Full title:

PREVENTION OF CENTRAL VENOUS CATHETER INFECTIONS: A SURVEY OF PAEDIATRIC ICU NURSES' KNOWLEDGE AND PRACTICE

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ABSTRACT:

Background: Central venous catheters are important in the management of paediatric intensive care unit patients, but can have serious complications which worsen the patients' health, prolong hospital stays and increase the cost of care. Evidence-based recommendations for preventing catheter-related bloodstream infections are available, but it is unknown how widely these are known or practiced in the paediatric intensive care environment.

Objectives: To assess nursing knowledge of evidence based guidelines to prevent catheter-related bloodstream infections; the extent to which Australia and New Zealand paediatric intensive cares have adopted prevention practices; and to identify the factors that encouraged their adoption and improve nursing knowledge.

Design: Cross-sectional surveys using convenience sampling.

Settings: Tertiary level paediatric intensive care units in Australia and New Zealand.

Participants: Paediatric intensive care nursing staff and nurse managers.

Methods: Between 2010 and 2011, the 'Paediatric Intensive Care Nurses' Knowledge of Evidence-Based Catheter-Related Bloodstream Infection Prevention Questionnaire' was distributed to paediatric intensive care nursing staff and the 'Catheter-Related Bloodstream Infection Prevention Practices Survey' was distributed to Nurse Managers to measure knowledge, practices and culture.

Results: The questionnaires were completed by 253 paediatric intensive care nurses (response rate 34%). The mean total knowledge score was 5.5 (SD=1.4) out of a possible ten, with significant variation of total scores between paediatric intensive care sites ($p = 0.01$). Other demographic characteristics were not significantly associated with variation in total knowledge scores.

All nursing managers from Australian and New Zealand paediatric intensive care units participated in the survey ($n=8$; response rate 100%). Wide practice variation was reported, with inconsistent adherence to recommendations. Safety culture was not significantly associated with mean knowledge scores per site.

Conclusions: This study has identified that there is variation in the infection prevention approach and nurses' knowledge about catheter-related bloodstream infection prevention. The presence of an improved safety culture, years of paediatric intensive care experience and higher qualifications did not influence the nurses uptake of recommendations, therefore further factors need to be explored in order to improve understanding and implementation of best practice.

INTRODUCTION

Central venous catheters (CVCs) are an essential part of the management of critically ill patients, serving both as reliable vascular access and the site of venous pressure monitoring. The use of CVCs however, can lead to complications that result in considerable morbidity, mortality and healthcare costs.

The most serious complication of CVCs is catheter-related blood stream infections (CR-BSI), and international healthcare agencies including the World Health Organization (World Health Organization, 2012), the Institute for Healthcare Improvement (Institute for Healthcare Improvement, 2011) and the US Centers for Disease Control and Prevention (CDC) have targeted it as a significant patient safety issue. Recent critical care studies report an incidence of between 1 to 5.5 per 1,000 catheter-days (Jeffries et al., 2009; Pronovost et al., 2006b; Schwebel et al., 2012). Children are particularly vulnerable, with CR-BSIs the most commonly reported nosocomial infection reported in paediatric ICU (Reyes et al., 2012; Richards et al., 1999). The attributable cost of CR-BSI varies between \$3,124 and \$60,536USD per event (Raad et al., 2007; Schwebel et al., 2012) and are associated with an attributable mortality of 0% to 11.5% (Timsit et al., 2011).

CR-BSI are a preventable cause of patient harm for the critically ill (Miller et al., 2011). Landmark work by Pronovost, Needham et al. (2006a) in their 'Keystone' project demonstrated that rates of CR-BSI can decrease to zero with the focussed attention on consistent adherence to the use of evidence-based guidelines and interventions (Berenholtz et al., 2004; Han et al., 2010). Nurses are responsible for the daily management of CVCs and are the driving force when applying these evidence-based guidelines.

BACKGROUND

Several studies have reported the effectiveness of interventions to reduce CR-BSI rates, including maximal sterile precautions by inserters (Carrer et al., 2005; Mermel et al., 1991; Raad et al., 1994), skin antisepsis prior to insertion (Humar et al., 2000; Maki et al., 1991; Mimoz et al., 1996), the use of securement devices (Yamamoto et al., 2002), and early catheter removal (Berenholtz et al., 2004; Pronovost et al., 2006b). In 1981 and in subsequent updates, the CDC collated evidence relating to the prevention of intravascular catheter-related infection and produced a comprehensive set of guidelines for the management of these patients (O'Grady et al., 2011; O'Grady et al., 2002).

In order to provide quality CVC care, it is essential that individual nurses have an understanding of evidence-based recommendations. Previous research (Labeau et al., 2009; Labeau et al., 2008) assessed adult ICU nurses' knowledge of CR-BSI prevention guidelines via validated tests. Specifically, Labeau, Vereecke et al. (2008) developed and validated a questionnaire for evaluating critical care nurses' knowledge of evidence based guidelines for preventing CVC infections in 762 Flemish nurses. They found, and subsequently validated in a further study of 3405 European intensive care nurses (Labeau et al., 2009), a lack of knowledge and deficiencies in training for the prevention of CR-BSI, differences in what is regarded as best practice and a lack of consistent policies (Labeau et al., 2009; Labeau et al., 2008). However, the clinical difference from the adult ICU environment means that these results may not be universally generalised to paediatric settings.

Nurses' knowledge of evidence-based CVC care needs to be supported by the policies, procedures and practices of their own ICU. Despite the publication of evidence based recommendations, changes in practice often lags behind guideline dissemination (Morritt et al., 2006). Rickard, Courtney et al. (2004) surveyed 14 ICUs in Australia to determine whether clinical practice reflected the CDC guidelines and found significant discrepancies. Other recent surveys in adult critical care settings (Bianco et al., 2013; Jeffries et al., 2009; Koutzavekiaris et al., 2011) have established that substantial variation exists in CR-BSI prevention activities. In paediatrics, studies examining practice and policy surrounding related activities, e.g. hand-washing when caring for CVCs, has found a similar variability (Brennan et al., 2004; Morritt et al., 2006; Warren et al., 2006).

Previous studies have explored the factors that encourage the adoption of evidence-based practice. Krein, Hofer et al. (2007), within their survey of 516 non-federally funded US adult ICUs, found an association between the use of CR-BSI prevention practices and a higher safety culture score and/or participation in an infection control collaboration. Other factors which have been suggested by literature to support evidence-based practice include the number of ICU beds, level of facility support for evidence-based practice, and metropolitan location (Jeffries et al., 2009; Morritt et al., 2006).

The inconsistent application of evidence-based practice has a significant impact on the frequency of CR-BSI in these vulnerable patients. In addition to the guidelines developed by the CDC, multiple resources are available to educate bedside nurses on CR-BSI prevention best-practice, however within adult ICU, practices and nursing understanding of best practice varies. There has been no similar study of both nursing knowledge and practice of evidence-based CR-BSI prevention in a paediatric ICU cohort. In order to ascertain whether variability in practice and nursing knowledge is similarly evident in paediatric ICU, a cross-sectional study was undertaken throughout Australia and New Zealand.

METHODS

Aims

The aims of the study were to:

- a) Assess the knowledge of evidence-based strategies to prevent CR-BSI in paediatric intensive care nurses throughout Australia and New Zealand and to identify characteristics that improve this knowledge.
- b) Determine the extent to which Australia and New Zealand tertiary paediatric ICUs have adopted CR-BSI prevention practices and to identify the factors that encouraged their adoption.

Design

A cross-sectional, descriptive study using a questionnaire and survey was undertaken between 2010 and 2011 via convenience sampling.

Participants

Nursing researchers and managers from all eight tertiary level paediatric ICUs in Australia and New Zealand were invited by phone and follow-up email to participate in the study. Through these representatives, a link to the 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire' was distributed to all paediatric ICU nurses ($n = 755$) via email, which led to an on-line survey tool. The nursing researchers and managers were not provided with a copy of the correct answers, and were eligible to participate. Secondly,

the 'CR-BSI practices survey' was distributed to each units' Nurse Manager via email. Participation was voluntary and responses were collected anonymously.

Data collection

Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire:
The 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire' was developed using a previously validated adult critical care ten-item questionnaire (Labeau et al., 2009; Labeau et al., 2008). Three items from the original validated questionnaire were included and the remainder were modified to ensure its relevance to paediatrics. The paediatric modifications were based on the recommendations provided by the CDC (O'Grady et al., 2002). Each item was formatted primarily as a multiple-choice question with four response alternatives or options (the correct answer and three distractors) (Labeau et al., 2008). The three distractors consisted of strategies whose preventative or therapeutic value has not been established in evidence-based studies. Some questions ($n = 2$) required short answers, in order to assess memory recall for simple procedures.

The questionnaire was comprised of ten questions; each correct answer given one point, a wrong answer not affecting the score negatively. For questions requiring short answers, a point was only awarded if all answers were provided and only one point was awarded per question in comparison to each answer. A maximum score thus consisted of a score of ten, a minimum score of zero points. The questionnaire also included questions on demographic characteristics of the respondents: gender; main work activity; nursing level; highest educational attainment; and years of paediatric ICU and critical care experience.

The Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire was piloted for face and content validity via a panel of five local paediatric ICU and CVC experts. Each panel member was an active clinician with at least ten years paediatric, ICU and/or CVC experience. The panel provided feedback on the clarity, relevance and scope of the questionnaire. This feedback was then used to revise the questionnaire and after further review, the panel agreed with its content and application.

CR-BSI Prevention Practices Survey:

The CR-BSI Prevention Practices Survey was developed using the CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections (O'Grady et al., 2002) and followed the format of Rickard, Courtney et al. (2004). Additional questions regarding hospital leadership and culture were based on Krein, Hofer et al. (2007) study examining CR-BSI preventative practices, with small modifications made to ensure its relevance to paediatrics. This includes information on participation in CR-BSI collaboratives, perceived barriers for the implementation of evidence-based practice, hospital and paediatric ICU demographic information and safety culture measurements. These questions were mainly formatted with 'tick list' of options for answers.

The 'safety culture measure' was based on the level of agreement using a five-point likert scale, ranging from strongly agree (=5) to strongly disagree (=1), with the following statements: (1) "*Leadership is driving us to be a safety-centred institution*" and (2) "*I would feel safe having family treated here as a patient*" (Krein et al., 2007; Lakshmi et al., 2007; Morritt et al., 2006). A possible score for the 'safety culture measure' ranged between two and ten.

Ethical considerations

Ethical approval was gained through the research team's hospital Human Research Ethics

Committee and in additional sites where required prior to study commencement. Participants were given a detailed subject information statement, and completion of the questionnaire or survey implied consent to participate.

Data analysis

Because of the use of an on-line survey tool, there were no missing data. Continuous variables were described as mean, range and standard deviation values. Categorical data were described using frequencies and percentages. After assessing the normality of distribution in the data, relationships between total scores, safety culture and demographics were assessed by analysis of variance (ANOVA) and Pearson's correlation coefficient (Fields, 2009). Variables with $p < 0.05$ were considered significant. Statistical analysis was performed using Statistical Package for Social Sciences for Windows 17.0 (SPSS, Chicago, IL).

RESULTS

Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire

Sample characteristics

The overall questionnaire response rate was 34% ($n = 253$), with all paediatric ICUs in Australia and New Zealand participating ($n = 8$). Table 1 provides the demographic characteristics of the participants. The majority of the respondents were active clinicians, with a Bachelor degree or post-graduate qualification and had on average 7.5 years of paediatric ICU nursing experience.

Knowledge questionnaire results

Table 2 describes the questions and results of the 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire'. Only 18% ($n = 46$) of participants correctly identified the five items required to deliver maximum sterile barrier precautions for the insertion of CVCs, with participants not identifying a cap in 74% of cases ($n = 187$), mask in 51% of cases ($n = 130$), sterile full body drapes in 36% of cases ($n = 90$), sterile gown in 29% of cases ($n = 73$) and sterile gloves in 10% of cases ($n = 26$).

While 95% ($n = 240$) of respondents stated that antibiotic ointment should not be applied to the insertion site of the CVC, only 19% ($n = 47$) correctly answered it was because it may cause antibiotic resistance. While the majority of respondents correctly answered that chlorhexidine gluconate is the recommended solution for preparing and disinfecting the insertion site (95%; $n = 240$) and should be applied to CVC sites during routine dressing changes (97%; $n = 245$), the use of the correct concentration of 2% chlorhexidine gluconate was not uniformly identified, with only 65% ($n = 164$) and 66% ($n = 168$) respectfully, giving a correct answer.

The mean total questionnaire score was 5.5 out of a possible ten ($SD = 1.4$; range 1-9), with no participant answering all ten questions correctly. There was significant variation of total scores between paediatric ICU sites (range 4.8–6.0; 7 df; $p = 0.01$). Detailed in Table 3, demographic characteristics, such as years of paediatric ICU nursing, total years of nursing, main work activity, nursing level and highest education achievement, were not significantly associated with variation between total knowledge scores.

CR-BSI preventative practices survey

Sample characteristics

Nursing managers from all paediatric ICUs in Australia and New Zealand participated in the 'CR-BSI Preventative Practices Survey' (response rate 100%; $n = 8$). From the paediatric ICUs

surveyed, the mean number of beds was 15.1 (range 8 - 21), mean admissions per year was 910.9 (range 685 - 1220) and mean number of paediatric ICU staff nurses was 73.5 (range 39 - 101).

Practice survey results

The extent to which Australia and New Zealand tertiary paediatric ICUs have adopted CR-BSI prevention practice is reported in Table 4. Some respondents reported rarely using maximum barrier precautions, never using 2% chlorhexidine gluconate and frequently routinely changing catheters even if there was no suspicion of a CR-BSI.

The mean safety culture score was 5.7 (SD 1.28) out of a possible ten. However, safety culture scores (Pearson correlation = 0.57; $p = 0.14$) were not significantly associated with mean knowledge total scores per paediatric ICU site.

When describing the major barrier preventing them from implementing evidence-based recommendations for reducing healthcare-associated infection, the majority of nursing managers identified a lack of resources ($n = 5$), with the remainder selecting it is 'too hard' ($n = 2$) or a lack of within hospital communication ($n = 1$). The majority of respondents agreed that the single most useful source of information on infection control was personnel based ($n = 5$). The majority of sites had an established surveillance system for monitoring CR-BSI rates either within paediatric ICU ($n = 2$) or facility-wide ($n = 5$).

DISCUSSION

The results of the questionnaire and survey within this study suggest fundamental gaps between research, knowledge and practice within paediatric ICU CVC care. While CR-BSI prevention guidelines have been available from the CDC since 1981, paediatric ICU nurses had only a moderate knowledge of the fundamental principles needed to inform their practice. Still, in comparison to previous adult studies using a similar questionnaire, overall paediatric ICU nursing knowledge of CR-BSI prevention practice was slightly superior. Overall mean results were 5.5 out of a possible ten in comparison to Labeau, Vandijck et al. (2009) findings of 4.4 out of a possible ten. However there are substantial improvements still to be made.

Paediatric ICU nursing knowledge of evidence-based CR-BSI prevention score variation was not significantly associated with years of paediatric ICU nursing, total years of nursing, main work activity, nursing level and highest education achievement. This contrasts with traditional thinking and previous studies (Koutzavekiaris et al., 2011; Labeau et al., 2009; Paolucci and Albert, 2011; Ward, 2011), which assumes experience, seniority and formalised education improves knowledge of best practice. Further factors need to be explored in order to improve understanding, and thereby implementation of best practice to prevent CR-BSI.

Although evidence-based practices are being researched and published, they will not be successful unless there is adequate understanding and implementation by the healthcare team. Our results report that the majority of Australian and New Zealand tertiary paediatric ICUs follow guideline recommendations involving the use of maximum sterile barrier precautions during CVC insertion, the use of sterile, transparent, semi-permeable dressing to cover catheter site and the prompt removal of the CVC when no longer essential. The implementation of these recommendations are encouraging, however other CR-BSI

prevention practices, including the use of 2% chlorhexidine gluconate and the clinically indicated replacement of CVCs, has not been as comprehensive.

Our study shows a greater use of evidence-based practices to prevent CR-BSIs than in previous studies in adult (Bianco et al., 2013; Braun et al., 2003; Rickard et al., 2004; Warren et al., 2006), paediatric (Harron et al., 2011) and neonatal (Douglas et al., 2009) critical care. This involves a higher incidence of 2% chlorhexidine gluconate use, administration set replacement, maximum sterile barrier precautions and monitoring of BSI rates. The reason for the higher usage is unclear; however several local and state-wide initiatives involving process-focussed interventions have been undertaken surrounding this issue in recent years and this may have been a factor in improving compliance.

Practices and nursing knowledge varied significantly between paediatric ICUs and the reason for this variation remains unclear. However, the overall need to improve knowledge and evidence-based practice is obvious across all units. Several studies advocate the use of process-focussed interventions within critical care to prevent or reduce the risk of CR-BSI (Gnass et al., 2004; Hatler et al., 2009). Well organised education programs, including the use of catheter-care bundles, that enable health care workers to provide, monitor and evaluate outcomes are critical to reducing rates of CR-BSI (Bizzarro et al., 2010; Institute for Healthcare Improvement, 2011; Jeffries et al., 2009; Kline, 2005; Miller et al., 2010). Education interventions focussed at clinical staff have previously led to a remarkable decrease in incidence of bloodstream infections (Coopersmith et al., 2002; Gnass et al., 2004; Kline, 2005; Ward, 2011; Warren et al., 2003; World Health Organization, 2012).

Other process improvement strategies aimed at reducing CR-BSI include the organisation of a leadership team with physician, nursing and infection control representatives. These provide the basis of a safety culture, an important strategy for improving the widespread deficits in patient safety evident in hospitals (Pronovost and Sexton, 2005). While in our study, safety culture scores were not significantly associated with paediatric ICU nurses knowledge total scores, fostering a culture of safety might facilitate the adoption of practices related to infection prevention (Krein et al., 2007). The lack of significance evident within our study may be as a result of an inadequate tool, as researchers have discussed the challenge in reliably assessing a concept as multifaceted as safety culture (Pronovost and Sexton, 2005). Checklists have also been advocated as a strategy to reduce CR-BSI rates, both during insertion and throughout catheter maintenance (Institute for Healthcare Improvement, 2011; Li and Bizzarro, 2011; Vandijck et al., 2009; World Health Organization, 2012).

Our study has several limitations. First, it is limited in its generalisability to only Australian and New Zealand paediatric ICUs and may not reflect the knowledge and practices of other regions. However it provides a comprehensive picture of this region as compared to a single site survey. The overall response rate was 34%, which is acceptable although not high and denotes the problem of self selection bias inherent in questionnaire research (Rello et al., 2007). Although the questionnaire was anonymous, it is to be expected that participants who consider CVC practice to be of high importance were more likely to participate, thus our reported scores are likely to be higher than for the entire paediatric ICU nurse cohort. However the demographic characteristics of the respondents are generally representative of the Australian and New Zealand paediatric ICU nursing population, when compared with other recent Australian and New Zealand paediatric ICU nursing descriptive studies (Long et al., 2013; Ramelet et al., 2012).

Secondly, due to the use of a self-report questionnaire there is a possibility for response bias. Additionally, survey and infection control adherence may be overestimated compared with that measured by independent observers. Thirdly, CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections were updated in 2011 (O'Grady et al., 2011), although the 2002 version (O'Grady et al., 2002) was in place for the period of this survey.

Reducing the risk of CR-BSI among paediatric ICU patients is an important patient safety issue and will save costs, reduce length of stay and improve mortality and morbidity (Ramritu et al., 2008). While the risk of CR-BSI in the paediatric ICU setting depends on many factors, some are associated with discretionary decisions made by healthcare professionals (Ramritu et al., 2008). Nurses need to be educated and informed by best practice guidelines to make the correct decisions when managing their patients' CVC. Previous authors studying paediatric ICU nurses' CVC practices have also identified the gap between the generation and application of research findings (Hatler et al., 2009).

CONCLUSION

This study has demonstrated that there currently is variation in the infection control approach and deficits in nurses knowledge within the paediatric ICU surrounding CR-BSI prevention. As in many areas of nursing practice, an obvious difference exists between theory and practice. While, within this study, the presence of a safety culture were not associated with paediatric ICU nurses use of recommendations, further factors and strategies need to be explored such as process-improvement strategies including education, bundles and checklists. The importance of preventing CR-BSI as a patient safety issue requires clinicians, managers, educators and researchers to focus more attention on the application of clinical research.

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Table 1 Demographic characteristics of respondents to 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire'

Characteristic	<i>n</i>	%
Site		
Paediatric ICU A	49	19
Paediatric ICU B	40	16
Paediatric ICU C	31	12
Paediatric ICU D	31	12
Paediatric ICU E	30	12
Paediatric ICU F	27	11
Paediatric ICU G	27	11
Paediatric ICU H	18	7
Gender		
Female	230	91
Male	23	9
Main work activity		
Clinical	217	86
Other (Research, education, management, mixed)	36	14
Highest educational achievement		
Diploma	26	10
Bachelor	157	62
Post graduate diploma or certificate	67	26
Masters or PhD	3	1
Nursing level		
Registered nurse	153	60
Clinical nurse	57	22
Clinical nurse consultant; nurse manager, educator or researcher	43	17
	Mean	Range
Years of paediatric ICU nursing	7.5	0 - 30
Total years nursing	13.4	0 - 45

Table 2 Results of 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire'

Question	<i>n</i> correct	% correct
1) What is the recommended dressing for CVC insertion sites?	242	95.7
2) What is the recommended solution for preparing and disinfecting the CVC insertion site?	164	64.8
3) Is it recommended to apply antibiotic ointment at the insertion site of a CVC?	47	18.6
4) What site selection for CVCs is recommended for children yet should be avoided in adults?	135	53.4
5) According to guidelines, which is the preferred antiseptic solution to be applied to CVC sites during routine dressing changes?	168	66.4
6) List five items required to deliver maximum sterile barrier precautions for the insertion of CVCs	46	18.2
7) What are the three paediatric risk factors for CVC related bloodstream infection?	135	53.4
8) List three ways to assess the position of the CVC after insertion	86	34.0
9) In paediatrics, is it recommended to replace CVCs routinely?	142	56.1
10) Which one of the following CVCs may be removed by a nurse in the paediatric ICU?	236	93.3
	Mean	Standard Deviation
TOTAL SCORE	5.5	1.4

Table 3 Variation of mean 'Paediatric ICU Nurses' Knowledge of Evidence-Based CR-BSI Prevention Questionnaire' results across demographic characteristics

Demographic	Mean	Range	P value
Site			0.01*
Paediatric ICU A	5.6	1 – 8	
Paediatric ICU B	5.8	3 - 8	
Paediatric ICU C	4.9	2 – 7	
Paediatric ICU D	5.8	3 – 8	
Paediatric ICU E	5.7	2 - 9	
Paediatric ICU F	4.8	2 – 7	
Paediatric ICU G	5.6	2 – 9	
Paediatric ICU H	6.0	4 - 8	
Nursing level			0.50
Registered nurse	5.44	1 – 9	
Clinical nurse	5.79	2 – 8	
Clinical nurse consultant; nurse manager, educator or researcher	5.54	3 - 9	
Main work activity			0.26
Clinical	5.5	1 – 8	
Other (Research, education, management, mixed)	5.8	3 - 9	
Highest educational achievement			0.24
Diploma	5.12	3 – 8	
Bachelor	5.61	1 – 9	
Post graduate certificate	5.28	2 – 9	
Post graduate diploma	5.89	2 – 8	
Masters or PhD	5.67	5 - 6	
Years of paediatric ICU nursing	-	-	0.76
Total years of nursing	-	-	0.26

Table 4 Results of 'CR-BSI Preventative Practices survey'

How frequently are these practices used in your facility?	Never % (n)	Rarely % (n)	Sometimes % (n)	Mostly % (n)	Always % (n)
Maximum barrier precautions (cap, mask, gloves, gown, full drapes)	0	12.5 (1)	0	50.0 (4)	37.5 (3)
2% Chlorhexidine gluconate for antisepsis of the insertion site	12.5 (1)	0	0	37.5 (3)	50.0 (4)
Use of suture-less securement devices	25.0 (2)	50 (4)	25.0 (2)	0	0
Use of sterile, transparent, semi-permeable dressing to cover catheter site	0	0	0	12.5 (1)	87.5 (7)
Transparent dressing replaced at least every 7 days	12.5 (1)	0	12.5 (1)	25 (2)	50 (4)
Administration sets replaced no more frequently than 72 hourly	0	12.5 (1)	0	25 (2)	62.5 (5)
Prompt removal of catheter when no longer essential	0	0	0	87.5 (7)	12.5 (1)
Routine catheter changes even if there is no suspicion of a central venous CR-BSI	50 (4)	12.5 (1)	12.5 (1)	12.5 (1)	0

NB. Where responses do not total 8, there is missing data