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TITLE

Survey of infection control in central venous catheters: Practice varies and is inconsistent with CDC Guidelines

ABSTRACT

Background

Intensive care patients with a central venous catheter are at risk of catheter-related infection, which increases morbidity, mortality and healthcare costs. Infection control practices, including care of the intravenous administration sets and catheter site, are undertaken by nurses in an attempt to avoid infection. Although practice guidelines are available, anecdotal reports suggest that infection control practices vary between practitioners and institutions; however, current practice has not been formally surveyed.

Aim

To evaluate the current infection control practices for central venous catheter care and to compare these to evidence-based practice guidelines.

Design

Prospective, cross-sectional descriptive survey.

Method

Intensive care units (n=14) from Australia were surveyed about their infection control policies for central venous catheter care. Results were tabulated and compared with evidence-based practice guidelines (Guidelines for the Prevention of Intravascular Catheter-Related Infections, Centers for Disease Control [CDC], United States).

Results

A wide variety of responses were received regarding duration of administration set use for standard, parenteral nutrition and propofol infusions; ad hoc administration set connection technique; dressing frequency, materials and solutions; and barrier precautions used during procedures. There was inconsistent adherence to the CDC Guidelines.

Conclusions

There is currently great variation in the infection control approach to central venous catheter care. Greater adherence to existing CDC Guidelines would assist in the standardisation of best practice and facilitate evidence-based care.

Keywords

Nursing, Central venous catheter, Infection control.

Descriptive Title

Infection control procedures for central venous catheters: A survey of current nursing practice and comparison with the Centers for Disease Control Guidelines

Short Title

Infection control survey

SUMMARY STATEMENT

What is already known on this topic?

- Patients with central venous catheters are at risk of catheter-related infection which increases morbidity, mortality and healthcare costs
- Many nursing practices attempt to minimize infective risk, although not all are supported by evidence
- The Centers for Disease Control provides evidence-based practice guidelines for the prevention of infection and the care of central venous catheters

What this study adds

- This study provides data on the state of current nursing practice with regards to the infection control care of central venous catheters
- This study provides information about the level of adherence by nurses to the Centers for Disease Control practice guidelines

BACKGROUND

Many patients, particularly those in intensive care units (ICUs) have a central venous catheter (CVC) for the administration of fluid, nutrition and medication, or for intravascular monitoring. CVCs break the body's natural defence barrier (the skin), and so put the patient at risk of catheter-related infection. Catheter related infection is devastating, with increased suffering and risk of death for patients and increased institutional costs due to the increased length and complexity of the hospital admission (Pittet et al. 1994).

CVCs are ordered and inserted by physicians, however post-insertion catheter care is predominantly a nursing responsibility, providing an opportunity for nursing care to impact upon catheter infection rates. Many practices are used to minimize infection risk including procedures involving the intravenous administration sets and the catheter entry site. Varying levels of evidence exist for the efficacy of infection control procedures involving CVC care, however this is improving as more research is undertaken and published.

The Centers for Disease Control (CDC) (Atlanta, Georgia, U.S.A.) is an important infection control body that has been influential in reviewing the evidence for effective infection prevention measures in many areas including intravascular therapy. The CDC published guidelines for the prevention of intravascular catheter-related infection in 1981 (CDC 1981), 1996 (Pearson 1996), and most recently in 2002 (O'Grady et al. 2002). The Guidelines were developed by a multidisciplinary group of health professionals, are evidence-based, and provide recommendations for best practice. The goal of the Guidelines is to promote patient safety and to decrease preventable infections (O'Grady et al. 2003). A wide variety of related topics are covered including administration sets, injection ports, site care, and dressing regimes. In addition to general guidelines, specific guidelines are provided for various catheters including CVCs.

Although the CDC Guidelines have existed for the past two decades, little is known about what practitioners actually do in clinical practice, and how closely clinical practice reflects the Guidelines. There is only one previous investigation into this area, a practice survey conducted in 1992 (Clemence et al. 1995). This survey involved a questionnaire distributed to nurses involved with central venous catheters in the hospital or home setting in the U.S.A. The investigated topics relevant to nurses included catheter site care (dressing type, frequency, antiseptic solutions, technique and protective garments). A range of practices were reported, and these were not always consistent with the evidence based Guidelines current at that time. This data supports anecdotal reports of wide procedural variation in the area of CVC infection control practice, however as it consists of only one study, undertaken in one country, and is now a decade old, we felt that an investigation into current practice was required.

SIGNIFICANCE

Central venous catheter infection control practice may vary between clinicians, and between healthcare organisational policies. Current levels of practice variation and the evidence-practice relationship are unknown. Because of this, it is difficult to assess research and educational priorities and also to interpret the clinical significance of research findings.

PURPOSE

The purpose of the study was to address this problem and to provide a cross-sectional descriptive analysis of the current care of central venous catheters in the Australian ICU

population and to compare current practice with the evidence-based guidelines provided by the CDC.

AIM

To evaluate the current infection control practices regarding central venous catheter care in Australian intensive care units and to compare practice with evidence-based practice guidelines.

RESEARCH METHOD

Design

Prospective, cross-sectional, descriptive survey.

Research Questions

1. What is the state of current nursing practice in regard to the duration of intravenous administration set use?
2. What is the state of current nursing practice in regard to the infection control procedures used for intravenous administration sets and catheter site care?

Sample

Australian intensive care units (n=14), with representation from each State and Territory.

Questionnaire

A questionnaire was developed using the Centers for Disease Control (CDC) Guidelines for the Prevention of Intravascular Catheter-Related Infections (Pearson 1996; O'Grady et al. 2002). The relevant Guideline sections used were: Hand hygiene; Aseptic technique during catheter insertion and care; Catheter site care; Catheter-site dressing regimes; Replacement of administration sets; and IV-injection ports. See Table 1. The questionnaire was validated by a reference group composed of expert ICU nurses who considered the research questions and the CDC Guidelines, and determined that the questionnaire accurately reflected the phenomena of interest.

Insert Table 1

Procedure

Intensive care units were contacted by telephone and invited to participate following an explanation of the survey aims. The questionnaire was then administered by telephone interview with the charge nurse or the senior nurse on duty in the participating intensive care units. Respondents were asked to provide answers that reflected unit policy or the predominant unit practice if no formal policy existed. The questionnaire elicited information about the duration of use of intravenous administration sets for standard infusions, total parenteral nutrition, lipid emulsion, and propofol infusions; infection control procedures used when connecting administration sets at an ad hoc time (at a time other than a routine set change); catheter site care (dressing frequency, type and solution); and barrier precautions used when replacing CVC administration sets or dressings. Demographic data was obtained to describe the ICU, patient population and the types of catheters used.

Ethical Considerations

Institutional Ethics Committee approval was not required, as the practice survey had no impact on patient care or confidentiality. An explanation of the survey was provided over the telephone and completion of the questionnaire was assumed to imply consent. Confidentiality of individual and institutional responses was protected.

Analysis

Continuous variables were calculated for range, mean and standard deviation values. Categorical data was described using percentages and frequencies. Some responses were given in hours, days or frequencies per week. To allow comparison of this data, it was transformed into hourly data, for example procedures performed weekly (alternating every third then fourth day), were classified as a maximum of 96 hours. All analysis was undertaken using the Statistical Package for the Social Sciences version 10.0 (SPSS[®], Chicago, U.S.A.). A comparison was made of all responses with the relevant CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections. These were last updated in 2002 (O'Grady et al. 2002), although the 1996 version (Pearson 1996) was in place for the period of this survey. The minor relevant variations between the two versions of the Guidelines were accounted for during data analysis.

RESULTS

Sample

All of the 14 Australian ICUs agreed to complete the questionnaire. All units were in public (government-operated) teaching hospitals in metropolitan or major regional areas. See Table 2 for a comparison of the ICUs sampled. A combination of plain and antimicrobial catheters was used routinely in all units.

Insert Table 2

Duration of intravenous administration set use

Standard Infusions (crystalloid or crystalloid-based)

A wide range of responses from 72-168 hours was given with a mean of 114.9 hours (SD 43.3), which equates to just under 4 days of use. The most frequent responses were at the two extremes, with 5 units each reporting use of 72 hours and of 168 hours. See Table 3. The CDC Guidelines recommend that administration sets for these infusions are replaced no more frequently than every 72 hours.

Total Parenteral Nutrition

The response range was also wide, from 24-168 hours, with a mean reported maximum usage of 87.4 hours (SD 53.8), which equates to 3.6 days of use. The most commonly occurring response was 24 hours. See Table 3. ICUs who infused a non-lipid TPN solution (amino acids and dextrose) and a separate lipid emulsion reported identical usage timeframes for the administration sets. The CDC Guidelines recommend replacement of the administration sets used for non-lipid TPN no more frequently than every 72 hours, but a shorter 24-hour usage for lipid-containing TPN and for separate lipid emulsions.

Propofol

ICUs most frequently reported a 72-hour maximum usage for propofol administration sets, but again, the range of responses was wide, from 12 to 168 hours (mean 96.0, SD 50.5). See

Table 3. The CDC Guidelines recommend 24 hour administration set use for lipid emulsions such as propofol.

Insert Table 3

Ad hoc Administration Set Change Procedure

The majority of units (64%) reported that they swabbed the catheter-set connection when reconfiguring an administration set at a time other than the initial catheter insertion or a routine set change. The predominant technique was with a 70% alcohol pre-packaged swab. Alternately, others reported using chlorhexidine or alcoholic chlorhexidine. The 1996 Guidelines recommended that the catheter hub be decontaminated before accessing the administration set, although a specific antiseptic was not stated. This procedure is no longer covered in the 2002 version of the Guidelines; however it is reasonable to generalise the recommendations for accessing injection ports to the accessing of the administration set, as both involve breaking the sterile circuit and potentially allow microbial contamination. The Guidelines recommend that injection ports be cleaned immediately prior to use with 70% alcohol or an iodophor (e.g. Betadine[®], Purdue-Pharma L.P., Connecticut, U.S.A.).

Catheter Site Care

Dressing Material

Semi-permeable transparent dressings were predominantly in use, with gauze dressings reported by only one unit. See Table 4. The Guidelines equally recommend both of these dressings except in cases of severe diaphoresis or a bleeding, or oozing catheter site, in which case gauze dressings are preferentially recommended.

Insert Table 4

Dressing Frequency

A wide range of answers from 72 to 240 hours was reported for frequency of semi-permeable transparent dressing replacement, with a mode of 168 hours and mean of 142.2 hours (S.D. 59.2). The one unit using gauze dressings replaced these at a maximum of 96 hourly intervals. See Table 4. The 1996 version of the CDC Guidelines considered dressing frequency to be an unresolved issue and gave no recommendations on the issue. The revised 2002 CDC Guidelines advocate 2nd daily replacement of gauze dressings and at least weekly replacement of semi-permeable transparent dressings. Many units commented that in addition to the routine timeframes, *prn* dressing changes were performed. Reasons for this were not requested. The Guidelines advise that dressings be additionally replaced if they are damp, loose, soiled or for site inspection.

Dressing Solutions

Most units reported use of antimicrobial products for post-insertion catheter site care. Responses were almost evenly divided between five products. See Table 4. The 1996 CDC Guidelines did not include any recommendation for antimicrobial solution use during a CVC dressing. The revised 2002 Guidelines recommend that skin be disinfected during dressing changes with a 2% chlorhexidine-based preparation (for patients over 2 months of age), however a tincture of iodine, an iodophor (e.g. Betadine[®]), or 70% alcohol are also acceptable. Use of a chlorhexidine impregnated sponge (Biopatch[™]) is considered an unresolved issue by the CDC and no recommendations are made for its use.

Barrier Precautions

Protective garments were worn in 57% of units to perform a dressing or a routine administration set change. Of these, plastic non-sterile aprons were most commonly used, followed by non-sterile and then sterile cloth gowns. All units reported wearing gloves (sterile 57%, non-sterile 43%) to perform a CVC dressing or routine administration set change. Most units denied wearing a mask when performing CVC care although 14% of units reported wearing a mask for processes involving TPN.

The CDC Guidelines do not advise the use of protective garments for CVC care and state masks are only to be used when admixing TPN, a procedure that is now generally performed in the pharmacy, not the ICU. The Guidelines recommend that gloves should be worn for a dressing change but that whether the gloves should be sterile or non-sterile is an unresolved issue. It is further noted that proper hand hygiene (with antiseptic containing soap and water or waterless alcohol-based gels or foams) must be attended to before and after the procedure, in addition to the use of gloves. The Guidelines' recommendations for accessing administration sets include no reference to gloves, but do state the necessity for proper hand hygiene as above.

DISCUSSION

The survey found only two areas of infection control practice that were totally adherent to the CDC Guidelines: the duration of administration set use for standard infusions, and the type of catheter dressing. The 100% Guideline adherence regarding the use of general infusion administration sets is probably explained by the non-specific nature of the recommendation, that is, sets are recommended to be replaced *no more frequently* than at 72 hours, rather than giving a definite optimal duration of usage. The broad nature of this recommendation meant that although there was a large variation in the reported timeframes used (72-168 hours) they were all Guideline compliant. The results displayed two strong trends. Firstly, one third of ICUs reported replacing administration sets 72 hourly, which suggests the Guidelines may be misinterpreted as recommending a maximum rather than a *minimum* 72 hours of use. Conversely, another third of ICUs used administration sets for 168 hours (1 week). This timeframe is within the broad Guidelines, but is far removed from the well-researched ≤ 72 hour interval, although reports are beginning to appear in the literature supporting longer administration set use (Raad et al. 2001; Rickard et al. 2002). There has been no published evaluation of the inherent efficacy of routinely replacing sets, although occasionally it is noted the practice may have no effect at any time interval (Maki et al. 1987; Ducharme et al. 1988). Routinely changing administration sets before one week, or indeed at any time, may be a waste of time and resources. However, until a randomised controlled trial supports use to beyond one week, it would be prudent to limit administration-set use to this, rather than an unlimited time.

Semi-permeable transparent dressings seem to be predominantly used in Australian ICUs, with all respondents reporting this dressing type, with the exception of one unit using gauze. The CDC equally recommends these two dressing types. This is consistent with a recent systematic review which found no difference between the products and attributed this to the small sample sizes studied to date (Gillies et al. 2003). In cases of diaphoresis or a bleeding, or oozing catheter site, gauze dressings are preferentially recommended by the CDC. Our survey did not seek to address these special circumstances and we cannot say whether Australian ICU nurses substitute gauze dressings in these cases.

The study identified several infection control practices that were not in accordance with the CDC Guidelines. As such, they are areas for potential practice improvement. These areas

included: the duration of administration set use for TPN and lipid emulsions, including propofol; the procedure for ad hoc administration set changes; the frequency of dressing replacement; the antimicrobial solution used when dressing the catheter site; and barrier precautions used for catheter care.

Many ICUs are currently replacing non-lipid TPN administration sets more frequently, and lipid sets (including propofol) less frequently than the Guidelines recommend. Historically all TPN was thought to carry a significantly higher microbial growth risk, but more recent data suggest that it is the lipid emulsion which is responsible (Didier et al. 1998; Matlow et al. 1999). Our respondents did not differentiate between lipid emulsion-only solutions and other forms of TPN and rarely recognised that propofol, a frequently used ICU infusion, is a lipid emulsion. This is a potential avenue for further education and practice change.

Many units reported complex infection control precautions for replacement of administration sets at routine intervals. In contrast, there was a lack of rigor for the approach used to replace administration sets intermittently. Administration-set configurations are not static throughout the catheterization period, but are manipulated frequently to add, remove or reconfigure infusions. A small majority of units reported that they used some type of decontaminant solution prior to performing an intermittent set change, usually a 70% alcohol pre-packaged wipe. This question also drew a large number of qualified responses with many respondents commenting that regardless of the presence/absence of a unit policy, decontamination was haphazardly performed. A thorough reading of the entire CDC Guidelines would allow a perception that hand hygiene and set decontamination should be attended in this situation. However there is no specific recommendation covering the procedure; this may at least partially explain the high level of practice uncertainty. To promote understanding and compliance by busy clinicians, it may be beneficial for future versions of the Guidelines to specifically outline the recommended procedure for intermittently connecting/disconnecting administration sets.

The reported frequencies for dressing replacements were not all consistent with the current CDC Guidelines and a wide range of timeframes were quoted. This is perhaps due to the 1996 Guidelines (in place during the study) giving no recommendation for CVC dressing frequency. In order to comply with the 2002 Guidelines, some units will need to change dressings more frequently than they are at present. Many respondents made the comment that additional dressings were performed as necessary, which is consistent with the Guidelines which recommend replacement if the dressing is damp, loosened or visibly soiled. The Guidelines for replacing semi-permeable transparent dressings are broad, giving a minimum (weekly) rather than a definitive time-frame. This is no doubt due to the limited amount of quality published research on the topic, with only one study (Rasero et al. 2000) cited by the Guidelines.

The 1996 Guidelines also made no mention of the practice of decontaminating the catheter site during dressing replacements. Despite this, all units reported the practice as standard. The updated Guidelines now recommend that skin be disinfected during dressing changes with one of three solutions. Current practice, which involves a large variety of antimicrobial products, as well as saline, will need to be adapted accordingly. Although the Guidelines allow tincture of iodine, an iodophor, or 70% alcohol; 2% chlorhexidine is stated to be preferred. Chlorhexidine is supported by a meta-analysis of 4143 catheters published subsequent to the finalisation of the Guidelines which showed a halving of infection risk when chlorhexidine, rather than 10% povidine-iodine was used for insertional and ongoing

catheter site care (Chaiyakunapruk et al. 2002). The analysis included chlorhexidine at concentrations of 0.5-1.0% in alcohol and 0.5-2.0% in aqueous, which suggests that levels lower than the CDC recommended 2% are acceptable. The most recently available site-care product, chlorhexidine-impregnated sponges (Biopatch™) have gained some market-share in Australia, despite their increased cost. The Guidelines state that there is inadequate research evidence at this time to recommend their use.

The CDC Guidelines do not advocate protective garments for CVC dressings or administration set changes, yet a number of units wore these routinely. Under standard precautions, unless soiling with blood or body fluids is anticipated, gowning of any type is unnecessary and costly, and should be abandoned. All ICUs reported wearing sterile or non-sterile gloves to perform dressings. Both glove types are acceptable for dressing replacement under the Guidelines, but are recommended purely as standard precautions, that is, to protect staff from possible body fluid exposure, rather than to prevent catheter infection. Units currently using the more expensive sterile gloves should consider changing to the clean, non-sterile variety. All units also reported wearing gloves to routinely replace administration sets. This is not a situation where exposure with blood or body fluids should be anticipated (unless dis/connecting a blood-product infusion), is not recommended by the Guidelines, and should be discontinued. A small number of units reported the wearing of masks whilst manipulating TPN administration sets. The CDC Guidelines do not recommend masks for this procedure and units should avoid this unnecessary practice. The Guidelines do recommend stringent attention to hand hygiene and an aseptic technique for all aspects of CVC care.

The predominant findings of this study were the wide diversity of current practice involving infection control care of central venous catheters, and a lack of consistent adherence to the CDC Guidelines. These findings are consistent with a survey on central venous catheter care undertaken in the U.S.A. in 1992, which also found varied practice and divergence from CDC Guidelines (Clemence et al. 1995). Sub-optimal compliance with practice guidelines has also been observed in other infection control studies in the areas of hand hygiene, glove-wearing, needle recapping, and respiratory isolation (White et al. 1997; Tait et al. 2000; Harbath et al. 2002; Stein et al. 2003).

There are some limitations to our study. The sample size was small and limited to one country, and therefore cannot be interpreted as representative of ICU practice. However, the study did include participants from each Australian State and Territory and the results therefore provide some indication of Australian practice. The decision to administer the questionnaire to the senior nurse on duty and request information on the unit policy or predominant unit practice was based on the assumption that the nurse would know this information and that this would elicit an accurate answer. It is possible however, that responses actually reflected the individual's practice bias or a perception of the "right" answer. The one previous practice survey on this topic involved a similar senior nursing sample; a practice questionnaire was distributed to attendees at a professional conference (Clemence et al. 1995). Results from self-report questionnaire surveys such as ours are subject to limitations, in that the behaviour reported may be different from that observed in practice. An observational design would have provided a more direct measure of infection control practice, although such studies require increased resources to undertake, and if subjects know that they are being observed, the Hawthorne effect causes modified infection control behaviour (Harbath et al. 2002). We did not have the resources to undertake a multi-centre observational study, and instead used the questionnaire method, as have previous

studies seeking to describe elements of infection control practice (Alvaran et al. 1994; Clemence et al. 1995; Beaujean et al. 2000; Tait et al. 2000).

Although the study results revealed a significant level of discrepancy between the CDC Guidelines and current practice, they do not explain why such discrepancies exist. The Guidelines are the most useful evidence-based document currently available for intravascular catheter care, are widely published and cited, and it is reasonable to expect that they should be reflected in clinical practice. Why is this not happening? Whilst we do not assume that all individual nurses would be familiar with the CDC Guidelines, those nurses who are responsible for the development or updating of unit policies should be. Additionally, it is important to periodically search the literature for relevant studies published subsequent to the Guidelines' publication and adapt policy and practice accordingly.

Our finding that there is a lack of adherence to evidence in unit policies almost certainly reflects a lack of resources or appropriate staffing positions to allow policies to be developed that reflect the current literature. Clinical policy development in Australia is often undertaken by nurses with advanced clinical skills, but limited experience in information retrieval and analysis. It would be beneficial for institutions to provide further support and training in policy development, and to encourage clinical nurses to develop policies in consultation with their local nurse researchers, academics, and other appropriate staff such as librarians.

The use of CVCs in large numbers and for extended periods of time is a relatively new phenomenon, and some aspects of CVC care have not yet been fully investigated. The CDC Guidelines are based on the best available evidence, but in some cases recommendations cannot be given due to inadequate or conflicting research. This may be limiting the perceived usefulness of the Guidelines by clinicians. Nurses have embraced an evidence based culture relatively recently, and the knowledge-practice gap is a well-known problem (Retsas & Nolan 1999; Pearson 2002). This may explain some of the practice variance observed. In recent years, antimicrobial catheters have been extremely effective in lowering catheter infection rates (Veenstra et al. 1999), and are used widely, although the CDC recommends their use only if infection rates remain a concern after all other basic precautions have been taken. In our study, almost all units reported using antimicrobial catheters as standard. Perhaps the use of these catheters has led to a complacent attitude to traditional anti-infective precautions, such as those covered in this study. Staff education about antimicrobial catheters should emphasize their role as an adjunct to, not a replacement for, basic principles of infection control.

Our study assumed that clinical practice guidelines are beneficial to patients and that they should be reflected in good practice. It could perhaps be argued that reliance on guidelines detracts from individual professional accountability. Whilst ideally, all nurses would frequently review the research literature and incorporate relevant findings into practice; realistically, busy clinicians may not have the time, skills or inclination to do so. Clinical practice guidelines aim to facilitate evidence-based practice, decrease practice variation, and promote cost-effective care (O'Grady 2003). Guidelines developed by reputable organisations such as the CDC provide a useful tool for professionals to navigate the body of published evidence which continues to grow in both quantity and complexity. The CDC Guidelines provide guidance on care interventions that are effective both individually and when provided in total. Recent data from 2043 ICU patients showed a significant 57% reduction in catheter-associated bloodstream infection in the 13 months after the provision of a comprehensive

educational intervention based on the CDC Guidelines (Warren et al. 2003). We contend that *Guideline-compliant care* should be interpreted as *good care* for central venous catheters.

RECOMMENDATIONS

1. That individual units review their policies and procedures for care of central venous catheters with particular reference to the CDC Guidelines. Our questionnaire may be a useful quality audit tool for practice review.
2. That where diversity of practice is found, education and motivation for staff should be provided about the 2002 CDC Guidelines and these should be formalised in the relevant institutional policies.
3. That further research is undertaken to resolve contentious or unsupported aspects of CVC care, and to evaluate effective ways to ensure clinicians are aware of, and comply with, evidence-based practice guidelines. The research should be of rigorous scientific design and execution, including large multi-site, randomised controlled trials where appropriate. Specific areas requiring further investigation include:
 - The optimal maximum duration of administration set use.
 - The decontamination technique to be used when connecting administration sets on a routine or ad hoc basis.
 - The optimal frequency for CVC dressing replacement.
 - The efficacy of barrier precautions when manipulating administration sets or site dressings.
 - The efficacy of chlorhexidine-impregnated sponges for CVC site care.

CONCLUSION

We conclude that there is a significant amount of current practice variation in the infection control methods used for CVC care, and that practice does not always reflect the CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections. Future research should endeavour to address the evidence gaps in the area of central venous catheter care, and also investigate ways to improve clinician awareness of, and adherence to, evidence-based practice guidelines. A greater degree of homogeneity in CVC infection control practice will assist in the prevention of catheter-related infection, ensure best practice care, promote the judicious use of health budgets, ease the transition of staff between healthcare organisations, and facilitate multi-centre research projects.

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TABLE LEGENDS

Table 1. Questionnaire for comparison of current practice with CDC Guidelines

Table 2. Characteristics of participating ICUs.

Table 3. Reported maximum duration of intravenous administration set use compared with the CDC Guidelines.

Table 4. Reported frequency and type of CVC site care compared with the CDC Guidelines.

Table 1. Questionnaire for comparison of current practice with CDC Guidelines

Infection Control Procedure	Current Practice	CDC Guidelines (O'Grady et al. 2002)	Level of Evidence*
Duration of administration set use for standard infusions		<i>IX.A.1. "Replace administration sets, including secondary sets and add-on devices, no more frequently than at 72-hour intervals..."(O'Grady et al. 2002,p.15)</i>	IA
Duration of administration set use for total parenteral nutrition infusions		<i>IX.A.2. "If the solution contains only dextrose and amino acids, the administration set does not need to be replaced more frequently than every 72 hours"(O'Grady et al. 2002,p.15)</i>	II
Duration of administration set use for lipid emulsion infusions		<i>IX.A.2. "Replace tubing used to administer blood, blood products, or lipid emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion"(O'Grady et al. 2002,p.15)</i>	IB
Duration of administration set use for propofol infusions		<i>"IX.A.3. "Replace tubing used to administer propofol infusions every ...12 hours, ... as per the manufacturer's recommendation (for infusions)"(O'Grady et al. 2002,p.15)</i>	IA
Decontamination of CVC hub-administration set connection prior to every connection/disconnection of an administration set		<i>X.A. Clean injection ports with 70% alcohol or an iodophor before accessing the system"(O'Grady et al. 2002,p.15)</i>	IA
		<i>III.A. "Observe proper hand-hygiene procedures either by washing hands with conventional antiseptic-containing soap and water or with waterless alcohol-based gels or foams. Observe hand hygiene before and after...accessing...(or) repairing... an intravascular catheter"(O'Grady et al. 2002,p.13)</i>	IA
CVC dressing type		<i>VII.A. "Use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site"(O'Grady et al. 2002,p.14)</i>	IA
		<i>VII.C. "If the patient is diaphoretic, or if the site is bleeding or oozing, a gauze dressing is preferable to a transparent, semi-permeable dressing"(O'Grady et al. 2002,p.14)</i>	II
		<i>VI.D. "No recommendation can be made for the use of chlorhexidine sponge dressings to reduce the incidence of infection"(O'Grady et al. 2002,p.18)</i>	Unresolved issue
		<i>VI.E. Do not use chlorhexidine sponge dressings in neonates aged <7 days or of gestational age <26 weeks"(O'Grady et al. 2002,p.18)</i>	II
Maximum time that CVC dressings are left intact		<i>VI.C.1 "Replace catheter-site dressing when it becomes damp, loosened, or soiled or when inspection of the site is necessary"(O'Grady et al. 2002,p.17)</i>	IA
		<i>VI.C.2 "Replace dressings used on short-term CVC sites every 2 days for gauze dressings and at least every 7 days for transparent dressings, except in those paediatric patients in which the risk of dislodging the catheter outweighs the benefit of changing the dressing"(O'Grady et al. 2002,p.17)</i>	IB
Solution used for CVC site care		<i>VI.A.1. Disinfect clean skin with an appropriate antiseptic...during dressing changes. Although a 2% chlorhexidine-based preparation is preferred, tincture of iodine, an iodophor, or 70% alcohol can be used"(O'Grady et al. 2002,p.14)</i>	IA
		<i>VI.A.2. No recommendation can be made for the use of chlorhexidine in infants aged < 2 months.(O'Grady et al. 2002,p.14)</i>	Unresolved issue
Barrier precautions are used for CVC care		<i>IV.C. "Wear clean or sterile gloves when changing the dressing on intravascular catheters"(O'Grady et al. 2002,p.14)</i>	IC
		<i>III.B. "Use of gloves does not obviate the need for hand hygiene"(O'Grady et al. 2002,p.13)</i>	IA

***Level of Evidence:** **IA.** Strongly supported for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies. **IB.** Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies, and a strong theoretical rationale. **IC.** Required by (U.S.) state or federal regulations, rules or standards. **II.** Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale. **Unresolved issue.** Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.

Table 2. Characteristics of participating ICUs

Size of ICU		Patients admitted per year	
<i>Beds</i>	<i>Sample</i>	<i>Patients</i>	<i>Sample</i>
≤ 6	3	≤500	4
7-14	6	501-1199	3
15-24	5	1200-1500	7

Table 3. Reported maximum duration of intravenous administration set use compared with the CDC Guidelines

Infusion Type	Set Usage* (hours)	No of ICUs	%
Standard	≥ 72	14	100
	< 72	0	0
TPN	≥ 72	10	71
	< 72	4	29
Lipid	≤ 24	10	71
	> 24	4	29
Propofol	≤ 12	2	14
	> 12	12	86

* Shaded cells represent the recommended duration of administration set use as per the CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections. Respondent answers in these shaded rows represent Guideline-compliant practice.

Table 4. Reported frequency and type of CVC site care compared with the CDC Guidelines

			No of ICUs	%
Type	Transparent semi-permeable		13	93
	Gauze		1	7
Frequency	Transparent semi-permeable	≤ weekly	11	85
		> weekly	2	15
	Gauze	≤ 48 hrs	0	0
		> 48 hrs	1	100
Solution	2% chlorhexidine		0	0
	Tincture of iodine/iodophor		3	21
	70% alcohol		3	21
	70% alcohol/0.5% chlorhexidine		3	21
	Saline		3	21
	Chlorhexidine sponges		2	14

* Shaded cells represent the recommended CVC site care as per the CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections. Respondent answers in these shaded rows represent Guideline-compliant practice.