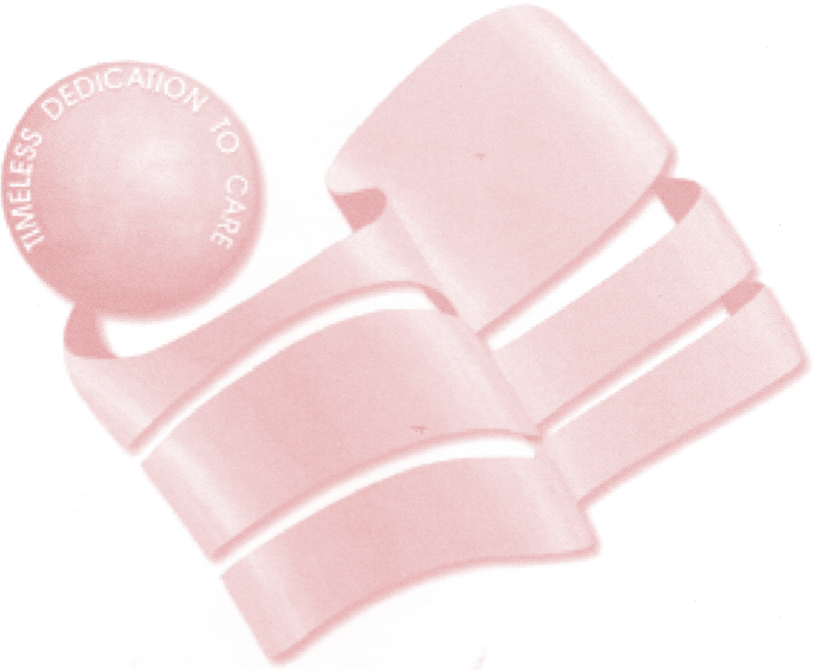
MOH NURSING CLINICAL PRACTICE GUIDELINES 1/2002

Prevention of Infections Related to Peripheral Intravenous Devices



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STATEMENT OF INTENT

This set of guidelines aims to serve as a guide for practitioners who are involved in caring for or treating adult patients with peripheral intravenous devices. The recommendations are based on the available research findings. However, there are some aspects in which there is insufficient published research and, therefore, consensus of experts in the field has been utilised to provide guidelines specific to conventional practice.

Every practitioner is accountable and responsible for the prevention of infection associated with peripheral intravenous devices. It is recommended that individual practitioners assess the appropriateness of the recommendations with regards to individual patient condition, overall treatment goal, resource availability, institutional policies and treatment options available before adopting any recommendation in clinical practice.

FOREWORD

The use of intravenous devices is an integral part of patient care in hospitals. These devices are used for the administration of fluid, nutrients, medications, blood products and to monitor the haemodynamic status of a patient. However, intravenous devices also provide a potential route for micro-organisms to enter the blood stream resulting in a variety of local or systemic infections. These cannula-related infections are often associated with prolonged hospitalisation, increased morbidity and mortality.

In order to minimise the risk of infection associated with these devices we are pleased to present the guidelines on "Prevention of infections related to peripheral intravenous devices" to all healthcare practitioners involved in the care of adult patients.

These guidelines are adapted with permission from the "Guidelines for prevention of intravascular device-related infections" produced by the Centers for Disease Control and Prevention, Atlanta, Georgia, USA.

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1 SUMMARY OF RECOMMENDATIONS

Handwashing

- Wash hands before and after palpating, inserting, replacing, or dressing any IV device.

Grade B, Level IIb

Barrier precautions during cannula insertion and care

- Wear non-latex or latex gloves when inserting an IV device.

Grade C, Level IV

- Wear non-latex or latex gloves when changing the dressings on IV devices.

Grade C, Level IV

- Use sterile or non-sterile clean gloves during change of dressings.

GPP

Selection of peripheral cannula insertion site

- Use an upper extremity site in preference to one on a lower extremity for cannula insertion. Transfer a cannula inserted in a lower extremity site to an upper extremity site as soon as the latter is available.

Grade A, Level Ib

Selection and replacement of IV devices

- Select a device with the lowest relative risk of complications (infectious versus non-infectious) and the lowest costs for the anticipated type and duration of IV therapy. The risk and benefits of replacing a device at a recommended schedule to reduce infectious complications should be weighed against the risk of mechanical complications and availability of alternative sites. Decisions regarding the type of device and its frequency of replacement should be determined on an individual patient basis.

Grade C, Level IV

- Select cannulas based on the intended purpose, duration of use, experience at the institution and known complications (e.g., phlebitis). Use a Teflon cannula, a polyurethane cannula or a steel needle.

Grade A, Level Ib

- Avoid the use of steel needles for the administration of fluids and medications that may cause tissue necrosis if extravasation occurs.

Grade B, Level III

- Remove any IV device as soon as it is no longer clinically indicated.

Grade C, Level IV

- Wear non-latex or latex gloves when removing IV cannula.

GPP

- Replace short, peripheral venous cannulas, and rotate peripheral venous sites every 48 to 72 hours to minimise the risk of phlebitis. Remove cannulas inserted under emergency conditions, where breaks in aseptic technique are likely to have occurred. Insert a new cannula at a different site within 24 hours.

Grade A, Level Ib

Cannula site care

- Before cannula insertion, cleanse the skin site with an appropriate antiseptic, including 70% alcohol or 10% povidone-iodine. Allow the antiseptic to remain on the insertion site for an appropriate length of time before inserting the cannula.

Grade A, Level Ib

- Do not palpate the insertion site after the skin has been cleansed with antiseptic (this does not apply to maximum barrier precautions during which the operator is working in a sterile field).

Grade C, Level IV

- Use either a transparent dressing or sterile gauze to cover the cannula site.

Grade A, Level Ib

- Replace cannula site dressings when they become damp, loosened, or soiled, or when the device is removed or replaced. Change dressings more frequently in diaphoretic patients.

Grade A, Level Ib

- Avoid touch contamination of the cannula insertion site when the dressing is replaced.

Grade C, Level IV

- Do not routinely apply topical anti-microbial ointment to the insertion site of peripheral venous cannulas.

Grade A, Level Ib

Cannula care

- Routinely flush peripheral venous locks with normal saline solution, unless they are used for obtaining blood specimens, in which case a diluted heparin (10 units per ml) flush solution should be used.

Grade A, Level Ia

- No recommendation for the routine use of topical venodilators (e.g., glyceryl trinitrate) or anti-inflammatory agents (e.g., cortisone) near the insertion site of peripheral venous cannulas to reduce phlebitis.

- No recommendation for the routine use of hydrocortisone or heparin in parenteral solutions to reduce phlebitis.

Replacement of administration sets and IV fluids

- In general, administration sets include the area from the spike of tubing entering the fluid container to the hub of the vascular device. However, a short extension tube may be connected to the vascular device and may be considered a portion of the device to facilitate aseptic technique when changing administration sets. Replace extension tubing when the vascular device is replaced.

Grade C, Level IV

- Replace IV tubing, including piggyback tubing and stopcocks, no more frequently than at 72-hour intervals, unless clinically indicated.

Grade A, Level Ib

- No recommendation for the frequency of replacement of IV tubing used for intermittent infusions.

- Replace tubing used to administer blood and blood products immediately after transfusion.

Grade C, Level IV

- Replace tubing used to administer lipid emulsions within 24 hours of initiating the infusion.

Grade B, Level III

Intravenous injection ports

- Clean injection ports with 70% alcohol before accessing the system.

Grade C, Level IV

Preparation and quality control of IV admixtures

- Check all containers of parenteral fluid for visible turbidity, leaks, cracks, particulate matter and the manufacturer's expiration date before use.

Grade C, Level IV

- Use single-dose vials for parenteral additives or medications whenever possible.

Grade B, Level III

- Refrigerate multi-dose vials after they are opened as recommended by the manufacturer.

Grade B, Level IIb

- Cleanse the rubber diaphragm of multi-dose vials with 70% alcohol before inserting a device into the vial.

Grade B, Level III

- Use a sterile device each time a multi-dose vial is accessed, and avoid touch contamination of the device before penetrating the rubber diaphragm.

Grade B, Level III

- Discard multi-dose vials, when suspected or visible contamination occurs or when the manufacturer's stated expiration date is due.

Grade B, Level III

In-line filters

- Do not use filters routinely for infection control purposes.

Grade B, Level IIa

Needleless intravascular devices

- No recommendation for use of needleless intravascular devices.

Prophylactic anti-microbials

- Do not administer anti-microbials routinely before insertion or during use of an IV device to prevent cannula colonisation or bloodstream infection.

Grade A, Level Ib

Surveillance for cannula-related infection

- Palpate the cannula insertion site daily for tenderness through the intact dressing.

Grade C, Level IV

- Inspect the cannula site visually if the patient has evidence of tenderness at the insertion site, fever without obvious cause, or symptoms of local or bloodstream infection.

Grade C, Level IV

- In patients who have large, bulky dressings that prevent palpation or direct visualisation of the cannula insertion site, remove the dressing, visually inspect the cannula site at least daily and apply a new dressing.

Grade C, Level IV

- Record the date and time of cannula insertion in an obvious location near the cannula-insertion site (e.g., on the dressing).

Grade C, Level IV

- Conduct surveillance for IV device-related infections to determine device-specific infection rates, to monitor trends in those rates, and to assist in identifying lapses in infection control practices within one's own institution.

Grade B, Level IIa

- Do not routinely perform surveillance cultures of devices used for IV access.

Grade B, Level IIb

Health care worker education and training

- Conduct ongoing education and training of health care workers regarding procedures for the insertion and maintenance of IV devices and appropriate infection control measures to prevent IV device-related infections. Audiovisuals can serve as a useful adjunct to educational efforts.

Grade A, Level Ib

2 INTRODUCTION

2.1 Background

The use of intravascular access devices (venous or arterial) is an integral part of patient care. Some access the veins or arteries through peripheral sites (mainly forearm and hand), while others are done through central vessels. These indwelling devices provide a route for administering infusions such as fluids, intravenous medications, blood products, nutrients, for procuring blood specimens and for monitoring haemodynamic status of critically ill patients.

During the use of intravenous (IV) devices, micro-organisms may enter the blood stream and is associated with a variety of local or systemic infections resulting in prolonged hospitalisation, increased morbidity and mortality (Pearson 1996) of the patients. However, the risk of infection associated with the devices can be minimised by appropriate infection prevention measures.

In this set of guidelines, the term "cannula" is adopted in preference to "catheter" as it better describes the device commonly used in peripheral venous access. It is also a term generally accepted by nurses in Singapore.

2.2 Definition

Phlebitis: The inflammation of a vein, which may be accompanied by pain, erythema, oedema, streak formation, and/or palpable cord (Pearson 1996).

Colonisation: The growth of an organism from the proximal or distal cannula segment, or the cannula lumen, and the absence of accompanying signs of inflammation at the cannulation site (Pearson 1996).

Local cannula-related infection: The growth of an organism from the proximal or distal cannula segment, or the cannula lumen, with accompanying signs of inflammation (e.g. erythema, warmth, swelling

or tenderness) at the cannula site. In the absence of laboratory confirmation, cannula-related infection may be diagnosed when there is purulent drainage from the skin-cannula junction (Pearson 1996).

Cannula-related bloodstream infection (CR-BSI): The isolation of the same organism both from the cannula segment and the blood of a patient with accompanying clinical symptoms of blood stream infectin (BSI) and no other apparent source of infection. In the absence of laboratory confirmation, defervescence after removal of an implicated cannula from a patient with BSI may be considered indirect evidence of cannula-related bloodstream infection (Pearson 1996).

Infusate-related bloodstream infection: The isolation of the same organism both from the infusate and separate percutaneous blood cultures, with no other identifiable source of infection (Pearson 1996).

2.3 Peripheral IV device-related infections

The most commonly used IV device is the short peripheral venous cannula which is mainly used in the forearm and hands. Due to its relatively short duration of use, it is rarely associated with BSI (Gantz et al 1984; Maki and Ringer 1991; Ena et al 1992). Phlebitis is the most important complication associated with peripheral venous cannulas, and is largely a physiochemical or mechanical, rather than an infectious, phenomenon. Risk factors for the development of phlebitis include type of infusate, cannula material, size, and host factors. When phlebitis does occur, the risk of local cannula-related infection may also increase (Gantz et al 1984; Larson and Hargiss 1984; Hoffman et al 1988).

The pathogenesis of cannula-related infections is complex but most appear to result from skin organisms at the cannula insertion site migrating into the cannula track, eventually colonising the cannula tip (Snydman et al 1982; Cooper and Hopkins 1985). Contamination of the cannula hub may also be an important contributor to the colonisation of cannula lumens (Linares et al 1985; Radd et al 1993; Salzman et al 1993). Handwashing and aseptic technique are the major preventive strategies for cannula-related infections.

2.4 Scope of the guideline

The guidelines presented in this document aim to provide:
(i) a conservative interpretation of its available evidence and
(ii) a practical and relevant advice to the healthcare workers in Singapore.

The recommendations are applicable for the management of adults receiving peripheral venous therapy, and may not be appropriate for the management of neonates and children on IV therapy. It is also not applicable when other intravsacular devices such as central, arterial or haemodialysis catheters are used.

The guidelines include recommendations on handwashing, aseptic techniques, site selection, type of cannula material and size, use of barrier precautions during cannula insertion, replacement of cannulas, administration sets, infusate, cannula-site care, use of filters, flush solutions, prophylactic antimicrobials and newer IV devices (e.g., impregnated cannulas, needleless infusion systems).

3 DEVELOPMENT OF GUIDELINES

3.1 Literature review

This set of guidelines is adapted from the Guideline for Prevention of Intravascular Device-Related Infections by the Centre for Disease Control of the United States of America (Pearson 1996), as no new evidence was found from searches on MEDLINE, CINAHL, Cochrane library between 1995 and 2000.

Current clinical practice in Singapore was reviewed by studying the existing guidelines and documentation used by various local hospitals and institutions.

For areas where available evidence is inconsistent or inconclusive, recommendations were made based on the clinical experience and judgement of the workgroup or expert committee reports.

3.2 Evidence criteria

For the definitions of the strength of evidence and the grades of recommendations in this guideline, the workgroup adopted the criteria used by the Scottish Intercollegiate Guidelines Network (SIGN), which originated from Agency for Healthcare Policy and Research, the former Agency for Healthcare Research and Quality. Literature retrieved were reviewed and evaluated based on these criteria.

3.2.1 Levels of evidence

Level	Type of Evidence
Ia	Evidence obtained from meta-analysis of randomised controlled trials.
Ib	Evidence obtained from at least one randomised controlled trial.
IIa	Evidence obtained from at least one well-designed controlled study without randomisation.
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study.
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

2.3.2 Grades of recommendation

Grade	Recommendation
A (evidence levels Ia, Ib)	Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
B (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.
C (evidence level IV)	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
GPP (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

3.3 Guidelines review

The draft guidelines was circulated to hospitals and institutions together with a structured questionnaire for review and evaluation of the recommendations in clinical practice.

These guidelines will be revised and updated periodically to incorporate the latest relevant research evidence and expert clinical opinions.

3.4 Limitations

The workgroup recommends that individual practitioners assess the appropriateness of the recommendations with regards to patient condition, overall treatment goal, resource availability, institutional policies, available treatment options and any recent research findings before adopting any recommendations in clinical practice.

4 ASEPSIS AND CANNULATION

4.1 Handwashing

Handwashing is generally considered the most important procedure in preventing infections because many types of these infections may be caused by organisms transmitted on the hands of healthcare personnel (Steere and Mallison 1975; Simmons et al 1990).

It is also accepted that aseptic technique during insertion of short peripheral venous cannulas provide adequate protection against nosocomial infection (Pearson 1996).

- Wash hands before and after palpating, inserting, replacing, or dressing any IV device.

Grade B, Level IIB

4.2 Barrier precautions during cannula insertion and care

There were no studies found on barrier precautions for peripheral venous cannula insertion. The workgroup decided to base the recommendations on evidence found on central venous catheter (CVC) insertion. Raad and colleagues (1994) reported that adopting maximal barrier precautions can minimise catheter contamination and subsequent CVC-related infections, regardless whether it is performed in the operating room or at the patient's bedside.

- Wear non-latex or latex gloves when inserting an IV device.

Grade C, Level IV

- Use sterile or non-sterile clean gloves during change of dressings.

GPP

4.3 Selection of peripheral cannula insertion site

When determining the site of cannula placement, several factors should be assessed (Pearson 1996). These include patient-specific factors

(e.g., pre-existing cannulas, anatomic deformity, bleeding diathesis), relative risk of mechanical complications (e.g., bleeding, pneumothorax) and risk of infection.

It has been shown that the subsequent risk of cannula-related infection is associated with the site of insertion. Peripheral venous cannulas inserted in the upper extremity have lower risk of phlebitis than those on the lower extremity (Phillips and Eyre 1958; McNair and Dudley 1959; Crane 1960). In addition, Maki (1992) reported that cannulas inserted into the veins of the hand have a lower risk of phlebitis than those inserted on the upper arm or into the veins on the wrist.

- Use an upper extremity site in preference to one on a lower extremity for cannula insertion. Transfer a cannula inserted in a lower extremity site to an upper extremity site as soon as the latter is available.

Grade A, Level Ib

4.4 Selection and replacement of IV devices

The material of which the device is made and the intrinsic properties of the infecting organism can affect cannula-related infection. Certain cannula materials are more thrombogenic than others, thus predisposing to cannula colonisation and cannula-related infection (Stillman 1977). For example, polyvinyl chloride or polyethylene was found to be less resistant to the adherence of micro-organisms than cannulas made of Teflon, silicone elastomer, or polyurethane (Sheth et al 1983; Ashkenazi et al 1986). They were also associated with more complications (Sheth et al 1983; Maki and Ringer 1987; Martin et al 1989).

Although steel needles have the same rate of infectious complications as Teflon cannulas (Band and Maki 1980; Tully et al 1981), they were more frequently associated with the infiltration of IV fluids into the subcutaneous tissues (Tully et al 1981). This is potentially serious if vesicant fluid is infused.

Routine or scheduled replacement of IV cannulas has been advocated as a method to prevent phlebitis and cannula-related infections (Pearson 1996). One study (Collin et al 1975) reported that the

incidences of thrombophlebitis and bacterial colonisation of cannulas increased dramatically when cannulas were left in place for more than 72 hours. Hence, Band and Maki (1980) suggested that short peripheral cannula sites be commonly rotated at 48 to 72-hour intervals to reduce the risk of infection and minimise patient discomfort associated with phlebitis.

- Select a device with the lowest relative risk of complications (infectious versus non-infectious) and the lowest costs for the anticipated type and duration of IV therapy. The risk and benefits of replacing a device at a recommended schedule to reduce infectious complications should be weighed against the risk of mechanical complications and availability of alternative sites. Decisions regarding the type of device and its frequency of replacement should be determined on an individual patient basis.

  Grade C, Level IV

- Select cannulas based on the intended purpose, duration of use, experience at the institution and known complications (e.g., phlebitis). Use a Teflon cannula, a polyurethane cannula or a steel needle.

  Grade A, Level Ib

- Avoid the use of steel needles for the administration of fluids and medications that may cause tissue necrosis if extravasation occurs.

  Grade B, Level III

- Remove any IV device as soon as it is no longer clinically indicated.

  Grade C, Level IV

- Wear non-latex or latex gloves when changing the dressings on IV devices.

  GPP

- Replace short, peripheral venous cannulas, and rotate peripheral venous sites every 48 to 72 hours to minimise the risk of phlebitis. Remove cannulas inserted under emergency conditions, where breaks in aseptic technique are likely to have occurred. Insert a new cannula at a different site within 24 hours.

  Grade A, Level Ib

5 MAINTENANCE

5.1 Cannula site care

Skin cleansing or antisepsis of the insertion site is regarded as one of the most important measures for preventing cannula-related infection (Rotter et al 1980; Ayliffe et al 1988).

The use of tincture of iodine (such as 70% alcohol and 10% povidone iodine) as an antiseptic before obtaining blood cultures suggest that it may be an effective antiseptic for preparation of the skin before insertion of IV cannulas (Strand et al 1993). Iodine may cause irritation to the skin (Strand et al 1993) and would require cleansing with alcohol.

A sustained-release chlorhexidine gluconate patch has been introduced as a dressing for cannula insertion sites (Shapiro et al 1990). However, its efficacy in reducing IV device-related infection is yet to be determined.

There was conflicting evidence on the use of anti-microbial ointments at the time of cannula insertion and during routine dressing changes to reduce microbial contamination of cannula insertion sites (Norden 1969; Zinner et al 1969; Maki and Band 1981). Several researchers have reported that the use of poly-antibiotic ointments that are not fungicidal may in fact increase the rate of colonisation of the cannula by Candida species (Zinner et al 1969; Maki and Band 1981, Flowers et al 1989).

The use of transparent, semi-permeable, polyurethane dressings has fast become the popular means of dressing cannula insertion sites. Several benefits have been cited. These dressings secure the device, permit continuous visual inspection of the cannula site, permit patients to bathe and shower without saturating the dressing, and require less frequent changes than the standard gauze and tape dressings, thus saving personnel time (Pearson 1996). However, there were conflicting evidences related to their use. Some studies (e.g. Craven et al 1985; Katich and Band 1985) suggest that their use increases both microbial colonisation of the cannula site and the risk of subsequent cannula-

related infection. Other studies (e.g. Ricard et al 1985; Maki and Ringer 1987; Hoffmann et al 1988), however, have shown no difference in cannula colonisation and infection rates between the use of transparent dressings and gauze and tape dressings. Nevertheless, transparent dressings can be safely left on peripheral venous cannulas for the duration of cannula insertion without increasing the risk of thrombophlebitis (Maki and Ringer 1987).

- Before cannula insertion, cleanse the skin site with an appropriate antiseptic, including 70% alcohol or 10% povidone-iodine. Allow the antiseptic to remain on the insertion site for an appropriate length of time before inserting the cannula.

  Grade A, Level Ib

- Do not palpate the insertion site after the skin has been cleansed with antiseptic (this does not apply to maximum barrier precautions during which the operator is working in a sterile field).

  Grade C, Level IV

- Use either a transparent dressing or sterile gauze to cover the cannula site.

  Grade A, Level Ib

- Replace cannula site dressings when they become damp, loose, or soiled, or when the device is removed or replaced. Change dressings more frequently in diaphoretic patients.

  Grade A, Level Ib

- Avoid touch contamination of the cannula insertion site when the dressing is replaced.

  Grade C, Level IV

- Do not routinely apply topical anti-microbial ointment to the insertion site of peripheral venous cannulas.

  Grade A, Level Ib

5.2 Cannula care

Thrombi and fibrin deposits on cannulas may serve as a nidus for microbial colonisation of the IV devices (Stillman et al 1977). Though flush solutions are designed to prevent thrombosis, rather than infection, the use of anticoagulants (e.g. heparin) or thrombolytic agents may have a role in the prevention of CR-BSI.

However, studies (e.g. Ashkenazi et al 1986; Ashton et al 1990; Weber 1991) indicate that 0.9% saline solution is as effective as heparin in maintaining cannula patency and reducing phlebitis among peripheral cannulas. In fact, the routine use of heparin, at 250 to 500 units per day, has been associated with thrombocytopenia and thromboembolic and hemorrhagic complications (Passannate and Macik 1988; Garrelts 1992).

IV additive such as hydrocortisone appeared to reduce phlebitis. For example, the risk of phlebitis associated with the infusion of certain fluids (such as potassium chloride (Sketch et al 1972), lidocaine (Bassan and Sheikh-Hamad 1983) and anti-microbials (Sketch et al 1972) may be reduced by the use of hydrocortisone (Sketch et al 1972). In other trials, topical application of venodilators such as glyceryl trinitrate (Khawaja et al 1988), or anti-inflammatory agents such as cortisone near the cannula site (Woodhouse 1979), has reduced the incidence of infusion-related thrombophlebitis and increased the life span of the cannulas (Woodhouse 1979; O'Brien et al 1990).

- Routinely flush peripheral venous locks with normal saline solution, unless they are used for obtaining blood specimens, in which case a diluted heparin (10 units per ml) flush solution should be used.

  Grade A, Level Ia

- No recommendation for the routine use of topical venodilators (e.g., glyceryl trinitrate) or anti-inflammatory agents (e.g., cortisone) near the insertion site of peripheral venous cannulas to reduce phlebitis.

- No recommendation for the routine use of hydrocortisone or heparin in parenteral solutions to reduce phlebitis.

5.3 Replacement of administration sets and IV fluids

Data from three well-controlled studies show that replacing administration sets 72 hours or more after initiation of use is safe and cost-effective (Maki et al 1987). However, certain fluids such as blood, blood products, and lipid emulsions are likely to support microbial growth if contaminated (Maki and Martin 1975; Jarvis and Highsmith 1984). Hence, more frequent replacement of IV tubing may be necessary (Ministry of Health 2000).

Evidence consistently shows that endemic BSIs in hospitals as a result of in-use contamination of IV fluids is infrequent and sporadic (Pearson 1996). The frequency ranged from 0.5% to 1.2% (Gorbea et al 1984; Josepson et al 1985). Maki (1976) estimated the incidence of BSI from contaminated fluids to be less than one per 1000 infusions.

- In general, administration sets include the area from the spike of tubing entering the fluid container to the hub of the vascular device. However, a short extension tube may be connected to the vascular device and may be considered a portion of the device to facilitate aseptic technique when changing administration sets. Replace extension tubing when the vascular device is replaced.

  Grade C, Level IV

- Replace IV tubing, including piggyback tubing and stopcocks at 72-hour intervals, unless clinically indicated.

  Grade A, Level Ib

- No recommendation for the frequency of replacement of IV tubing used for intermittent infusions.

- Replace tubing used to administer blood and blood products immediately after transfusion.

  Grade C, Level IV

- Replace tubing used to administer lipid emulsions within 24 hours of initiating the infusion.

  Grade B, Level III

5.4 Intravenous injection ports

Stopcocks (or 3-way plug) are commonly used for administration of medications, administration of IV infusions, or collection of blood samples. They may represent another portal of entry for micro-organisms into vascular cannulas or IV fluids. Pearson (1996) noted that stopcock contamination is common (between 45% and 50%), the relative contribution of stopcock contamination to IV cannula or IV fluid contamination is unclear. Few studies have been able to demonstrate that the organism(s) colonising stopcocks are responsible for cannula-related infection (McArthur et al 1975; Walrath et al 1979).

As an alternative to stopcocks, the use of a closed-needle sampling system can reduce sampling port and IV fluid contamination significantly (Crow et al 1989). "Piggyback" systems may also be used. However, "piggyback" systems pose a risk for contamination of the IV fluid if the needle entering the rubber membrane of an injection port is exposed partially to air or comes into direct contact with the tape used to fix the needle to the port (Pearson 1996).

- Clean injection ports with 70% alcohol before accessing the system.

Grade C, Level IV

5.5 Preparation and quality control of IV admixtures

Some parenteral medications are dispensed in multi-dose parenteral medication (MDVs) that may be used for prolonged periods for one or more patients. Longfield and colleagues (1984) reported that though the overall risk of extrinsic contamination (i.e. introduced into the system during use) of MDVs appears to be small (estimated 0.5 per 1000 vials), the consequences of contamination may be serious. Contamination of MDVs as a result of breech in asepsis handling is known to result in nosocomial outbreaks (Alter et al 1983; Jarvis and Highsmith 1984).

Highsmith and colleagues (1982) reported that when bacteria or yeasts were inoculated into some commonly used medications, such as heparin, potassium chloride, procainamide, methohexital, succinylcholine chloride, and sodium thiopental for 96 hours at room temperature, rarely were micro-organisms recovered irrespective of whether they contained a preservative.

Pearson (1996) reported that micro-organisms could proliferate in lidocaine and insulin only if the inocula were prepared in peptone water (with one exception). Even in these instances, when vials were kept at 4°C as recommended, micro-organisms did not proliferate in the insulin.

Available evidence suggests that MDVs can be stored safely at room temperature unless manufacturers' recommendations or drug stability dictate otherwise (Pearson 1996). Lehmann (1977) found that bacteria remained viable significantly longer in refrigerated preservative-containing MDVs than in vials stored at room temperature.

- Check all containers of parenteral fluid for visible turbidity, leaks, cracks, particulate matter, and the manufacturer's expiration date before use.

  Grade C, Level IV

- Use single-dose vials for parenteral additives or medications whenever possible.

  Grade B, Level III

- Refrigerate multi-dose vials after they are opened as recommended by the manufacturer.

  Grade B, Level IIb

- Cleanse the rubber diaphragm of multi-dose vials with 70% alcohol before inserting a device into the vial.

  Grade B, Level III

- Use a sterile device each time a multi-dose vial is accessed, and avoid touch contamination of the device before penetrating the rubber diaphragm.

  Grade B, Level III

- Discard multi-dose vials, when suspected or visible contamination occurs or when the manufacturer's stated expiration date is due.

  Grade B, Level III

6 MISCELLANEOUS ISSUES

6.1 In-line filters

In-line filters may reduce the incidence of infusion-related phlebitis (Allcutt et al 1983; Maddox et al 1983; Falchuk et al 1985). However, there was no evidence that they prevent infections associated with IV devices and infusion systems (Pearson 1996). Advocators of in-line filters claim that:

- reduce the risk of infection from contaminated infusate and contamination introduced proximal to the filter;
- reduce the risk of phlebitis in patients who require high doses of medication (e.g., anti-microbials) or in those in whom infusion-related phlebitis already has occurred;
- remove particulate matter that may contaminate IV fluids (Turco and Davis 1973) and;
- filter endotoxins produced by gram-negative organisms in contaminated infusates (Baumgartner et al 1986).

It is important to examine the above theoretical advantages with the understanding that infusate-related BSI rarely occurs (Pearson 1996). Pre-use filtration at the production level is clearly a more practical and less costly way to remove most particulates from infusates (Pearson 1996). Furthermore, when used with certain solutions (e.g. dextran, lipids, mannitol), in-line filters may become blocked and require increased line manipulations and decrease the availability of administered drugs (Butler et al 1980). Hence, the routine use of in-line filters is perceived to increase cost, personnel time and possible infections (Freeman and Litton 1974).

- Do not use filters routinely for infection control purposes.

Grade B, Level IIa

6.2 Needleless intravascular devices

Needleless infusion systems were introduced to reduce the incidence of sharps injuries and the resultant risk of transmission of blood-borne infections to healthcare workers. There is limited evidence to support reduction in the potential risk of contamination of the cannula and infusate and subsequent cannula-related infection associated with the use of needless infusion systems (Pearson 1996).

- No recommendation for use of needleless intravascular devices.

6.3 Prophylactic anti-microbials

Prophylactic administration of anti-microbials has been used to reduce the incidence of CR-BSIs, but scientific studies on the efficacy of this practice are inconclusive (Pearson 1996).

- Do not administer anti-microbials routinely before insertion or during use of an IV device to prevent cannula colonisation or bloodstream infection.

Grade A, Level Ib

7 SURVEILLANCE

7.1 Surveillance for cannula-related infection

The establishment of intensive infection surveillance and control programmes was strongly associated with reduction in nosocomial infection rates. Essential components of an effective programme include conducting organised surveillance and control activities, trained infection control physicians and nurses, and a system of reporting infection rates (Haley et al 1985).

Unlike surveillance of quantitative skin cultures, targeted quantitative skin cultures done when cannula infection is suspected are highly sensitive, specific and predictive (Raad et al 1995).

- Palpate the cannula insertion site daily for tenderness through the intact dressing.

  Grade C, Level IV

- Inspect the cannula site visually if the patient has evidence of tenderness at the insertion site, fever without obvious cause, or symptoms of local or bloodstream infection.

  Grade C, Level IV

- In patients who have large, bulky dressings that prevent palpation or direct visualisation of the cannula insertion site, remove the dressing, visually inspect the cannula site at least once daily and apply a new dressing.

  Grade C, Level IV

- Record the date and time of cannula insertion in an obvious location near the cannula-insertion site (e.g., on the dressing).

  Grade C, Level IV

- Conduct surveillance for IV device-related infections to determine device-specific infection rates, to monitor trends in those rates, and to assist in identifying lapses in infection control practices within one's own institution.

  Grade B, Level IIa

- Do not routinely perform surveillance cultures of devices used for IV access.

  Grade B, Level IIb

8 EDUCATION AND TRAINING

8.1 Health care worker education and training

Educational and enforcement programmes designed to improve handwashing procedures can significantly reduce endemic nosocomial infection rates (Conly et al 1989). Studies have shown that the incidence of sepsis corresponded to a greater number of untrained nurses (Vanherweghem et al 1986).

- Conduct ongoing education and training of health care workers regarding procedures for the insertion and maintenance of IV devices and appropriate infection control measures to prevent IV device-related infections. Audiovisuals can serve as a useful adjunct to educational efforts.

Grade A, Level Ib

9 CLINICAL AUDIT

Hospital and institution administrators should consider these guidelines in their in-house quality assurance programmes. Nurses should critically review the implications of these guidelines on their routine care, patient-teaching and educational needs.

9.1 Outcome indicators

The recommended key outcome indicator is indwelling cannula phlebitis rate.

Indwelling phlebitis rate may best be assured through audits of randomly selected individual episodes of care and a retrospective review of cases at regular intervals. Pearson (1996) recommends keeping phlebitis occurrence rate to below 5%. The phlebitis rate is calculated according to a standard formula:

$$\frac{\text{Number of phlebitis (1+ or higher) incidents}}{\text{Total number of IV peripheral lines}} \times 100 = \%\ \text{Peripheral Phlebitis}$$

9.2 Assessment tool

The degree of phlebitis shall be measured according to a uniform scale and shall be documented in the nursing record. A phlebitis scale provides a uniform standard for measuring degrees of phlebitis. The presence of pain does not constitute phlebitis. However, pain must always be evaluated to determine appropriate intervention. Pain around the cannula is usually a precursor to phlebitis that requires cannula removal and documentation in the nursing record. A phlebitis scale should be established in organisational policy and procedure. Pearson (1996) recommends the following Phlebitis Rating Scale:

Phlebitis Scale	Description
0	No clinical symptoms
1+	Erythema with or without pain Oedema may or may not be present No streak formation No palpable cord
2+	Erythema with or without pain Oedema may or may not be present Streak formation No palpable cord
3+	Erythema with or without pain Oedema may or may not be present Streak formation Palpable cord

9.3 Audit

Audit is strongly recommended at ward level. It will be advantageous to establish current baseline practice against which change may be measured.

9.4 Management role

Hospital and institution administrators, together with quality assurance teams should ensure that outcome indicators are met. They may use hospital or institution that perform well as a benchmark of quality practice.

10 IMPLEMENTATION OF GUIDELINES

It is expected that these guidelines be adopted after discussion with clinical and management staff of their respective hospitals and institutions. They may review how these guidelines may complement or be incorporated into their existing institution protocols.

Feedback may be directed to the Ministry of Health for consideration in future review.

REFERENCES

Allcutt DA, Lort D, McCollum CN. 1983. Final inline filtration for intravenous infusions: a prospective hospital study. *Br J Surg,* 70:111-3.

Alter MJ, Ahtone J, Maynard JE. 1983. Hepatitis B virus transmission associated with a multiple-dose vial in a hemodialysis unit. *Ann Intern Med*, 99:330-3.

Ashkenazi S, Weiss E, Drucker MM. 1986. Bacterial adherence to intravenous catheters and needles and its influence by cannula type and bacterial surface hydrophobicity. *J Lab Clin Med*, 107:136-40.

Ashton J, Gibson V, Summers S. 1990. Effects of heparin versus saline solution on intermittent infusion device irrigation. *Heart Lung*, 19:608-12.

Ayliffe GA, Babb JR, Davies JG, Lilly HA. 1988. Hand disinfection: a comparison of various agents in laboratory and ward studies. *J Hosp Infect,* 11:226-43.

Band JD, Maki DG. 1980. Steel needles used for intravenous therapy. Morbidity in patients with hematologic malignancy. *Arch Intern Med*, 140:31-4.

Bassan MM, Sheikh-Hamad D. 1983. Prevention of lidocaine-infusion phlebitis by heparin and hydrocortisone. *Chest*, 84:439-41.

Baumgartner TG, Schmidt GL, Thakker KM, et al. 1986. Bacterial endotoxin retention by inline intravenous filters. *Am J Hosp Pharm*, 43:681-4.

Butler DL, Munson JM, Deluca PP. 1980. Effect of inline filtration on the potency of low-dose drugs. *Am J Hosp Pharm*, 37:935-41.

Collin J, Collin C, Constable FL, Johnston ID. 1975. Infusion thrombophlebitis and infection with various cannulas. *Lancet*, 2:150-3.

Conly JM, Hill S, Ross J, Lertzman J, Louie TJ. 1989. Handwashing practices in an intensive care unit: The effects of an educational program and its relationship to infection rates. *Am J Clin Pathol*, 17:330-9.

Cooper GL, Hopkins CC. 1985. Rapid diagnosis of intravascular catheter-associated infection by direct gram-staining of catheter segments. *N Engl J Med,* 312:1142-7.

Crane C. 1960. Venous interruption of septic thrombophlebitis. *N Engl J Med,* 262:947-51.

Craven DE, Lichtenberg A, Kunches LM, et al. 1985. A randomized study comparing a transparent polyurethane dressing to a dry gauze dressing for peripheral intravenous catheter sites. *Am J Infect Control*, 6:361-6.

Crow S, Conrad SA, Chaney-Rowell C, King JW. 1989. Microbial contamination of arterial infusions used for hemodynamic monitoring: a randomized trial of contamination with sampling through conventional stopcocks versus a novel closed system. *Infect Control Hosp Epidemiol,* 10:557-61.

Ena J, Cercenado E, Martinez D, Bouza E. 1992. Cross-sectional epidemiology of phlebitis and catheter-related infections. *Infect Control Hosp Epidemiol,* 13:15-20.

Falchuk KH, Peterson L, McNeil BJ. 1985. Microparticulate-induced phlebitis: Its prevention by in-line filtration. *N Engl J Med,* 312:78-82.

Flowers RH, Schwenzer KJ, Kopel RF, Fisch MJ, Tucker SI, Farr BM. 1989. Efficacy of an attachable subcutaneous cuff for the prevention of intravascular catheter-related infection: A randomized, controlled trial. *JAMA,* 261:878-83.

Freeman JB, Litton AA. 1974. Preponderance of gram-positive infections during parenteral alimentation. *Surg Gynecol Obstet,* 139:905-8.

Gantz NM, Presswood GM, Goldbert R, Doern G. 1984. Effects of dressing type and change interval on intravenous therapy complication rates. *Diagn Microbiol Infect Dis*, 2:325-32.

Garrelts JC. 1992. White clot syndrome and thrombocytopenia: Reasons to abandon heparin IV lock flush solution. *Clin Pharm*, 11:797-9.

Gorbea HF, Snydman DR, Delaney A, Stockman J, Martin WJ. 1984. Intravenous tubing with burettes can be safely changed at 48-hour intervals. *JAMA*, 251:2112-5.

Haley RW, Culver DH, White JW, et al. 1985. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. *Am J Epidemiol,* 121:182-205.

Highsmith AK, Greenhood R, Allen JR. 1982. Growth of nosocomial pathogens in multiple-dose parenteral medication vials. *J Clin Microbiol,* 15:1024-8.

Hoffmann KK, Western SA, Kaiser DL, Wenzel RP, Groschel DH. 1988. Bacterial colonization and phlebitis-associated risk with transparent polyurethane film for peripheral intravenous site dressings. *Am J Infect Control,* 16:101-6.

Infusion Nurses Society. 2000. *Infusion nursing standards of practice.*

Jarvis WR, Highsmith AK. 1984. Bacterial growth and endotoxin production in lipid emulsion. *J Clin Microbiol*, 19:17-20.

Joanna Briggs Institute of Evidence Based Nursing and Midwifery. 1998. Management of peripheral intravascular devices. *Best Practice,* 2(1):1-6.

Josephson A, Gombert ME, Sierra MF, Karanfil LV, Tansino GF. 1985. The relationship between intravenous fluid contamination and the frequency of tubing replacement. *Infect Control*, 6:367-70.

Katich M, Band J. 1985. Local infection of the intravenous-cannulae wound associated with transparent dressings. *J Infect Dis,* 151:971-72.

Khawaja HT, Campbell MS, Weaver PC. 1988. Effect of transdermal glyceryl trinitrate on the survival of peripheral intravenous infusions: A double-blind prospective clinical study. *Br J Surg,* 75:1212-5.

Larson E, Hargiss C. 1984. A decentralized approach to maintenance of intravenous therapy. *Am J Infect Control*, 12:177-86.

Lehmann CR. 1977. Effect of refrigeration on bactericidal activity of four multiple-dose injectable drug products. *Am J Hosp Pharm*, 34:1196-200.

Linares J, Sitges-Serra A, Garau J, Perez JL, Martin R. 1985. Pathogenesis of catheter sepsis: A prospective study with quantitative and semiquantitative cultures of catheter hub and segments. *J Clin Microbiol,* 21:357-60.

Longfield R, Longfield J, Smith LP, Hyams KC, Strohmer ME. 1984. Multidose medication vial sterility: An in-use study and a review of the literature. *Am J Infect Control,* 5:165-9.

Maddox RR, John JF Jr, Brown LL, Smith CE. 1983. Effect of inline filtration on postinfusion phlebitis. *Clin Pharm,* 2:58-61.

Maki DG. 1976. Sepsis arising from extrinsic contamination of the infusion and measures for control. In: Phillips I, Meers PD, D'Arcy PF, eds. (1976). *Microbiological Hazards of Infusion Therapy.* Lancaster, England: MTP Press.

Maki DG. 1992. Infections due to infusion therapy. In: Bennett JV, Brachman PS, eds. 1992. *Hospital Infections*. (3rd ed). Boston, MA: Little, Brown and Co.

Maki DG, Band JD. 1981. A comparative study of polyantibiotic and iodophor ointment in prevention of vascular catheter-related infection. *Am J Med,* 70:739-44.

Maki DG, Botticelli JT, LeRoy ML, Thielke TS. 1987. Prospective study of replacing administration sets for intravenous therapy at 48- vs 72-hour intervals: 72 hours is safe and cost-effective. *JAMA*, 258:1777-81.

Maki DG, Martin WT. 1975. Nationwide epidemic of septicemia caused by contaminated infusion products, IV: Growth of microbial pathogens in fluids for intravenous infection. *J Infect Dis,* 131:267-72.

Maki DG, Ringer M. 1987. Evaluation of dressing regimens for prevention of infection with peripheral intravenous catheters: Gauze, a transparent polyurethane dressing, and an iodophor-transparent dressing. *JAMA*, 258:2396-403.

Maki DG, Ringer M. 1991. Risk factors for infusion-related phlebitis with small peripheral venous catheters: A randomized controlled trial. *Ann Intern Med,* 114:845-54.

Martin MA, Pfaller MA, Wenzel RP. 1989. Coagulase-negative staphylococcal bacteremia: Mortality and hospital stay. *Ann Intern Med*, 110:9-16.

McArthur BJ, Hargiss C, Schoenknecht FD. 1975. Stopcock contamination in an ICU. *Am J Nurs,* 75:96-7.

McNair TJ, Dudley HA. 1959. The local complications of intravenous therapy. *Lancet*, 2:365-8.

Ministry of Health. 2000. *Infection Control Manual*. Ministry of Health, Singapore.

Norden CW. 1969. Application of antibiotic ointment to the site of venous catheterization a controlled trial. *J Infect Dis*, 120:611-5.

O'Brien BJ, Buxton MJ, Khawaja HT. 1990. An economic evaluation of transdermal glycerly trinitrate in the prevention of intravenous infusion failure. *J Clin Epidemiol*, 43:757-63.

Passannate A, Macik BG. 1988. Case report: The heparin flush syndrome - a cause of iatrogenic hemorrhage. *Am J Med Sci*, 296:71-3.

Pearson ML. 1996. Guideline for prevention of intravascular device-related infections. The Hospital Infection Control Practices Advisory Committee. *American Journal of Infection Control*, 24(2):262-93, 17/52/76311.

Phillips RW, Eyre JD. 1958. Septic thrombophlebitis with septicemia. *N Engl J Med*, 259:729-31.

Raad I, Baba M, Bodey GP. 1995. Diagnosis of catheter-related infections: Role of the surveillance and targeted quantitative skin cultures. *Clin Infect Dis*, 20:593-7.

Raad I, Costerton W, Sabharwal U, et al. 1993. Ultrastructural analysis of indwelling vascular catheters: A quantitative relationship between luminal colonization and duration of placement. *J Infect Dis*, 168:400-7.

Raad II, Hohn DC, Gilbreath BJ, et al. 1994. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol*, 15: 231-8

Ricard P, Martin R, Marcoux JA. 1985. Protection of indwelling vascular catheters: Incidence of bacterial contamination and catheter-related sepsis. *Crit Care Med*, 13:541-3.

Rotter M, Koller W, Wewalka G. 1980. Povidone-iodine and chlorhexidine gluconate-containing detergents for disinfection of hands. *J Hosp Infect*, 1:149-58.

Salzman MB, Isenberg HD, Shapiro JF, Lipsitz PJ, Rubin LG. 1993. A prospective study of the catheter hub as the portal of entry for microorganisms causing catheter-related sepsis in neonates. *J Infect Dis*, 167:487-90.

Shapiro JM, Bond EL, Garman JK. 1990. Use of a chlorhexidine dressing to reduce microbial colonization of epidural catheters. *Anesthesiology*, 73:625-31.

Sheth NK, Rose HD, Franson TR, Buckmire FL, Cooper JA, Sohnle PG. 1983. Colonization of bacteria on polyvinyl chloride and Teflon catheters in hospitalized patients. *J Clin Microbiol*, 18:1061-3.

Simmons B, Bryant J, Neiman K, et al. 1990. The role of handwashing in prevention of endemic intensive care unit infections. *Infect Control Hosp Epidemiol*, 11:589-94.

Sketch MH, Cale M, Mohiuddin SM, Booth RW. 1972. Use of percutaneously inserted venous catheters in coronary care units. *Chest*, 62:684-9.

Snydman DR, Pober BR, Murray SA, Gorbea HF, Majka JA, Perry LK. 1982. Predictive value of surveillance skin cultures in total parenteral nutrition-related infection. Prospective epidemiologic study using semiquantitative cultures. *Lancet*, 1385-8.

Steere AC, Mallison GF. 1975. Handwashing practices for the prevention of nosocomial infections. *Ann Intern Med,* 83:784-7.

Stillman RM, Soliman F, Garcia L, et al. 1977. Etiology of catheter-associated sepsis: Correlation with thrombogenicity. *Arch Surg*, 112:1497-502.

Strand CL, Wajsbort RR, Sturmann K. 1993. Effect of iodophor vs iodine tincture skin preparation on blood culture contamination rate. *JAMA,* 269:1004-6.

Tully JL, Friedland GH, Baldini LM, Goldman DA. 1981. Complications of intravenous therapy with steel needles and Teflon catheters: A comparative study. *Am J Med*, 70:702-6.

Turco SJ, Davis NM. 1973. Particulate matter in intravenous infusion fluids—phase 3. *Am J Hosp Pharm*, 30:611-3.

Vanherweghem JL, Dhaene M, Goldman M, et al. 1986. Infections associated with subclavian dialysis catheters: The key role of nurse training. *Nephron*, 42:116-9.

Walrath JM, Abbott NK, Caplan E, Scalan E. 1979. Stopcock: Bacterial contamination in invasive monitoring systems. *Heart Lung*, 8:100-4.

Weber DR. 1991. Is heparin really necessary in the lock and, if so, how much? *Drugs Intelligence and Clinical Pharmacy Annals of Pharmacotherapy*, 25:399-407.

Woodhouse CR. 1979. Movelat in the prevention of infusion thrombophlebitis. *Br Med J*, 1:454-5.

Zinner SH, Denny-Brown BC, Braun P, Burke JP, Toala P, Kass EH. 1969. Risk of infection with indwelling intravenous catheters: Effect of application of antibiotic ointment. *J Infect Dis*, 120:616-9.

SELF ASSESSMENT

This list of questions is included in this clinical practice guideline as an extension of the learning process. You may choose to respond to these questions after reading the CPG.

1	Phlebitis associated with peripheral venous cannulas is often a physiochemical or mechanical, rather than an infectious phenomenon.	True / False
2	Peripheral venous cannulas inserted in the upper extremity have lower risk of phlebitis than those on the lower extremity.	True / False
3	Cannulas inserted under emergency conditions should preferably be replaced at a different site within 24 hrs.	True / False
4	Routine application of topical anti-microbial ointment to the insertion site of peripheral venous cannulas effectively eliminate phlebitis.	True / False
5	Diluted heparin is preferred over normal saline as the routine flush solution to maintain cannula patency and reduce phlebitis among peripheral cannulas.	True / False
6	All administration sets must be changed within 48 hrs.	True / False
7	Cannula insertion site should be palpated at least daily for tenderness.	True / False
8	Cannula site should be visually inspected if the patient has evidence of tenderness at the insertion site, fever without obvious cause, or symptoms of local or bloodstream infection.	True / False

9 Institutions should routinely perform surveillance cultures of devices used for IV access for all patients. True / False

10 Educational and enforcement programmes designed to improve handwashing procedures can significantly reduce endemic nosocomial infection rates. True / False

Please refer to the following pages for answers to these questions

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