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Using a checklist to identify barriers to compliance with evidence-based guidelines for central line management: a mixed methods study in Mongolia

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SUMMARY

Objectives: This study aimed to determine the extent to which a checklist has potential for identifying barriers to compliance with central line management guidelines, to evaluate the potential utility of checklists to improve the management of central lines in Mongolia, and to define the gap between current and best practices.
Methods: A 22-item checklist was developed based on the Centers for Disease Control and Prevention (CDC, USA) guidelines and existing central line-associated bloodstream infection (CLABSI) checklists. The checklist was used to observe 375 central line procedures performed in the intensive care units of four tertiary hospitals of Mongolia between July and December 2010. In parallel, 36 face-to-face interviews were conducted in six other tertiary hospitals to explain practice variations and identify barriers.
Results: The baseline compliance level across all components of the checklist was 68.5%. The main factors explaining low levels of compliance were outdated local standards, a lack of updated guidelines, poor control over compliance with existing clinical guidelines, poor supply of medical consumables, and insufficient knowledge of contemporary infection control measures among health care providers.
Conclusions: The health authorities of Mongolia need to adequately address the prevention and control of CLABSIs in their hospitals. Updating local standards and guidelines and implementing adequate multifaceted interventions with behavioral, educational, and logistical components are required. Use of a checklist as a baseline evaluation tool was feasible. It described current practice, showed areas that need urgent attention, and provided important information needed for future planning of CLABSI interventions.

1. Introduction

The most critically ill hospital patients are admitted to intensive care units (ICUs). For approximately half the total days they spend in ICUs, these patients have a central line for prolonged venous access.[1] Central line-associated bloodstream infections (CLABSI) are common and cause significant morbidity and mortality. While in some developed countries the CLABSI rate has ranged from 2.3 to 7.7 cases per 1000 central line-days, in developing countries this rate may reach 40.0 to 60.0 cases; this is associated with significant extra mortality, which can be 3–10 times higher than for non-CLABSI patients.[2–4]

The incidence of CLABSI can be reduced by applying simple and inexpensive evidence-based practices.[5–8] In 2006, the Michigan Keystone ICU Project reported the results of an evidence-based intervention for CLABSI, involving the five key recommendations of the US Centers for Disease Control and Prevention (CDC).[5] A checklist was used as a tool to limit variations in the implementation of recommendations.[9] The CLABSI rates were substantially reduced in 103 participating ICUs, from 7.7 to 1.1 infections per 1000 central line-days within 36 months.[10,11] Plans are now being developed to implement this multifaceted quality improvement intervention and collaborative model in all states of the USA.[2,11]

The simplicity and effectiveness of using checklists have attracted the attention of health professionals, and a growing

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body of research supports the application of checklists in various areas of infection control[12–14] and beyond.[15–17] Checklists have been evaluated in health care settings in a wide range of developed and developing countries,[12,18–20] where in the latter they could provide a particularly useful, cost-effective means for improving quality of patient care.

To date, there has been no research that describes the practice of central line management in Mongolia, either published or unpublished. Our study aimed to determine the extent to which a checklist has potential for identifying barriers to compliance with central line management guidelines, to evaluate the potential utility of checklists to improve the management of central lines in Mongolia, and to define the gap between current and best practices. We have interpreted the study findings to provide insight into the development of improved CLABSI prevention programs in developing countries.[21,22]

2. Methods

2.1. Study overview

The study was conducted in Ulaanbaatar, the capital city of Mongolia, from July to December 2010. The 10 largest hospitals participated in the study, representing 90% (3571/4005 beds) of the national tertiary hospital bed pool.[23] A mixed-methods design was used, incorporating a prospective observational study in four hospitals and qualitative interviews in another six hospitals. Ethics approval was obtained from the Ministry of Health (MoH), Mongolia and the University of Queensland, Australia.

In Mongolia, central lines are placed by anesthesiologists or intensivists (i.e., ICU doctors). Central arterial catheters are seldom used because ICUs lack equipment for arterial blood pressure and pH monitoring, and consequently our observations were only for central venous line procedures.

2.2. Observational study

The four largest hospitals, including the State Central Clinical Hospital No. 1 (498 beds, 10 ICU beds), the Maternity, Child Health & Research Centre (662 beds, 52 ICU beds), the National Centre for Trauma & Orthopaedics (412 beds, 10 ICU beds), and the Shastin Memorial Hospital No. 3 (392 beds, 30 ICU beds) participated in this study, conducted from July to December 2010. A total of 39 nurses from the 12 ICUs of the four participating hospitals were recruited as observers, providing approximately one observer per shift per ICU over the fieldwork period. A 3-hour training session in the study methods was conducted at each of the four hospitals for the observers and the Infection Control Practitioners (ICPs) who were responsible for facilitating observations.

The data collection sheet was developed based on the CDC (Atlanta, USA) *Guidelines for the prevention of intravascular catheter-related infections* and CLABSI checklists utilized in some US hospitals.[5,24,25] Requirements for hand washing duration were obtained from the World Health Organization (WHO) guidelines.[26] To reduce intrusiveness of the study on the participants, observers measured the duration of hand and catheter site sanitation via the silent counting method (i.e., one thousand, two thousand, ...) commonly used in nursing practice.[27] The one-page data collection sheets consisted of 22 items of general information and before-, during-, and after-procedure requirements. They could be completed in as little time as 1 minute. In total, 42 doctors, three residents, and 90 nurses in the ICUs who were inserting, replacing, or removing the central lines were observed.

The required sample size was determined using WHO guidelines.[28] The descriptive analysis was carried out using statistical software package SPSS 18.0 (SPSS Inc., Chicago, USA).

2.3. Qualitative study

In July–August 2010, the principal investigator conducted interviews in six tertiary hospitals of Ulaanbaatar, excluding the four that participated in the observational study. A purposive sampling method and supplementary snowballing technique[29] was used to recruit 18 doctors and 18 nurses from the 10 ICUs of the participating hospitals. All participants were asked to provide consent to participate (three participants refused due to the sudden arrival of critically ill patients). The principal investigator used a semi-structured interview guide based on the design of the observational study data collection sheet (i.e., the checklist). Participants were asked to (1) describe their day-to-day practice and management of central lines, (2) provide their opinions and perceptions on why current practice differs from best practice, as indicated by CDC guidelines (using the checklist as an aid), and (3) elucidate the potential barriers to best practice and ways to avoid them if a checklist program was to be implemented in Mongolian hospitals. The discussions were recorded digitally in MP3 format. Thematic saturation was reached after discussions with the 36 health professionals.

A variation upon the five-step framework approach was used in the thematic analysis using NVivo-8 software (QSR International Pty Ltd, Melbourne, Australia).[30] Triangulation methods (involving cross-referencing between participant groups and with the observational study) were also used to enhance the reliability of the findings.

3. Results

3.1. Profiles of central line practices

A total of 375 central line procedures were observed (Table 1). The average central line utility level of participating hospitals was 4.08, ranging from 2.4 to 12.5 procedures per 100 ICU beds per day. Central line procedures were mostly performed during the day time (282/375, 75.2%), predominantly in the ICU (315/375, 84%). In dialysis rooms, only central line removals (11/375, 2.9%) were performed. Of 375 procedures, 317 (84.5%) were catheter insertions, 24 (6.4%) were replacements, and 34 (9.1%) were removals. The mean duration from catheter insertion date to replacement was 5.9 days (95% confidence interval (CI) 2.8–8.9) and to removal was 16.5 days (95% CI 11.2–21.9). The overall level of compliance with recommended best practice in central line management was 68.5% (61.0% for before-procedure, 85.3% for during-procedure, and 59.5% for after-procedure requirements) (Table 2).

3.2. Use of evidence-based practices

3.2.1. Appropriate hand hygiene

Although there were no problems with the availability of sinks, operators sanitized their hands in 315/375 (84%) procedures, and in another 60/375 (16%) procedures they wore sterile gloves without hand sanitation (Table 2). Doctors explained that in emergency cases they are not always able to sanitize their hands. However, our analysis showed that doctors failed to sanitize their hands more frequently in elective (22.4%) than in emergency (11.4%) procedures (Chi-square $p < 0.004$). Operator hand washing failure was significantly higher in catheter replacement (16.7%) and removal (38.2%) than for insertion (13.6%, Chi-square $p < 0.001$). This was supported by our qualitative data from nurses, who criticized doctors for giving less attention to the catheter care after inserting the central line compared to the time of insertion.

Table 1
General profile of central line management practices in four tertiary hospitals in Ulaanbaatar, Mongolia, 2010 ($n = 375$)

Variables	Frequency	Percentage
Number of procedures observed		
State Central Clinical Hospital No. 1	113	30.1
Maternity, Child Health & Research Center	114	30.4
National Center for Trauma & Orthopedics	55	14.7
Shastin Memorial Hospital No. 3	93	24.8
Patient age		
Newborn (0–1 month)	15	4
Child (1 month–18 years)	112	29.9
Adult (19–59 years)	197	52.5
Elderly (≥60 years)	51	13.6
Time the procedure was performed		
Day time (08.00–16.00)	282	75.2
Evening time (16.00–23.00)	80	21.3
Night time (23.00–08.00)	13	3.5
Place where the procedure was performed		
ICU (medical, surgical, pediatric)	315	84
Angiography catheter laboratory	35	9.3
Surgical theater	14	3.7
Dialysis room	11	2.9
Mode		
Emergency	219	58.4
Elective	156	41.6
Catheter site		
Subclavian	291	77.6
Jugular	35	9.3
Femoral	46	12.3
Peripheral for PICC	3	0.8
Procedure type		
Insertion	317	84.5
Replacement[a]	24	6.4
Removal[b]	34	9.1

ICU, intensive care unit; PICC, peripherally inserted central catheter; 95% CI, 95% confidence interval.
[a] Replacements were performed after mean = 5.9 days (95% CI 2.8–8.9, range 1–30).
[b] Removals were performed after mean = 16.5 days (95% CI 11.2–21.9, range 1–61).

Rubbing with alcohol-based solutions (50.2%) and washing with solid antibacterial soap (33.0%) were the two main hand sanitation methods used in study hospitals. Qualitative data revealed that in recent years (although with occasional interruptions), alcohol-based solutions have been available both at the bedside and as pocket hand sanitizers. Some major hospitals produce alcohol-based solutions in their pharmacy to reduce costs. Although there were many complaints about skin dryness and irritations among health care workers, skin-care products are not supplied at any of the study hospitals. In the majority of the observations (74.0%), operators did not sanitize their hands for long enough, as defined by the WHO guidelines (<20 s with alcohol or <40 s with water and soap). The most common reason reported was due to being too busy.

Of the 315 operators who sanitized their hands, 24 (7.6%) used personal towels, changed at the end of each day, and 15 (4.8%) used group towels, changed twice per shift. Many study participants explained that because towels (supplied by hospitals once per year) deteriorated quickly, they had to pay for replacements several times per year using their own money.

3.2.2. Use of chlorhexidine for skin preparation

Chlorhexidine was not used. Qualitative data indicated that, in Mongolia, chlorhexidine has only recently been used as a surgical hand rub and for surface and instrument cleaning. Most participants did not know that 2% chlorhexidine is more effective than povidone–iodine and alcohol, and is recommended by the CDC for catheter site preparation.

The 2.5–7.5% povidone–iodine and 70% alcohol were the only disinfectants used. These disinfectants are produced by a local pharmaceutical company and are supplied to all hospitals (Table 2). Sufficient time was spent on antiseptic preparation of the catheter site (>30 s for dry site, >2 min for groin) in 316 (84.3%) procedures. Sufficient time was given to drying of the antiseptic (>30 s for dry, >1 min for groin) in 261 (69.6%) procedures. One doctor explained that "We don't know that timing is important . . . At the university, we thought we should use iodine and alcohol alternatively 3 times each, which generally takes almost 1 minute, and then, wipe [the antiseptic] off until it dries to prevent the patient [feeling] a stinging sensation. . .In many cases, there is no time for waiting".

3.2.3. Use of full-barrier precautions

Operators wore a cap, mask, sterile gown, and sterile gloves in 74.4%, 64.8%, 62.9%, and 87.2% of all observations, respectively (Table 2). Discussions revealed that operators wear these only if they are supplied in factory-made catheter kits or in hospital-prepared sterile central line cotton packages. In the last 3 years, many hospitals have prepared cotton packages containing hats, masks, gloves, gowns, drapes, and hand towels, and re-use them several times to reduce costs compared to the expensive commercial catheter kits. However, in many cases, the number of cotton packages is still insufficient because "After 6–7 sterilizations, the cotton packages deteriorate and become impossible to re-use" (ICU nurse). Some hospital ICUs provide sterilized sleeveless coats to doctors and nurses for every shift, and operators do not use sterile gowns. Sterile gloves run out occasionally and operators wear non-sterile gloves and treat them with antiseptics. Non-sterilized gloves were commonly used when the catheter was being removed from the patients (insertion 6.4% compared to removal 79.4%, $p < 0.0001$). Additionally, some senior doctors do not like to wear gloves (3.5%) and instead they use surgical hand rub for disinfection.

Of all observed procedures, drapes were used in only 85.6% (full size drapes in 36.8% and small drapes in 63.2%). Many doctors expressed a need for full body drapes because the small drapes, which come in catheter kits or are produced by the hospitals, present challenges in keeping lines and guidewires sterile within a limited space. Therefore, some ICU doctors have been requesting administrators to enlarge the size of the drapes in their cotton packages. The procedures in which no drape was used included 17 insertions, five replacements, and 32 removals, and most of them were observed from one ICU, which has only one sterile central line cotton package per shift. In eight (2.5%) procedures, ordinary non-sterile bed linen was used to cover the patient's body during the catheter insertion.

3.2.4. Use of the subclavian vein as the preferred insertion site

The subclavian vein was the most common site for central lines (291/375, 77.6%), followed by the femoral (12.3%) and jugular (9.3%) veins (Table 1). Although foreign visiting teams and those who trained abroad promote more frequent use of the jugular site, Mongolian doctors prefer to use techniques in which they are confident (i.e., insertion in the subclavian veins). They also favor the jugular site less because central lines placed there need more frequent dressings than those in the subclavian vein. Femoral site insertions were used mostly at the angiography catheter laboratory (32/46, 69.6%) and were removed the same day (45/46, 97.8%). Discussions revealed that most of the participants did not know that the groin area must be treated with antiseptics and dried for longer than other sites.

3.2.5. Removal of unnecessary catheters

Of all observed insertions, in only 22/341 procedures (6.5%) were existing catheters not removed (Table 2). The qualitative study participants were conscious about leaving unnecessary

Table 2
Characteristics of central line management and practices in four tertiary hospitals in Ulaanbaatar, Mongolia, 2010 ($n = 375$)

Variables	Frequency	Percentage
Before procedure		
Obtained consent for procedure		
Yes	305	81.3
No	70	18.7
Obtained supervision		
Yes	156	41.6
No	219	58.4
Operator removed rings/watch		
Yes	250	66.7
No	125	33.3
Operator sanitized hands		
Yes	315	84
No	60	16
Operator hand sanitation method (of those sanitized, $n = 315$)		
Alcohol based solutions	158	50.2
Washing with antiseptic soap	104	33.0
Washing with normal soap	29	9.2
Washing and alcohol based solutions	24	7.6
Operator hand sanitation duration (of those sanitized, $n = 315$)		
Enough (>20 s for alcohol, >40 s for water)	82	26.0
Not enough (<20 s for alcohol, <40 s for water)	233	74.0
Operator hand drying method (of those sanitized, $n = 315$)		
Paper tissue	131	41.6
Sterilized towel	34	10.8
Shaking and waiting	89	28.3
Electric drier	22	7.0
Personal towel	24	7.6
Group staff towel	15	4.8
Operator wore a cap		
Yes	279	74.4
No	96	25.6
Operator wore a mask		
Yes	243	64.8
No	132	35.2
Operator wore a gown		
Yes, sterile gown	236	62.9
Yes, non-sterile gown	101	26.9
No	38	10.1
Operator wore gloves		
Yes, sterile gloves	327	87.2
Yes, non-sterile gloves	35	9.3
No	13	3.5
Operator performed procedure with an assistant		
Yes	344	91.7
No (they were alone)	31	8.3
Assistant sanitized hands ($n = 344$)[a]		
Yes	245	71.2
No	99	28.8
Assistant wore a cap ($n = 344$)[a]		
Yes	255	74.1
No	89	25.9
Assistant wore a mask ($n = 344$)[a]		
Yes	208	60.5
No	136	39.5
Assistant wore a gown ($n = 344$)[a]		
Yes, sterile gown	139	40.4
Yes, non-sterile gown	116	33.7
No	89	25.9
Assistant wore gloves ($n = 344$)[a]		
Yes, sterile gown	205	59.6
Yes, non-sterile gown	104	30.2
No	35	10.2
All personnel and patients in the procedure room wore a mask		
Yes	79	21.1
No	296	78.9
Patient position		
Supine	282	75.2
Supine with pillow under chest	49	13.1
Trendelenburg position	32	8.5
Chest up	12	3.2
Antiseptics used for catheter site preparation		
Povidone–iodine (2.5–7.5%)	201	53.6
Alcohol (70%)	43	11.5
Povidone–iodine and alcohol	131	34.9
Duration of the catheter site preparation using antiseptics		
Enough time (>30 s for dry site, >2 min for groin)	316	84.3
Not enough time (<30 s for dry site, <2 min for groin)	59	15.7
Drying of the catheter site after using antiseptics		
Enough time (>30 s for dry, >1 min for groin)	261	69.6
Not enough time (<30 s for dry, <1 min for groin)	114	30.4
Drape used		
Yes	321	85.6
No	54	14.4
Drape size ($n = 321$)		
Big drape (full body cover)	118	36.8
Small drape (body part cover)	203	63.2
Drape type ($n = 321$)		
Sterile (sterile pack or sterilized by hospital)	313	97.5
Non-sterile	8	2.5
During procedure		
Sterile field maintained		
Yes	295	78.7
No	80	21.3
Palpation after skin antisepsis		
Yes	236	62.9
No	139	37.1
Ports not using during the procedure clamped		
Yes	325	86.7
No	50	13.3
Lumens monitored		
Yes	338	90.1
No	37	9.9
Insertion and replacement success ($n = 341$, excluding removals = 34)		
Successful within 3 sticks	292	85.6
Successful in more than 3 sticks	31	9.1
Obtained second operator	15	4.4
Refused to stick	3	0.9
After procedure		
Sterile dressings		
Gauze and tape	345	92
Transparent polyurethane	30	8
Dressing date registered		
Yes	203	54.1
No	172	45.9
Catheter locking ($n = 338$, excluding removals = 34, refused to stick = 3)		
Saline 0.9%	338	100
Not used	0	0
Placement verified by X-ray or fluoroscopy ($n = 341$, excluding removals = 34)		
Yes	165	48.4
No	176	51.6
Unnecessary catheter removed ($n = 341$, excluding removals = 34)		
Removed central	6	1.8
Removed peripheral	138	40.5
Not removed	22	6.5
There was no other catheter	175	51.3

[a] Observer's self-reports.

catheters in the patient and the associated increased risk of bloodstream infections. Generally, doctors recommend that nurses change central line dressings only if they get 'dirty'. However, the ordinary gauze and tape that Mongolian hospitals use for central line dressings (345/375, 92.0%) peel off easily from the skin. Therefore, nurses have to assess the wound and change dressings almost every day. Transparent polyurethane was used in only 30/375 (8%) procedures in the observational study, because this tape is used only if it is provided in the catheter kits. Many nurses wished for the supply of transparent tapes to be improved. Antibiotic-impregnated dressings were considered a luxury, and doctors ask patients to buy them from a public pharmacy in some critical cases.

3.3. Perceptions of the feasibility of implementing a checklist program

The qualitative study participants expressed controversial views about introducing a central line insertion checklist in

Mongolian hospitals. While a few of the participants were concerned that a checklist would only add to paperwork which is "already too much", the majority of the participants expressed their willingness to use a checklist in their day-to-day clinical practice. Their reasoning was: (1) central line procedures were not performed frequently in most hospitals and a checklist would not add much workload; (2) checklists are simple and do not need much time to complete; and (3) checklists could be helpful "not like other unnecessary paperwork". Because there is a shortage of staff in most ICUs, it would not be possible for a checklist to be implemented by a person other than the operator and assistant. Both doctors and nurses were willing to be responsible for handling the catheter checklist. However, some doctors and nurses were skeptical about the power of nurses to enforce the checklist if doctors did not follow it. Some doctors said that "nurses are not skilled enough to control doctors".

Participants emphasized that without improving the supply of necessary consumables such as catheter kits, maximal barriers, drapes, antiseptics, functional beds, dressing materials, and mobile X-ray machines, it would be impossible to implement the checklist program. They also highlighted that the clinical guidelines for central lines should be developed and distributed to hospitals with proper guidance, including short training programs not only for doctors and nurses, but also for those administrators and clinical managers who are responsible for resource allocation. Some participants warned that if a checklist program was enforced without establishing a proper environment, the checklist would be susceptible to false reporting (i.e., gaming). "A checklist should be used for the sole purpose of helping clinical staff [as opposed to performance evaluation, followed by punishment]" said one doctor.

4. Discussion

Using a checklist to identify the level of and barriers to compliance with evidence-based guidelines for central line management is feasible in resource-limited ICUs. This study identified an overall low level of compliance with recommended best practice in central line management in Mongolian hospitals (Figure 1). Particularly low (<50%) compliance occurred in obtaining supervision, the duration of hand sanitation, hand drying, assistants wearing maximal barriers, all room attendants wearing masks, the use of full body drapes, using transparent polyurethane for dressing, and verifying catheter placement using X-ray. Using 2% chlorhexidine for skin preparation and locking catheters with antibiotics were not done at all. We found that low compliance may be explained by several barriers to the implementation of best practice.

First, the current standards for central line procedures are outdated and there are no national guidelines for central line practices. There were no formal standards for central line

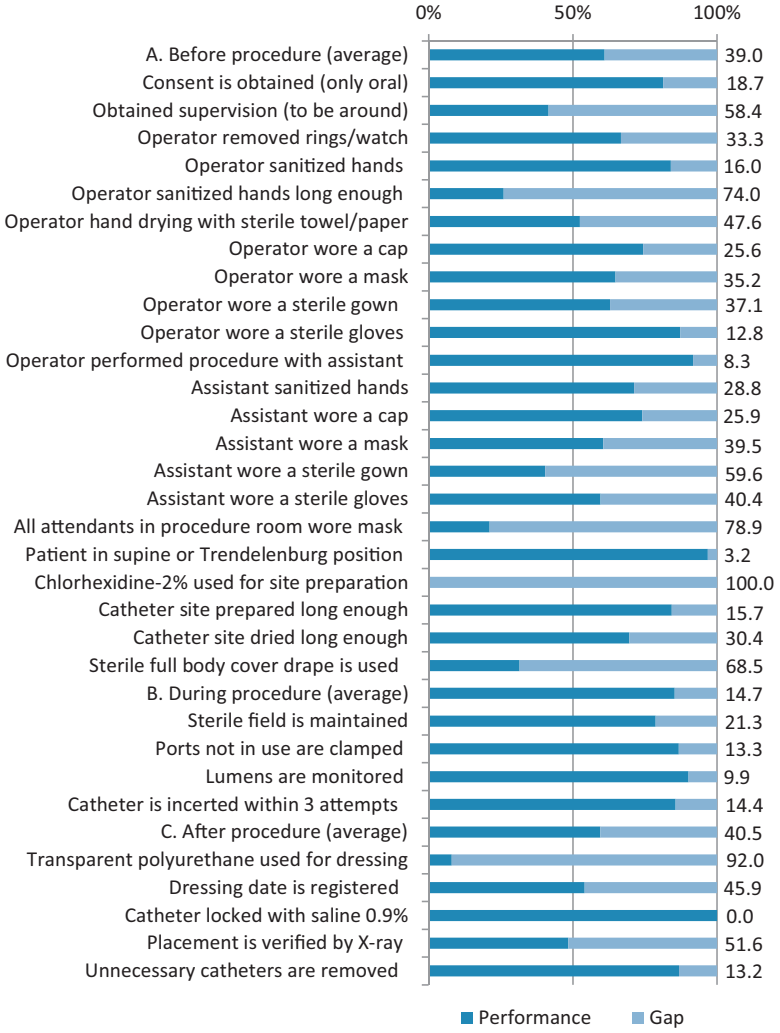

Figure 1. Performance and central line management practices and gaps compared to CDC (US, Atlanta) recommendations in four tertiary hospitals in Ulaanbaatar, Mongolia, 2010 (n = 375).

insertion and management in Mongolia until 2008 when *The standards for common medical procedures* were amended to include a specific section for central line management practice.[31,32] The new standards included requirements related to consent, supervision, wearing maximal barriers including drapes, patient position, catheter locking, and verifying placement, but important requirements such as the use of full body drapes, restricting palpation after skin preparation, and using 2% chlorhexidine for skin antisepsis were not included.[32] Therefore, until recently, resources needed for implementation of these requirements lacked justification and practices lacked benchmarks. Hospital-level guidelines that were adopted from international guidelines were illegal because, by law, the clinical guidelines should fit within the respective national standard.[33] Consequently, the current standards for central line procedures should be updated and the national guidelines for prevention and control of CLABSI should be developed as a matter of urgency and distributed to hospitals.

Second, compliance with existing guidelines is poor due to poor reinforcement from hospital administrators and the MoH. In our study, for instance, none of our observed patients were asked to sign a consent form, though the guidelines that require hospitals to take written consent for all invasive procedures were approved by the MoH in 2008. Consent forms are available only for surgery patients in major hospitals.

Third, the supply of medical resources is inadequate to support the implementation of evidence-based guidelines. It was notable that hospitals lack enough supply of medical consumables and equipment such as maximal barriers, dressing materials, disinfectants, catheter kits, beds, and mobile X-ray machines that are essential for safe central line practice. Many hospitals used cost-saving alternatives to overcome these shortages, including preparing cotton packages, choosing cheaper catheter kits, and preparing disinfectants in the hospital pharmacy.

Fourth, health care worker knowledge on contemporary infection control measures was insufficient to implement all aspects of best practice. It was notable that ICU staff members were not aware of the recommendations for using chlorhexidine in central line care or about the necessary duration of skin preparation with disinfectants. It is also important to highlight psychological and cultural barriers to the empowerment of nurses for enforcement of best practice.

The reported barriers specific to resource-rich settings are less materialistic. They are predominantly culture-oriented and the main attention is given to overcoming psychological barriers regarding nurse empowerment, collaboration between staff, support from senior level managers, and improving behavior and culture that ensure that patients reliably receive the recommended evidence-based interventions.[2,17–19,34,35] Building institutional commitment, continuous involvement of senior leaders, building team work and team accountability, and empowering nurses seem to be effective strategies to overcome some of these barriers. In contrast, barriers in resource-limited settings are more resource-oriented: overcrowding, understaffing, insufficient training of staff, limited medical supplies, and poor compliance with existing guidelines.[36–40] Strategies such as establishing multidisciplinary teams, revising standards and guidelines, staff training, hand hygiene campaigns, improving the supply of medical consumables, and performance feedback could lead to improved outcomes.

Low staff adherence to existing guidelines, inadequate supply of medical consumables, and insufficient knowledge of infection methodologies seem to be common challenges to infection control in both resource-limited and resource-rich countries.[34–38] Indeed, a number of intervention studies conducted in resource-limited settings used similar strategies to those used in resource-rich countries, including team building, education campaigns, more effective resource allocation, continuous monitoring, and feedback, and these have proved to be effective.[36–40]

Rosenthal highlighted that implementation of the five CLABSI prevention measures would be insufficient in hospitals in countries with limited resources because the basic infection prevention infrastructure is not yet fully established.[4] However, the level of overall compliance found in our study (68.5%) was similar to that reported (62%) by Berenholtz et al. at the Johns Hopkins Hospital before their intervention.[18] This comparison gives us some optimism that implementation of an intervention to improve central line management practice would be worthwhile in Mongolia. Additionally, the WHO's Safe Surgery Saves Lives program demonstrated that a surgical safety checklist program reduced morbidity and mortality in resource-limited countries such as India, Jordan, the Philippines, and Tanzania.[12,16]

In conclusion, the study results demonstrate that the health authorities of Mongolia need to improve the prevention and control of CLABSIs in their hospitals. To improve adherence to evidence-based practice of central line management, current standards should be updated, guidelines should be developed, and adequate multifaceted interventions with behavioral, educational, and logistical components tailored for local needs should be carefully designed and implemented. A checklist could form a cost-effective adjunct to this approach.

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