Management of central venous catheters at the intensive care units in Yemen

Survey of practices

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ABSTRACT

الأهداف: وصف الممارسات الحالية التي تطبقها وحدات العناية المركزة من أجل مكافحة العدوى ذات الصلة باستخدام القسطرة الوريدية المركزية في المستشفيات اليمنية ومقارنتها بالمبادئ التوجيهية القائمة على الأدلة.

الطريقة: أُجريت هذه الدراسة في وحدات العناية المركزة بمستشفيات العاصمة صنعاء، الجمهورية اليمنية وذلك خلال الفترة من 3 إلى 15 يوليو في العام 2010م. لقد شملت الدراسة 25 وحدة عناية مركزة في 14 مستشفى، حيث تم جمع المعلومات المتعلقة بالممارسات المطبقة لمكافحة العدوى المصاحبة لاستخدام القسطرة الوريدية المركزية. وتم توزيع الاستبيان الذاتي على مدراء التمريض في وحدات العناية المركزة، ومن ثم تم فرز وجدولة النتائج باستخدام برنامج التحليل الإحصائي، ومقارنتها بالمبادئ التوجيهية.

النتائج: أشارت الدراسة إلى أن 44% فقط من الوحدات لديها سياسة مكتوبة حول كيفية استخدام القسطرة الوريدية المركزية. ولقد كانت أكثر الممارسات المتبعة والتي تتماشى مع المبادئ التوجيهية هي: ارتداء القفازات، ونوع الضمادات المستعملة في مكان إدخال القسطرة، في حين لم يتم استخدام محلول الكلورهكسيدين (2%) في أي من الوحدات. ولقد التزم أكثر من نصف الوحدات بالممارسات الموصى بها بخصوص كلاً من: نظافة اليدين (قبل وبعد إدخال القسطرة، واستعمالها، واستبدال وإصلاح القسطرة، أو استبدال الضمادات)، والمكان المفضل لإدخال القسطرة، واستعمال القسطرة المغلفة بمضادات الميكروبات، وإتباع الطريقة المعقمة أثناء إدخال القسطرة والعناية بمكان دخولها، وتطهير مداخل الحقن الوريدية، وتغطية الصمامات الثلاثية وأطراف جهاز توصيل المحلول التي لا تكون قيد الاستعمال، وكذلك استبدال أو إزالة القسطرة. وفي المقابل فقد التزمت الأقلية فقط في باقي الأقسام الأخرى بالممارسات الموصى بها.

خاتمة: أثبتت الدراسة تنوع الممارسات الحالية، وعدم الالتزام بما يتفق مع المبادئ التوجيهية القائمة على الأدلة من أجل الوقاية من الإصابة بعدوى الأوعية الداخلية ذات الصلة باستخدام القسطرة.

Objectives: To describe the intensive care units (ICU) current infection control practices regarding the management of central venous catheters (CVCs) in Yemeni hospitals and compare the current practices with the evidence-based guidelines.

Methods: This study was carried out in ICUs of Sana'a hospitals, Republic of Yemen, in July 2010. We gathered the data regarding the infection control practices associated with CVC management in 25 ICUs of 14 hospitals. A self-administered questionnaire was distributed to ICUs' nurse managers in Sana'a city. The results were analyzed and tabulated using the Statistical Package for Social Sciences software version 11, and compared with the evidence-based guidelines.

Results: Only 44% of units had written policies for CVC management. The 2 most commonly used practices that comply with the guidelines were: wearing of gloves and dressing material. None of the units used 2% chlorhexidine solutions. More than half of the units were adherent to the recommended practice for hand hygiene (before and after insertion, accessing, dressing or replacing/repairing of CVC), preferred insertion site, antimicrobial-coated catheters, aseptic technique during catheter insertion and site care, disinfection of intravenous access ports, capping stopcocks and infusion set tips while they are not in use, and CVC replacement/removal. In all other sections, only the minority were adherent to the recommended practices.

Conclusions: There is a diversity of current practices and lack of consistent adherence to the evidence-based guidelines for the prevention of intravascular catheter-related infections.

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Central venous catheters (CVCs) are life-sustaining devices[1] used for fluid administration, drug therapy, transfusion of blood and blood products, total parenteral nutrition (TPN) and blood sampling. In addition, CVCs are also used for hemodynamic monitoring, hemo/plasma filtration, and extra-corporeal membrane oxygenation in the intensive care units (ICUs).[2-4] These devices break the body's natural defense barrier, and place the patient at risk of catheter-related bloodstream infections (CR-BSIs).[4] Catheter-related bloodstream infections account for 10-20% of all nosocomial infections.[1] Central venous catheter related-bloodstream infections (CVCR-BSIs) account for 90% of all CR-BSIs[3] and 30% of all device-associated infections.[5] Central venous catheter related-bloodstream infections have been estimated to occur in 3-7% of all patients with CVCs,[6] and are associated with increased morbidity, mortality, and healthcare costs.[1,4] Patients in ICUs are at an increased risk for CVCR-BSIs as 48% of those patients have CVCs, accounting for 15 million catheter days per year in the United States (US) ICUs.[7] The rate of CVCR-BSIs is ranged from 5.3-6 per 1000 catheter/days in the developed countries ICUs[8-10] and from 7.7-18.5 (mean, 12.5) per 1000 catheter/days in 8 developing countries.[5] Approximately 250,000 cases of CVCR-BSIs occur in US hospitals annually.[1,7] Approximately 82,000 of these cases occur in ICUs and resulted in an estimated 28,000 attributable deaths in ICUs annually in the US alone.[8,11] The attributable mortality has an estimated rate of 18% (0-35%) for each CVCR- BSIs.[7,8] The attributable cost per CVCR- BSIs is estimated as $18,432–$56,000,[7,11,12] and the annual cost of caring for patients with CVCR- BSIs ranges from $296 million to $2.3 billion in the US.[7] Although the rates of CR-BSI are high, 10-70% of all CVCR- BSIs are preventable.[1,8,13] Several studies using numerous interventions have shown reductions in the rates of CR-BSIs and the ensuing morbidity, mortality, and costs.[8,11,14] The Centers for Disease Control and Prevention (CDC) published guidelines for the prevention of intravascular catheter-related infection since 2 decades, however, little is known about up to what extent the hospitals will adopt evidence-based practices, what practitioners actually do in clinical practice, and how closely practice reflects the guidelines.[3,4,6] Although several previous surveys report variation in ICU policy and practices regarding the CVCs infection control practices,[3,4,6] there is a lack of studies evaluating ICUs infection control practices associated with the management of CVCs in Yemen hospitals. Consequently, the extent to which CVCR-BSI prevention practices are used by Yemen hospitals is unknown. This study was carried out to describe the current infection control practices regarding insertion, use, and ongoing care of non-tunneled CVCs in the ICUs of Yemen hospitals and compare it to the current practice with CDC evidence-based guidelines to determine the extent to which Yemen ICUs have adopted CVCR-BSIs prevention practices.

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Methods. A survey was carried out to gather data that describe the existence of policies and the existing practices for non-tunneled CVCs management (insertion, use, and ongoing care practices). The study was carried out in Sana'a city, capital of Yemen, in 25 ICUs of 14 (teaching and non-teaching) hospitals. For the purposes of this study, we included only ICUs in which the CVCs were applied.

During the period from 3 July to 15 July 2010, a 6-page, self-administered questionnaire of CVCs management practices was distributed to the studied ICUs. Nurse managers familiar with the unit daily practices, were asked to complete the questionnaire with answers that reflected the predominant unit practice regarding CVCs management. The questionnaire was administered to the senior nurse on duty when the nurse manager of the unit is not available, on vacation or medical leave during data collection. The questionnaire was developed by the researcher, based on the CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections.[7] Questions included were related to each practice mentioned in the CDC guidelines for the insertion, use, and ongoing care of CVCs. The validation of the developed survey was obtained through a review of 3 experts with a particular interest in ICU-acquired infections: nursing faculty member (medical-surgical nursing), critical care nursing and critical care medicine experts (each had at least 3 years of experience in ICU, a master's degree in critical care). The experts were asked if all questions were clearly worded and would not be misinterpreted. Experts evaluated the relevance and adequacy of the match between the questions of the survey and the guidelines. The remarks of the experts were collected and discussed and then used to revise the questionnaire. The survey was then distributed to a pilot group of 6 intensive care senior nurses (who did not participate in the actual survey sample) to evaluate the readability and time to complete. No questions were added or dropped, but some modifications to its wordings were made to increase the clarity of questions.

The final questionnaire contained 32 questions formatted in 7 main sections: (1) practices related to hand hygiene, (2) practices related to selection of catheter type and insertion site, (3) practices related to the CVCs insertion procedures, (4) practices related to the catheter site care, (5) practices related to accessing CVC lumens, care of the stopcocks and the intermittent infusion set tips while they are not in use, (6) practices related to the replacement of IV administration sets, and (7) practices related to the replacement and removal of CVCs. Additional data were obtained to describe the ICUs characteristics, the presence of unit policy for CVC's management, and the hospital personnel inserting CVCs. For the purposes of this survey, maximal sterile barrier precautions for CVC insertion required the inserter to wear a cap, mask, sterile gloves, long-sleeved sterile surgical gown and large sterile drape surrounding the catheter insertion site.[6,7]

Institutional Ethics Committee approval was not required, as the practice survey has no impact on patient care or confidentiality. Participation in the survey was voluntary. An explanation of the survey was provided before completion. The completion of the questionnaire was assumed to imply consent. Confidentiality of participants (individuals) and participating institutions was maintained. The study was approved by the Research and Ethical Committee of Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Republic of Yemen.

Survey responses from each unit were collected and entered into a Personal Computer (PC). Response frequencies and percentages were analyzed using the Statistical Package of Social Sciences version 11 software, (SPSS Inc., Chicago, IL, USA).

Results. Thirteen units in 4 teaching tertiary-care hospitals and 12 units in 10 non-teaching hospitals (one unit in a military hospital and 11 units in 9 private hospitals) participated in the survey. Twenty-two nurse managers and 3 senior nurses provided information about practices in the ICUs. Only 38.4% of teaching and 50% of non-teaching units had written policies. A lower percentage of teaching versus non-teaching units reported adherence to hand washing before and after: inserting CVC (61.5% versus 83.3%), accessing CVC and replacing dressing (53.8% versus 58.3%), palpating insertion site (38.4% versus 41.6%) and replacing/repairing CVC (61.5% versus 66.6%). Correspondingly, lower percentage of teaching versus non-teaching units reported using alcohol-based foams/gels and antibacterial soap for hand hygiene before inserting or accessing CVC (23% versus 66.6%) and before replacing dressing or administration sets (38.4% versus 50%). Approximately 46.1% of teaching units and 58.3% nonteaching units reported using antimicrobial-coated catheters for patients whose CVC is expected to remain in place for >5 days.

As shown in **Table 1**, only 16% of all units (15.3% teaching and 16.6% nonteaching) reported using one, 2 or 3 lumens CVC as indicated by patient condition. The remaining units reported using multiple-lumens CVC, routinely. As the preferred CVC anatomical insertion site, subclavian vein reported by lower percentage of the teaching versus nonteaching units (46.1% versus. 66.6%). The remaining units reported either subclavian or jugular veins. A lower percentage of teaching versus non-teaching units reported using maximal sterile barrier precautions (15.3% versus 41.6%). Similarly, 76.9% of teaching versus 83.3% of nonteaching units reported maintaining the aseptic technique/sterile field throughout the CVC insertion procedure. Higher percentage of the teaching versus non-teaching units (100% versus 91.6%) reported using either 70% alcohol, 10% povidone-iodine, 1% tincture of iodine or combinations of these solutions for skin preparation before CVC insertion (**Table 1**) and skin care during dressing replacement (**Table 2**). Using the transparent, semi-permeable dressings was reported by higher percentage of teaching versus non-teaching units (53.8% versus 25%). All units who used transparent dressings reported replacing dressing at least weekly (ranged from ≥3 times per day to weekly). Only one unit (from teaching units) who used gauze dressings reported replacing dressing at 48 hours intervals, remaining units reported replacing dressing at <48 or >48 hours intervals.

Higher percentage of teaching versus nonteaching units reported using sterile technique for dressing replacement (69.2% versus 41.6%). All units reported wearing gloves for dressing replacement. Furthermore, 76.9% of teaching and 75% of nonteaching units reported using sterile gloves, as indicated in **Table 2**. Lower percentage of teaching versus nonteaching units reported using antimicrobial ointment at the CVC insertion sit (7.6% versus 25%). Nearly equal percentage of teaching and nonteaching units reported using sterile gloves (38.4% versus 33.3%) and non-sterile gloves (61.5% versus 58.3%) to access CVC and replace intravenous administration set. Likewise, approximately 69.2% of teaching versus 58.3% of nonteaching units reported capping stopcocks and intermittent infusion set tips with a sterile cap while they are not in use. Fifty-two percent (13/25) of all units (53.6% of teaching and 50% of nonteaching) reported disinfection of intravenous access ports/needleless connectors by swabbing with alcohol or povidone-iodine before accessing it. The remaining units accessing it without disinfection or

Table 1 - Practices related to the selection of catheter and insertion site, and the catheter insertion procedure.

Practices	Units of teaching hospitals n=13	Units of non-teaching hospitals, n=12	All units N=25
	n (%)		
Number of catheter lumens			
Multiple-lumens, routinely			
Three lumens	11 (84.6)	8 (66.6)	19 (76)
Two lumens	0 (0.0)	2 (16.6)	2 (8)
One, two, or three as indicated*	2 (15.3)	2 (16.6)	4 (16)
Preferred CVC anatomical insertion site			
Subclavian vein*	6 (46.1)	8 (66.6)	14 (56)
Jugular vein	3 (23)	1 (8.3)	4 (16)
Either subclavian or jugular veins	4 (30.7)	3 (25)	7 (28)
Skin antiseptics preparations used to prepare skin of insertion site before insertion			
10% povidone-iodine (iodophor)*	7 (53.8)	6 (50)	13 (52)
70% alcohol + 10% povidone iodine	4 (30.7)	5 (41.6)	9 (36)
70% alcohol + 1% iodine	1 (7.6)	0 (0.0)	1 (4)
1% tincture of iodine*	1 (7.6)	0 (0.0)	1 (4)
0.5% alcoholic chlorhexidine†	0 (0.0)	1 (8.3)	1 (4)
2% chlorhexidine*	0 (0.0)	0	0 (0)
Barrier precautions used during catheter insertion			
Cap*	8 (61.5)	6 (50)	14 (56)
Mask*	12 (92.3)	9 (75)	21 (84)
Sterile gloves*	13 (100)	12 (100)	25 (100)
Long-sleeved sterile gown*	7 (53.8)	6 (50)	13 (52)
Large sterile drapes *	3 (23)	6 (50)	9 (36)
Smaller sterile drapes	2 (15.3)	3 (25)	5 (20)
Non-sterile gown	2 (15.3)	2 (16.6)	4 (16)
Maximal sterile-barrier precautions*	2 (15.3)	5 (41.6)	7 (28)

*Data represent the recommended practice as per the Centers for Disease Control and Prevention (CDC) Guidelines.
†0.5% alcoholic chlorhexidine: 70% alcohol/0.5% chlorhexidine

Table 2 - Practices related to the care of insertion site.

Practices	Units of teaching hospitals, n=13	Units of non-teaching hospitals, n=12	All units N=25
	n (%)		
Dressing material			
Transparent, semi-permeable dressings*	1 (7.6)	2 (16.6)	3 (12)
Occlusive, sterile gauze dressings*	5 (38.4)	8 (66.6)	13 (52)
Either gauze or transparent dressing*	6 (46.1)	1 (8.3)	7 (28)
Other	1 (7.6)	1 (8.3)	2 (8)
Frequency of dressing replacement			
Transparent, semi-permeable dressings.			
≤Weekly*	7 (53.8)	3 (25)	10 (40)
>Weekly	0 (0.0)	0 (0.0)	0 (0)
Occlusive, sterile gauze dressings			
<48 hours	7 (53.8)	5 (41.6)	12 (48)
48 hours*	1 (7.6)	0 (0.0)	1 (4)
>48 hours	3 (23)	4 (33.3)	7 (28)
Techniques used for dressing replacement			
A sterile procedure*	9 (69.2)	5 (41.6)	14 (56)
Clean procedure	3 (23)	4 (33.3)	7 (28)
Either sterile or clean procedure	1 (7.6)	3 (25)	4 (16)
Barrier precautions used for dressing replacement			
Cap	2 (15.3)	2 (16.6)	4 (16)
Mask	9 (69.2)	7 (58.3)	16 (64)
Sterile gloves*	10 (76.9)	9 (75)	19 (76)
Non-sterile gloves*	3 (23)	3 (25)	6 (24)
Sterile/non-sterile gown	5 (38.4)	3 (25)	8 (32)
Skin antiseptic preparations used for dressing replacement			
10% povidone-iodine*	7 (53.8)	6 (50)	13 (52)
70% alcohol*	1 (7.6)	5 (41.6)	6 (24)
70% alcohol + 10% povidone-iodine	3 (23)	0 (0.0)	3 (12)
70% alcohol + 1% iodine	1 (7.6)	0 (0.0)	1 (4)
1% tincture of iodine*	1 (7.6)	0 (0.0)	1 (4)
0.5% alcoholic chlorhexidine†	0 (0.0)	1 (8.3)	1 (4)
2% chlorhexidine*	0 (0.0)	0 (0.0)	0 (0)

*Data represent the recommended practice as per the Centers for Disease Control and Prevention (CDC) Guidelines.
†0.5% alcoholic chlorhexidine: 70% Alcohol/0.5% chlorhexidine.

Table 3 - Practices related to accessing central venous catheters (CVC) and replacing administration sets.

Practices	Units of teaching hospitals n=13	Units of non-teaching hospitals n=12	All units N=25
		n (%)	
Disinfection of IV access ports/needleless connectors before accessing or manipulation			
Yes			
Swabbing with 70% alcohol*	4 (30.7)	5 (41.6)	9 (36.0)
Swabbing with povidone-iodine*	3 (23.0)	1 (8.3)	4 (16.0)
Swabbing with normal saline*	0 (0.0)	3 (25.0)	3 (12.0)
No	5 (38.4)	3 (25.0)	8 (32.0)
Either yes or no	1 (7.6)	0 (0.0)	1 (4.0)
Routine replacement of IV administration sets			
Non-lipid TPN infusions†			
Yes (within)			
<72 hours (24 to 48 hours)	5 (38.4)	5 (41.6)	10 (40.0)
≥72 hours (3-7 days)*	2 (15.3)	1 (8.3)	3 (12.0)
With each new infusion bottle	1 (7.6)	3 (25.0)	4 (16.0)
No, only when indicated	4 (30.7)	2 (16.6)	6 (24.0)
Other	1 (7.6)	1 (8.3)	2 (8.0)
Lipid emulsions infusions‡			
Yes (within)			
≤24 hours of initiation*	3 (23.0)	4 (33.3)	7 (28.0)
>24 hours (from 48-96 hours)	1 (7.6)	3 (25.0)	4 (16.0)
With each new infusion bottle	1 (7.6)	3 (25.0)	4 (16.0)
No, only when indicated	6 (46.1)	2 (16.6)	8 (32.0)
Other	1 (7.6)	1 (8.3)	2 (8.0)
Propofol infusions			
Yes (within)			
≤12 hours*	4 (30.7)	5 (41.6)	9 (36.0)
>12 hours (48-96 hours)	3 (23.0)	5 (41.6)	8 (32.0)
No, only when indicated	4 (30.7)	1 (8.3)	5 (20.0)
Others (not used in the unit)	2 (15.3)	1 (8.3)	3 (12.0)

*Data represent the recommended practice as per the Centers for Disease Control and Prevention (CDC) Guidelines. †Non-lipid total parenteral nutrition (TPN): solution contains only amino acids and dextrose. ‡Lipid emulsions: either combined with amino acids and glucose in a 3-in-1 admixture or infused separately. IV - intravenous

cleaned it by swabbing with normal saline, as indicated in **Table 3**.

Only 15.3% of teaching and 8.3% of nonteaching units (12% of all units) reported replacing the intravenous set of non-lipid TPN solution routinely at ≥72 hours intervals (3-7 days). The remaining units reported replacing it either at <72 hours intervals, with each new infusion bottle or only when indicated. Only 28% of all units (23% of teaching and 33.3% of nonteaching) reported replacing the intravenous set of lipid emulsion routinely at ≤24 hours of initiating the infusion. The remaining units reported replacing it either at >24 hours (48-96 hours) intervals, with each new infusion bottle or only when indicated. Similarly, only 36% of all units (30.7% of teaching and 41.6% of nonteaching) reported replacing the intravenous set of propofol routinely at ≤12 hours of initiating the infusion. The remaining units reported replacing it either at >12 hours (48-96 hours) intervals or only when indicated (**Table 3**). Higher percentage of teaching versus non-teaching units (84.6% versus 58.3%) reported replacing the CVC only when clinically indicated (not routinely), the remaining units reported replacing it routinely every 1-3 weeks. Sixty-eight percent of all units (69.2% of teaching and 66.6% of nonteaching) reported replacing CVC with a new catheter inserted at a new site when a catheter-associated infection is suspected or documented. Twenty five percent of all units (23% of teaching and 16.6% non-teaching) reported exchanging CVC over a guide wire. Sixty-four percent of all units (61.5% of teaching and 66.6% of nonteaching) reported daily reviewing the need for CVC and removing catheter as soon as it is no longer needed. The remaining units reported reviewing the need for CVC either every 3 days or 7 days.

Discussion. This survey provides a snapshot of current practices associated with the management of

CVCs in Yemen ICUs. A range of practices was reported and these were not always consistent with the evidence-based guidelines. The majority of units had not written policies about catheter insertion, use and ongoing care. This finding is lower than the finding of a previous survey which found that only the minority (20%) of 25 units had not written policies.[6] Author hypothesized, but could not prove, that most of units had no policies because no one responsible for the development and updating of unit policies. Most units were not provided by intensivists, critical care nurse specialists and/or infection control professionals. A broad range of internists, surgeons and nursing staff are the unit's medical director or nursing managers. This survey showed a low adherence to hand washing (40-72%) before and after insertion, use, and care of CVC. The adherence of Yemen ICUs to hand hygiene is lesser than what has been reported about US intensivists (75%)[15] and healthcare workers (HCWs) of one neonatal ICU in US (81%).[16] Similarly, the use of Yemen ICUs to the recommended hand-hygiene preparations (44%) is lesser than what has been reported about HCWs of that neonatal ICU in US (65%%).[16] Lack of time, facilities and resources (such as room layout, availability and placement of sinks and the availability of hand hygiene preparations such as alcohol-based foams/gels), which facilitate adherence to hand hygiene, are the possible reasons for this low adherence. More than half of units meets the suggested guidelines and specified the subclavian vein as a preferred anatomic site for CVC insertion. This survey showed a greater compliance than previous studies, which found that only 20.3-36% of units surveyed specified subclavian vein as a preferred anatomic site for CVC insertion.[6,17] Similarly, only 17% of US intensivists reported using subclavian vein for CVC insertion.[15] Less than one third of units applied maximal sterile barrier precautions during CVCs insertion. Even if the definition of maximal sterile barrier precautions was broadened to include the use of smaller sterile drapes, only 36% of units met this less stringent definition. Although the study showed a low compliance, these findings are consistent with a previous survey revealed that only 28% of US intensivists reported using maximal barrier precautions.[15] On the other hand, the compliance in using maximal sterile barrier precautions in Yemen ICUs is lesser than the survey found in the US (58%).[18] None of ICUs used the preferred 2% chlorhexidine-based solution for skin disinfection before CVC insertion and during dressing replacement. Nearly, all units applied skin antiseptic solutions that are reasonable, but not the best practice. This data support the findings of previous surveys that tincture of iodine, 10% povidone-iodine, and 70% alcohol were the most frequently antiseptics used during dressing replacement.[3,4] On the other hand, the survey in US hospitals revealed that 73% were using chlorhexidine gluconate for insertion site disinfection.[18] The guidelines allowance to use other solutions and the absence of commercial chlorhexidine-based formulation for use as a skin antiseptic solution at the time of the survey; were the reasons for the non adaptation. Although all unit (except 2) followed the recommended practice by using of either sterile gauze or transparent sterile dressing, sterile gauze dressings were the most frequent type of CVC dressing used in Yemen units. These findings are not in accordance with the results of previous studies demonstrated that transparent dressings were predominantly in use.[3,4,17] The guidelines equal recommendation of these 2 dressing types and the less availability of transparent dressings at the time of the survey were the suggested reasons for the low adaptation of transparent dressings. The reported frequencies for dressing replacement were not all consistent with the guidelines and a wide range of time-frames was reported. Five percent (1/20) of units who used gauze dressings and all units (10/10) who used transparent dressings followed the recommended practice. These findings support previous surveys of all units using gauze dressings replaced it at >48 hours intervals,[4] and most units using transparent dressings replaced it at ≤168 hours intervals (≤weekly).[3,4] The definitively addressed frequency of gauze dressings and wide timeframe for replacing transparent dressings provided by the guidelines [giving a minimum (weekly) rather than a finite timeframe] were the reasons for low compliance with frequency of gauze dressings replacement and high compliance with frequency of transparent dressings replacement. However, the majority (9/10) of units routinely replaced transparent dressings more frequent (from ≥3 times per day to every 3 days). More than half of units followed the recommended practice by using aseptic technique for dressing replacement. These findings are consistent with a previous study found that sterile technique was used for dressing replacement by 88.6% of respondents (87% of teaching and 90% of nonteaching hospitals).[3] Nearly all units reported wearing gloves (sterile or non-sterile) for dressing replacement, accessing CVC lumens and replacement of administration sets. These findings are consistent with a survey showed that all Australian units applied gloves (sterile or non-sterile) for dressing and administration sets replacement.[4] Appropriate aseptic technique during dressing replacement does not necessarily require sterile gloves; a new pair of disposable non-sterile gloves can be used in conjunction with a "no-touch" technique for the dressing replacement.[7] Therefore, both glove types are acceptable for dressing replacement under the guidelines. Only about half of Yemen units (52%) reported that they cleaned the

intravenous access ports/needleless connectors with an approved antiseptic solution immediately before accessing. Less than two thirds (64%) of units reported that they capped stopcocks and intermittent infusion set tips with a sterile cap while they are not in use. These findings are not in agreement with a previous survey (in US) revealed that a larger proportion of nurses reported adherence to the recommended guidelines.[19]

The adherence of Yemen ICUs is lesser than the Australian ICUs adherence to the recommended practices regarding the replacement of non-lipid TPN and lipid emulsion intravenous administration sets. On the other hand, the adherence of Yemen units is greater than the Australian units adherence to the recommendation regarding the replacement of propofol intravenous administration sets.[4] The current survey showed that about quarter of Yemen ICUs deviated from good practice by routinely replacing CVC at 7 days to 3 weeks intervals. These findings are in accordance with the previous study which revealed that 83.5% of US hospitals reported avoidance of routine CVC change.[18] Despite the advice, one fifth (20%) of Yemen ICUs deviated from good practice and exchanged CVC over guide wires when catheter-related infection was suspected or documented. These findings are supported by Warren et al[6] study, who found that 28% of ICUs had policies that permitted CVCs to be exchanged over guide wires if catheter-related infection was suspected. The study revealed strengths and flaws of current infection control practices regarding CVC management in Yemen ICUs. Clinical practice guidelines aim to facilitate evidence-based practice, decrease practice variation and promote cost-effective care; and it is reasonable to expect that they should be reflected in clinical practice,[4] but often changes in practice lag behind guideline dissemination.[18] In addition to reasons suggested by some authors,[15,20,21] in this study, the lack of adherence to guidelines almost reflects a lack of resources and appropriate staffing to allow policies to be developed and implemented.

The limitations of this study are: First, responses were all self-reported. The potential for response bias exists, with some respondents providing what they perceive to be the preferred answer. However, efforts were made to minimize this type of response by ensuring the anonymity of the respondent. Although observational studies are needed to verify the responses, the author did not have the resources to undertake a multi-center observational study, instead used the questionnaire method, as previous studies are seeking to describe elements of infection control practice.[3,4,6,15-18] Second, the study only covered Sana'a city, capital of Yemen, which contain most (more than half) of ICUs in Yemen in which the CVCs are applied. However, some ICUs present in other districts need further study.

In conclusion, the predominant findings of this study were the diversity of current practice and lack of consistent adherence to the guidelines recommendations. Some of the hospitals have not yet implemented certain key practices. Recommendations for practice: 1) Intensive care unit's should develop and review their policies (if there are policies) for actual practices as a first step. It would be beneficial for hospitals to provide support and education in policy development/review, and to encourage clinical nurses to develop/review policies in consultation with local nurse researchers, academics and other appropriate staff. 2) Education and motivation for staff should be given for more active dissemination of the recommendations by CDC. 3) Hospitals can begin by developing infection control program and encouraging infection control professional (ICP) certification in infection control to improve adoption of key CVCR-BSI prevention practices.

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