters.

6-3.2 Recommendations

- ✓ **R53** – It is recommended to replace the tubing after each administration of blood products, and within 24 hours following the administration of lipid emulsions **(B1)**.
- ✓ **R54** – It is recommended to change the delivery system (tubing and accessories) whenever the catheter is changed **(B3)**.
- ✓ **R55** – It is recommended to change the delivery system (tubing and accessories) every 96 hours if the catheter is to be left in place for longer than such a period **(B3)**.

7-1 Literature review

A – Existing recommendations

> “**Guidelines for the Prevention of Intravascular Catheter-Related Infections**” - CDC - 2002 [4].

Training and assessment of professional practice – The CDC’s recommendations were as follows:

- “Educate health-care workers regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection-control measures to prevent catheter-related infections **(IA)** [40, 145-153].
- Assess knowledge of and adherence to recommendations periodically for all persons who insert and manage intravascular catheters **(IA)** [40, 145, 148, 154, 155].
- Ensure appropriate nursing staff levels in ICUs to minimize the incidence of catheter-related bloodstream infections [156-158].”

Surveillance – The CDC’s recommendations were as follows:

- “Monitor catheter sites visually or by palpation through the intact dressing on a regular basis. If patients have tenderness at the insertion site, fever without obvious source, or other signs suggesting a local or catheter-related systemic infection, the dressing should be opened to allow thorough examination of the site **(IB)** [159-161].
- Encourage patients to report to their health-care provider any changes in their catheter site or any new discomfort **(II)**.
- Record the professional’s name, date and time of catheter insertion or removal, and dressing changes **(II)** [162-164].

> “**Preventing infections associated with indwelling intravascular access devices**” – Federal Ministry of Health, Canada – 1997 [5]

This Health Canada document indicates that studies carried out over the past 20 years consistently reveal a decline in the risk of infection, following improvements in aseptic conditions [165-169]. The efficacy of specialized teams in the insertion and management of intravascular catheters has been documented [170]. However, it is not possible to attribute the efficiency and influence of these teams to an increase in their competence or to an increase in staffing levels.

Prevention program – The Health Canada recommendations were as follows:

“Written policies and procedures concerning catheter-related infection prevention should be included in the infection prevention program of each institution or organization, and should be reviewed at least annually **(AIII)** [171].

Each institution or organization should ensure access to the expert advice of physicians, intravascular therapy nurse specialists, pharmacists, and infection control practitioners in maintaining its policies and procedures **(AIII)** [171].

Each institution or organization should ensure that an effective surveillance system is in place to identify intravascular catheter-associated infections **(AIII)** [171].

Training of personnel – Health Canada’s recommendations were as follows:

“Each institution or organization should ensure that all those providing care, including emergency response attendants, nurses and physicians, maintain a high level of skill through regularly scheduled training and adhere to approved policies and procedures pertinent to intravascular catheters. An intravascular therapy team will facilitate the maintenance of a high level of skill **(AI)** [153].

Patients should have timely access to skilled practitioners throughout the duration of intravascular therapy **(AIII)**”.

Patient education – The Health Canada recommendations were as follows:

“Each institution or organization should ensure that its patients understand, as far as possible, the nature of care required with the intravascular catheters they are receiving, and the importance of hand washing, asepsis and other safety measures, recognize early signs of infection or other complications, and know to whom they should report complications **(BIII)**.”

The teaching method used to educate patients should be adapted to meet the needs of the individual patients **(BIII)**.

Since patients may not recognize the signs and symptoms of infection [172], professionals must be particularly attentive to ensure effective teaching and monitoring of patients **(AIII)** [171]”.

Evaluation of the risk of intravascular catheter-associated infection – The Health Canada recommendations were as follows:

“Clear definitions of intravascular-catheter infections must be established. These may differ from those used for clinical or research purposes. Infection rates should be expressed in terms of infections per 1000 catheter-days, and structured according to type of catheter and patient group. Rates of catheter use should also be evaluated. The procedures used for data collection and by the personnel involved should be determined according to the requirements and resources of a given organization. Analysis and reporting of infection rates may be continuous or periodic, at the discretion of each organization. Documentation of intravascular catheter use and related procedures is essential to an effective surveillance program. The minimum documentation required should include: insertion sites, type(s) of catheter, procedure or therapy, date of insertion or replacement, and name of the person performing the procedure **(AIII)**. Compliance with the policies and procedures regarding insertion technique and care of insertion sites and catheters should be checked on a regular basis **(AIII)**. The rates of infection should be evaluated in three ways: 1) by comparing the rate of infection within the user’s institution with that of other institutions recognized for the excellence of their practices; 2) by comparing the rate of infection within the user’s institution with the rates in the literature; 3) by monitoring the rate over time, within the same institution, to detect trends **(BIII)**. Those institutions failing to achieve low rates of infection should consider adopting more conservative limits **(BIII)**”.

> “**100 recommendations for the surveillance and prevention of nosocomial infections**”
– CTIN – 1999 [1]

Recommendation No 89 indicates that: “the general policy of a unit concerning catheter use is of major importance”.

Education and evaluation of professional practices – Recommendation No 89 indicates that: “Written, periodically revised procedures must be available in each unit and be known and applied by all of the personnel. Observance of this must be routinely assessed. New personnel must be trained in the application of these insertion and care procedures. In high-risk units,

personnel specifically trained in the insertion and maintenance of catheters shall be available for catheter maintenance.

The usefulness of keeping intravascular catheters in patients is to be discussed on a daily basis by physicians, in consultation with the paramedical team”.

Surveillance – Recommendation No 89 indicates that: “Continuous surveillance of vascular catheter-related infections must be implemented in high-risk units. It is essential to provide feedback to the care team concerning infection rates, in order to maintain a high level of vigilance”.

Recommendation No 20 indicates that “In services with a high risk of infection (in particular critical care, units where immuno-depressed patients are treated, onco-hematology, neonatology) a high priority level is given to the surveillance of bacteremias, catheter infections and, if relevant, nosocomial pneumopathies. The information returned to the relevant hospital teams is the bacteremia rate (for 100 patients, 1000 hospital days, 100 catheterized patients, or 1000 vascular catheter-days). These rates may be studied as a function of different risk factors (age, gender, type of catheter ...)”.

B – Critical analysis of recent literature

Haley’s multi-center study has shown that the implementation of infection surveillance and of a preventative program reduced the rates of nosocomial infections of the urinary tract and the operating site, and of pneumopathy and bacteremia [173]. A recent review of the literature has allowed two studies specifically related to peripheral venous catheters to be identified. Curran’s multi-center study [173] showed a decrease in the number of cases of catheter phlebitis, following the implementation of a surveillance program for complications related to peripheral venous catheters, including feedback to the professionals. In this study, 2934 catheters were monitored, the phlebitis rates were 8.5% (125/1463) before implementation of the program, and 5.3% (78/1471) afterwards ($p < 0.001$). The rates of catheter colonization or infection were not studied. Couzigou’s study evaluated the influence of an establishment working group’s elaboration and distribution of recommendations on the prevalence of local complications in short peripheral venous catheters [174]. The recommendations of this study were distributed among the institution's nursing staff. The definition of a local complication was the presence of an erythema, purulence, or tenderness of the catheterized vein. The frequency of catheter-related infections was not evaluated as such. The implementation of written recommendations was an independent factor for a reduction in the frequency of local infections (OR = 0.31; 95% CI: [0.09-0.97]).

C – Regulations

The regulations define the modalities to be used to inform the patient, in particular concerning the risk of infection. Among these texts, the law of March 4th 2002 stipulates that “ ... all persons have the right to be informed about their state of health ...” and that “... this information shall concern the various investigations, treatments or preventative actions proposed to the patient, their usefulness, their consequences, the normally foreseeable frequent or serious risks they carry, as well as the possible alternative solutions, and the foreseeable consequences should these be refused ...” [175]. Whenever this information pertains to the risk of infection, more specific modalities are described in the DHOS\E2 - DGS\SD5C circular No 21 of January 22 2004 relating to the reporting of nosocomial infections and to the informing of patients in health institutions. This obligation of informing patients is reproduced in the codes of professional deontology.

The identification of an infectious risk (surveillance) and its prevention (drafting of procedures and education of professionals), as recorded in the 100 recommendations [1], are also reproduced in reference 16 of chapter 2 in the Accreditation Manual for Health Establishments (second procedure) [176]. This reference adds that: “A surveillance and infectious risk prevention program, adapted to the patient and to high-risk activities, has been implemented”.

7-2 Recommendations

- ✓ **R56** – It is strongly recommended to draft written procedures concerning the insertion, maintenance, monitoring and removal of peripheral venous catheters **(A2)**.
- ✓ **R57** – It is strongly recommended to inform the patient of the infectious risk associated with peripheral venous catheters **(A - Statutory)**.
- ✓ **R58** – It is recommended to involve the patient or close family and friends with the prevention and detection of an infection related to peripheral venous catheters, by means of a suitable educational approach **(B3)**.
- ✓ **R59** – It is strongly recommended to clinically monitor the condition of the patient and the insertion site, on an at least daily basis **(A3)**.
- ✓ **R60** – It is recommended to introduce an infectious risk surveillance program related to peripheral venous catheters; the surveillance strategy* should be drawn up by the CLIN (French Nosocomial Infection Control Committee) and the infection control team, in collaboration with the clinical units **(B2)**.
- ✓ **R61** – It is recommended, in the context of a program for preventing peripheral venous catheter-related infections, to routinely evaluate** the methods applied by professionals in charge of the insertion and maintenance of peripheral venous catheters **(B3)**.

* *The surveillance methods may be chosen amongst those proposed in the following:*

- Inclusion of infections related to short venous peripheral catheters in “on the day” prevalence surveys.
- Implementation of an impact survey over a short period (1 to 3 months) in units and/or for activities in which peripheral venous catheters are frequently placed.
- Implementation of a bacteremia investigation at the patient’s bedside.
- Outpatient surveillance outside health establishments pertains rather to the “monitoring of infectious risk”, that is, to the care the professional must take with regard to the observation of recommendations aimed at preventing and evaluating catheter-related infections.

** *The working group proposes the use of the following criteria for the evaluation of practices:*

Choice of equipment

- Use of safety equipment

Hand hygiene

- Disinfection of the hands by hand rubbing or washing.
- Wearing of gloves.

Antisepsis

- Detergent cleaning.
- Use of an alcohol-based antiseptic.

Dressing

- Sterile dressing (transparent semipermeable or with gauze).

Frequency of catheter and venous line replacement in adults

- Frequency of catheter replacement: 96 hours.
- Frequency of administration set replacement adapted to the administered products.

Quality / traceability

- Existence of a written procedure.
- Dates of catheter insertion and removal, daily monitoring of the access point, to be traceable in the patient's records.

Whereas the infectious risk related to central catheters has frequently been studied, there is relatively little epidemiologic data available, in France and elsewhere, pertaining to peripheral venous catheters; this is the case for example for the rates of incidence of bacteremia and for even stronger reasons, for local rates of infection corresponding to 1000 catheter-days in different types of health-care structure. As a consequence, the data used to develop these recommendations is, in certain aspects, relatively scarce and would require the initiation of complementary studies. In particular, in the case of three essential aspects, the working group considered the existing studies to be insufficient -

- > concerning skin antisepsis, there are two questions for which there appears to be no answer based on scientific evidence:
 - what is the efficacy of alcoholic povidone-iodine for the prevention of catheter-related risks of infection?
 - what is the efficacy of antisepsis with no prior detergic cleaning?
- > concerning the systematic replacement of catheters at a predetermined frequency, no randomized blind trial has been found, comparing the rates of incidence of infectious complications as a function of the frequency of catheter replacement, whether or not this frequency is predetermined.

APPENDIX 1 - Methodology and bibliographical search

1- Methodology for the drafting of recommendations

The “Recommendations for Clinical Practice” (RPC) method, elaborated by the HAS (French National Authority for Health) [6], was chosen as a consequence of the range of topics in the theme to be treated, with its numerous questions and sub-questions, and from the need for an extended period of time for the drafting of the recommendations. This method allowed an analysis of the literature to be made by the working group responsible for drafting the recommendations, and enabled expert opinion to be taken into account.

This method, summarized below, involves the contributions of 4 groups:

- the promoter, who initiates the process, ensures that it is correctly financed, and indicates the delay foreseen for the drafting of the recommendations; in the context of this effort, the SFHH who initiated the present project received a grant from the HAS;
- the organizing committee, who establishes the bounds of the theme, defines the questions, selects the participants and takes care of the logistics of the full process;
- the working group, which produces the knowledge synthesis and drafts the recommendations; it is assisted by “project leaders” for the bibliographical search (selection, critical analysis and literature synthesis) as well as for the drafting of recommendations (writing of preparatory texts, summary of the propositions made by the group);
- the reading group, which validates the information supplied to it, contributes additional information, and expert advice.

The method takes place in three phases: the preliminary working phase, the recommendation drafting phase, and the circulation phase. The organizing committee, the working group and the reading group are multi-disciplinary and representative of the different relevant professional domains (doctors and paramedical professionals), the different operational modes and various geographical origins.

2- Bibliographical search

To start with, existing recommendations were searched for in three databases:

- Medline (keywords: Catheterization, Peripheral [mesh] AND venous – Type of publication: Practice Guideline – Languages: French and English);
- Nosobase (Heading: recommendations – Theme: vascular access);
- *Bibliothèque Médicale A.F. Lemanissier* (Heading “*consensus et lignes directrices*” – Theme “*infections nosocomiales*”).

Database	Keywords	Conditions	Identified references
Medline	- “Catheterization, Peripheral” [Mesh] AND venous AND “cross infection” [Mesh]	2000-2005 English or French	9
	- “Catheterization, Peripheral” [Mesh] AND venous AND “infection” [Mesh]		38
	- “Catheterization, Peripheral” [Mesh] AND venous AND “septicemia” [Mesh]	- with summaries	0
	- “Catheterization, Peripheral” [Mesh] AND venous		118
Nosobase	- “Peripheral venous catheter”	2000-2005	13
INIST	AND <i>veineux</i> AND <i>périphérique</i>	2000-2005	9

Those recommendations containing a literature review, and which had quoted levels of evidence, were retained:

- The recommendations of the Center for Disease Control and Prevention (CDC), 2002, “Guidelines for the Prevention of Intravascular Catheter-Related Infections” [4];
- The recommendations of the Health Canada federal ministry “Preventing infections associated with indwelling intravascular access devices” – Federal Ministry of Health, Canada – 1997 [5];
- The C-CLIN Paris North guide: “Good practice guide for venous catheterism” – October 2001 [6].

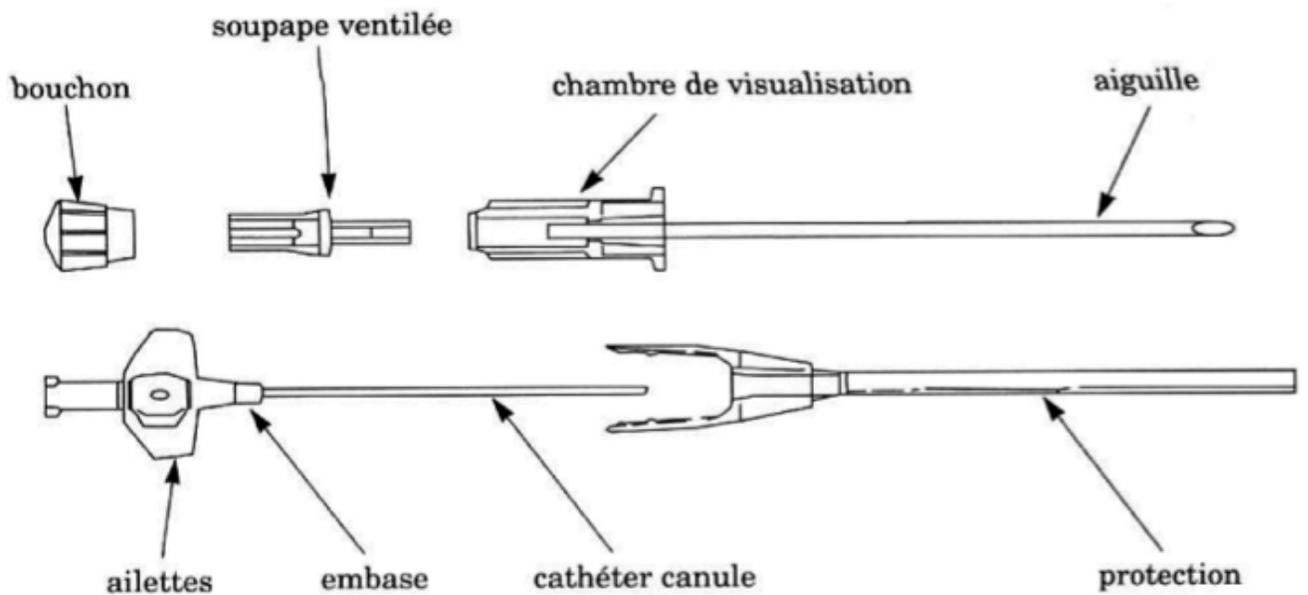
These documents pertain to all types of intravascular catheter, but have specific chapters dedicate to peripheral venous catheters.

Later, a systematic review of the literature published between January 2000 and May 2006 was carried out. Finally, consultation of the Cochrane Library allowed 6 references to be identified, of which two were related to peripheral venous catheters.

A total of 199 papers were thus identified. Reading of their titles and abstracts allowed articles not related to short peripheral venous catheters to be eliminated. The remaining papers were then analyzed. This systematic search was complemented by a review of the references found at the end of the analyzed papers. The “100 recommendations for the surveillance and prevention of nosocomial infections” – CTIN, 1999, and the “Good practice guidelines for the prevention of infections associated with healthcare dispensed outside health facilities” – DGS, 2004, were consulted, although they did not have any recommendation levels.

APPENDIX 2 - Catheter and steel cannula device

1 – Drawing of a peripheral venous catheter



Drawing of a short catheter

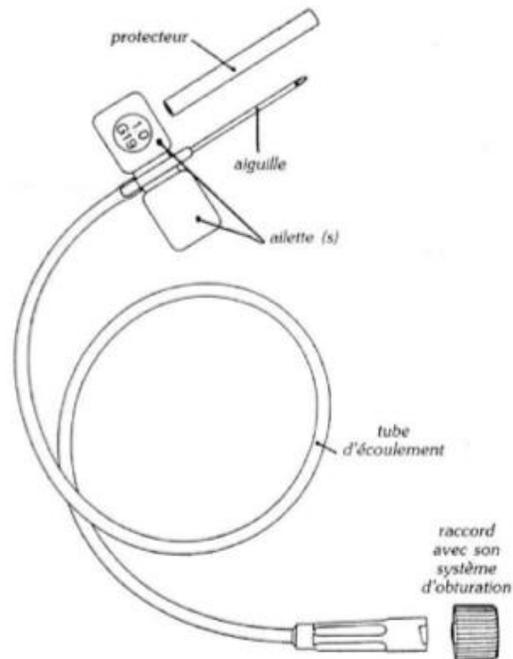
Vocabulary for diagram:

<i>Bouchon</i>	<i>Cap</i>
<i>Soupape ventilée</i>	<i>Ventilated valve</i>
<i>Chambre de visualisation</i>	<i>Visualization chamber</i>
<i>Aiguille</i>	<i>Needle</i>
<i>Ailettes</i>	<i>Fins</i>
<i>Embase</i>	<i>Hub</i>
<i>Cathéter canule</i>	<i>Cannula</i>
<i>Protection</i>	<i>Protection</i>

2 – Size and diameter of peripheral venous catheters

Nominal external diameter	Color	Gauge
$0.65 \leq D < 0.80$	Yellow	24
$0.80 \leq D < 1.00$	Blue	22
$1.00 \leq D < 1.20$	Pink	20
$1.20 \leq D < 1.40$	Green	18
$1.40 \leq D < 1.60$	White	17
$1.60 \leq D < 1.90$	Grey	16
$1.90 \leq D < 2.20$	Orange	14
$D < 2.20$	Red	13

3 – Drawing of a steel cannula device



Vocabulary for diagram:

<i>protecteur</i>	<i>protective tube</i>
<i>aiguille</i>	<i>needle</i>
<i>aillette (s)</i>	<i>fin (s) (flexible plastic wings)</i>
<i>tube d'écoulement</i>	<i>drain tube</i>
<i>raccord avec son système d'obturation</i>	<i>connector with its stopper system</i>

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...

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