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An evaluation of infection control in private and public sector intensive care units in South Africa

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Abstract

Background: Appropriate infection control policies and practices are key to reducing the risk of healthcare-associated infections in patients in intensive care units (ICUs).

Objective: To evaluate infection control in ICUs using the Infection Control Assessment Tool (ICAT).

Methods: Six public and five private adult ICUs were included. Seven modules from the ICAT were administered including ICU, hand hygiene, and isolation and standard precautions. Modules were scored on a quantitative scale as per the tool guidelines and trained independent nurses observed practices.

Results: All ICUs reported to have a 1:1 nurse-to-patient ratio. One public ICU did not have the required 1:2 hand wash basin-to-bed ratio. We observed 100% adherence to handwashing or alcohol rub at each of the five moments of hand hygiene; however, the correct amount of alcohol rub was used in only 2% (n = 2) of the 117 observations. The median score for isolation and standard precautions was 79%.

Discussion: There was good infection control practice in ICUs. However, ICUs did not have isolation policies for all the infections listed in the ICAT and did not screen visitors to the ICU. We identified shortcomings in the ICAT and a more suitable tool is required for our healthcare setting.

Keywords

Hand hygiene, infection control assessment tool, isolation and standard precautions

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Background

Patients in intensive care units (ICUs) are particularly vulnerable to healthcare-associated infections (HCAIs) where up to 50% of patients can acquire an infection during their admission (Bagheri Nejad et al., 2011). Appropriate and evidence-based infection control policies and practices are key elements to reduce the burden of these infections.

In the last two decades, there has been an increase in the reporting of outbreaks of HCAIs in South Africa. These outbreaks frequently occur in neonatal units, involve multidrug resistant organisms and have resulted in high morbidity and mortality (Dramowski et al., 2017; Rothe et al., 2013). Deficiencies in infection control practices have been found to be a major contributor to these outbreaks. The National Core Standards for Health Establishments in South Africa is a set of guidelines implemented in 2011 to improve the overall quality of healthcare to patients. Substandard infection control has been recognised as a key

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issue, and infection control has been identified as a 'fast-track' area, indicating that healthcare facilities must aim to comply with the standards for infection control as a priority (National Department of Health, 2011).

Checklists and audits of infection control practice are frequently used to monitor compliance to infection control policies. The Infection Control Assessment Tool (ICAT) is a systematic approach to conducting a comprehensive evaluation of infection control in healthcare facilities in low- and middle-income countries (LMICs). The tool was developed by the United States Agency for International Development and the South African version of the ICAT is derived from the generic ICAT which was field-tested and adapted for use in South Africa in 2009 and revised in 2014 (South African National Department of Health, 2014). The tool consists of 22 modules that are structured in a simple, user-friendly manner to easily identify deficiencies in infection control activities in order to improve specific areas and procedures within a healthcare facility. The ICAT can be used in its entirety or individual modules can be applied to assess specific activities.

Aim of the study

The utility of the ICAT in South African ICU settings has not been investigated. Furthermore, there has not been a comparison of infection control in private and public sector healthcare facilities. In this paper, we report on an evaluation of infection control practices in public and private sector ICUs in South Africa.

Methods

Study design and setting: A descriptive cross-sectional design was used. We used a purposive sample of six public and five private sector adult ICUs in the province of KwaZulu-Natal (KZN). The ICUs in the public sector included three general (medical and surgical), one trauma, one cardiothoracic and one neurosurgical ICU. In the private sector, the sample included two medical, two surgical and one cardiac ICU. The study was conducted in 2014 and 2015.

Data collection and processing: Seven ICAT modules were used: ICU; airway suctioning; hand hygiene (HH); isolation and standard precautions; intravenous (IV) catheters; IV fluids and medications; and urinary catheters. Each module covers procedures and practices related to its topic (Table 1). A minor modification was made in the section on prophylaxis and monitoring in the ICU module, to the question on monitoring of patients' blood glucose levels. We used a range of values for the blood glucose levels instead of an absolute value. We found that the scoring for a question in the isolation and standard precautions module was incorrect. The question was 'How often are the number of isolation rooms and/or the capacity of the airborne diseases ward *not* sufficient for the number of patients requiring isolation?' A mark was allocated if the answer was 'usually' or 'always', whereas the mark should have been allocated if the answer was 'never' or 'sometimes'. The scoring for this question was adjusted accordingly before data collection. Each module in the ICAT has sections of related questions that can be answered either by yes/no, multiple choice or checklist responses. The tool is available for free download (South African National Department of Health, 2014). The ICAT was administered by the principal investigator who interviewed the nursing manager of each of the ICUs.

Trained independent nurses observed the practices related to each module. These observations were intended to confirm whether reported responses were in keeping with what was practised in the ICU so the observers used the same questions that were administered during the interview and indicated with a yes/no whether the practice was carried out. These observations included any healthcare worker in the ICU during the observation period and were not quantified. The nursing notes were checked to determine timing of change of IV and urinary catheters. The ICU managers were informed of the days when the observers would be in the ICU, but the staff were not made aware of what was being observed. HH and injection administration were observed in the public ICUs using the ICAT checklists. In addition, the amount of alcohol rub used (palmful or not) and duration of procedure (20–30 s) was assessed (Table 2). The following aspects were assessed for injection administration: (1) was HH practised before injection administration; (2) were sterile needle and syringe used; (3) was the vial disinfected with alcohol; (4) was sterile cotton or gauze used to break the ampoule; (5) if a multi-dose vial was used, was there closed storage thereafter; (6) were clean, single-use gloves used for IV injection; (7) were the skin and IV port disinfected with alcohol; (8) were sharps disposed of in a yellow sharps container; and (9) was HH practised after injection was administered. The questionnaires and observation checklists were checked for completeness before entering the data into a Microsoft Excel database.

Data analysis: A correct or recommended response carries a point value (range of 0–3 points as per the ICAT assessment criteria) and points for each section were tallied. We calculated the median score and range for each module and sections within each module. The observation checklists for HH and injection administration were scored separately. Adherence to HH was calculated as a percentage of the total number of checks in each column divided by the total number of encounters.

Permission and ethics: Permission was obtained from each hospital manager and the KZN Department of Health. Ethics approval was obtained from the Biomedical Research and Ethics Committee at the University of KZN (BE53/14).

Table 1. Aspects assessed per section and module of the ICAT.

Module	Section	Aspects assessed
ICU	Staffing	Nursing staff-to-bed ratio
	General practices	Cleaning of the ICU
		Staff HH
	Mechanical ventilation	Handling of ventilator circuits and humidifiers
	Prophylaxis and monitoring	Written procedures
		Prophylaxis for deep vein thrombosis, stress ulcers and ventilator-associated pneumonia
		Blood glucose monitoring
HH	Equipment and supplies	Availability of equipment and supplies for good HH practices
	Practices	HH practices
Airway suctioning		Airway suctioning fluids
		Changing and storage of suction catheters
		General infection control practices
Isolation and standard precautions	Isolation policies and precautions	Policies and precautions for isolating patients with potential contagious infections to prevent the spread to other patients and to healthcare workers
	Supplies for isolation precautions	Supplies available for isolation precautions
	Precautions for other airborne diseases (excluding tuberculosis)	Where patients are isolated; capacity of the isolation rooms
IV catheters		Type of catheters used
		Frequency of changing IV catheter
		Type of skin antiseptic used
IV fluids and medications		Preparation of intravenous fluids
		Handling and changing infusion tubing
		Procedures for using single or multi-dose vials of injectable fluids
Urinary catheters	Procedures for use of indwelling urinary catheters	Indications for use of indwelling urinary catheters
		Procedures for changing urinary catheters Supply of catheters
	Procedures for insertion and maintenance of urinary catheters	Use of gloves; type of antiseptic used; placement of bag

Results

The overall median scores obtained by the ICUs was above 75% for five of the seven modules. The scores obtained are compared between the private and public ICUs (Table 3).

ICU: All ICUs reported to have sufficient nursing staff with a 1:1 nurse-to-patient ratio. The lower score obtained by the public ICUs for general practices was due to three of the ICUs requiring the staff to put on a gown or apron when entering the ICU. None of the ICUs scored full marks in the general practices section as the question on the method used for HH gave a point for waterless alcohol hand antiseptic and a point for using a 'very soft brushes with soap or antiseptic agent', and none of the ICUs used brushes for HH.

In the section on mechanical ventilation, the median score was 50% with private ICUs having a lower score of 33%. The low scores in this section were due to variation in the handling of the ventilator circuit and humidifiers across ICUs. All ICUs provided eligible patients with prophylaxis for stress ulcers and deep vein thrombosis, but differed in their screening of patients' readiness for extubation.

Hand hygiene: All the ICUs scored 100% in the section on HH practices. In the section on HH equipment and supplies, one public ICU did not meet the ratio of at least one hand wash basin to two beds.

Airway suctioning: The overall median score was 91%. None of the ICUs complied with the recommended frequency of change of the airway suction catheter (at least

Table 2. Observation checklist for HH practices adapted from the ICAT.

Patient bed no.	Type of health worker			Type of HH before patient contact					Type of HH after patient contact					Type of HH after body fluid exposure					Type of HH after contact with patient surroundings					Type of HH before an aseptic procedure				
	Doctor	Nurse	Other	Hand washing	Alcohol rub	Palmful	Duration	None	Hand washing	Alcohol rub	Palmful	Duration	None	Hand washing	Alcohol rub	Palmful	Duration	None	Hand washing	Alcohol rub	Palmful	Duration	None	Hand washing	Alcohol rub	Palmful	Duration	None
Total																												

once every shift). Some ICUs did not comply with the frequency of change of the nebuliser.

Isolation and standard precautions: The difference in scoring between the private and public ICUs was due to some ICUs not having policies posted on walls and the number of infections for which ICUs had specific isolation precautions. None of the ICUs had a policy for screening and restricting visitors with illnesses. In the section on precautions for other airborne diseases, all the private ICUs scored 100% compared to four of the six public ICUs.

Intravenous catheters: The lower score in public ICUs was due to the ICUs not practising the routine changing of peripheral IV catheters within or after 72 h. In the question on the type of antiseptic used for inserting IV catheters, there were six options which scored a point each. All the ICUs used chlorhexidine only, and therefore did not score the full points for this question. There were multiple options for the type of catheter used for central venous access and ICUs lost points if they only used one type.

Intravenous fluids and medications: The median score in public and private ICUs was 65%. Premixed IV fluids were commercially sourced and the commercial IV infusion tubing was always compatible with the bottles or bags used in the unit. All ICUs reported that admixture of standard IV fluids (e.g. adding potassium chloride) was at the patient bedside and not at the pharmacy as recommended in the ICAT. All ICUs also reported to change the infusion tubing of blood products only when the infusion was complete. There was variation in the changing of the infusion tubing for total parenteral nutrition fluids and dextrose/saline fluids. All the public ICUs and three private ICUs reported to change total parenteral nutrition fluid infusion tubing every 12–24 h. In two private ICUs, this infusion tubing was changed when the infusion was complete. In the public ICUs, the infusion tubing for dextrose/normal saline was changed every 72 h or when the infusion was complete, and all private ICUs changed this infusion tubing every 72 h. One ICU had a written policy for the handling and storage of multi-dose vials.

Urinary catheter: In the section on the use of an indwelling catheter, the overall median score was 67%. None of the ICU managers listed all the indications for an indwelling catheter; and all the ICUs reported to have a written policy to routinely change an indwelling urinary catheter. In the question on how to obtain a urine sample from a patient with an indwelling catheter, there were two options that scored a point each: aspirate through special aspiration port or aspirate through catheter or collection tubing. In all the ICUs, only one method was used (aspirate through special aspiration port); therefore, none scored fully on this question.

Observations

From the observations conducted for each of the modules, we found no differences in reported and actual practices. All four ICUs had 100% adherence to handwashing or alcohol rub at each of the five moments of HH. Of the 117 observations where alcohol rub was used, only 2% (n = 2) included a palmful of alcohol rub and 77% (n = 90) practised for the appropriate duration. In 68% (n = 80) of observations, healthcare workers performed both handwashing and alcohol rub at each of the five moments of HH.

All injections (n = 82) were administered by nursing staff. There was 87% and 97% adherence for performing HH before and after injection administration, respectively; 97% adherence to disinfecting the vial with alcohol and using clean single use gloves for IV injection; and 87% adherence to using sterile cotton gauze to break the vial, and to disinfecting the skin or IV port with alcohol. All the observations were 100% adherent to using a sterile needle and syringe and discarding the sharps in a dedicated sharps container.

Discussion

This multicentre study demonstrated that infection control is generally well practised in ICUs. In modules where an ICU achieved low scores, this was mainly related to the design of the tool rather than inadequate infection control

Table 3. Percentage of recommended infection control practices in ICUs, South Africa, 2014–2015.

Module and section	Public ICUs Median score (range)	Private ICUs Median score (range)	All ICUs Median score
Intensive care unit			
Staffing	100	100	100
General practices	67 (67–83)	83 (0)	83
Mechanical ventilation	50 (33–50)	33 (17–67)	50
Prophylaxis and monitoring	85 (70–91)	87 (87–91)	87
Overall module	77 (70–81)	81 (79–91)	78
Airway suctioning	82 (64–91)	91 (45–91)	91
HH			
Equipment and supplies	100 (95–100)	100	100
Practices	100	100	100
Overall module	100	100	100
Isolation and standard precautions			
Isolation policies and precautions	69 (46–83)	79 (79–83)	79
Supplies for isolation precautions	100	100	100
Precautions for other airborne diseases	100	100	100
Overall module	89 (73–94)	93 (90–94)	93
Intravenous catheters	55 (52–62)	66 (62–66)	62
Intravenous fluids and medications	65 (45–80)	65 (50–70)	65
Urinary catheters			
Use of indwelling urinary catheters	67 (67–80)	73 (60–73)	67
Insertion and maintenance of urinary catheters	100 (80–100)	100	100
Overall module	80 (76–80)	84 (76–84)	80

practice. In some modules, there were questions where only one of the recommended options was applicable to an ICU and the ICU did not score points for the other recommended options. The ICAT has been used to assess infection control related surgical practices at six health facilities in six LMICs, and the researchers also highlighted the limitation of the ICAT in producing falsely low scores (Weinshal et al., 2015).

However, there were some deficiencies in infection control practice noted.

The routine use of aprons or gowns is not recommended as it has not been shown to reduce infection rates in ICUs. The use of disposable aprons is to protect the clothing from spills or sprays and should be changed between patients (Loveday et al., 2014; Pratt et al., 2007). Anecdotal reports from the staff in ICUs that require the use of aprons suggest that some staff do not change their apron between patients. This practice may result in increased risk of transmission of infections between patients or between patients and healthcare workers. The use of soft brushes for routine HH is not recommended as it may result in increased bacterial shedding due to damage of the skin (Boyce and Pittet, 2002).

Our results indicate that isolation and standard precautions is an area that requires attention in all the ICUs in our study. The lack of guidelines on some infectious diseases may result in practices that pose an increased risk of transmission of pathogens between patients, between healthcare workers and patients, and between visitors to the ICU and patients. The counselling of family members and visitors on the risks of patients acquiring an infection should be mandatory as advocated by the World Health Organization (Reid, 2001). While the active screening of visitors may be impractical, clear posters outside the ICU should indicate that visitors should avoid their visit if they are ill, particularly with a respiratory infection. The lack of sufficient isolation facilities in public ICUs is in keeping with the under-resourced public healthcare system in South Africa.

The ICAT-recommended practice for changing of infusion tubing is based on the 2002 Centers for Disease Control and Prevention (CDC) Guidelines for the Prevention of Intravascular Catheter-Related Infections. The current CDC guidelines recommend that infusion tubing that is not for blood products or fat emulsions should be changed not more frequently than every 96 h (CDC, 2011). More recent

research has indicated that replacing of peripheral venous catheters on a clinical needs basis, rather than on a routine basis, does not increase the risk of infection (Brown and Rowland, 2013). The ICAT is also in discord with the CDC guidelines with regard to the infusion tubing for blood and total parenteral nutrition fluids which recommends that this type on infusion tubing should be changed within 24 h of initiating the infusion (CDC, 2011). Those ICUs that were practising current guidelines with regard to changing of infusion tubing lost points for these questions.

In the urinary catheter module, there were questions that test theoretical knowledge rather than actual practice, such as the indications for an indwelling urinary catheter. In all the ICUs, the nurses obtained a urinary specimen from the aspiration port, as recommended in the CDC Guidelines for the Prevention of Catheter-Associated Urinary Tract Infections. An aseptic specimen from the drainage bag is recommended if a large volume of specimen is required (CDC, 2009). The question on obtaining a urine specimen should be rephrased such that an ICU does not lose a point because they only use one method of obtaining a urine specimen. All ICUs had a policy to routinely change indwelling catheters, which is not recommended in the ICAT, nor in current CDC guidelines (CDC, 2009). Some aspects of the ICAT were not applicable to our healthcare setting, such as the use of a feeding tube as a urinary catheter, indicating that this tool may be suited to extremely resource-constrained healthcare settings. In the section on mechanical ventilation and the module on airway suctioning, the ICAT is not appropriate for the ventilator circuits that are in use in our ICUs.

Our observed 100% adherence to HH at each of the five recommended points is much higher than the below 50% adherence reported in a systematic review in ICU settings (Erasmus et al., 2010). It is also higher than more recent reports from ICUs at a tertiary hospital in India (52% before and 63% after a HH education program) (Taneja and Mishra, 2015) and in multiple ICUs in Japan (Sakihama et al., 2016). This high adherence to HH may be due increased efforts and HH campaigns by the National and Provincial Departments of Health to encourage healthcare workers to adhere to HH principles. Although staff were not aware of what practices were being observed, the excellent adherence may be attributed to the Hawthorne effect as has been reported in other studies (Hagel et al., 2015; Srigley et al., 2014). Observations of practice when staff are not aware that they are being observed would provide more accurate data on infection control practices. The low proportion of HH observations with the correct amount of alcohol rub used may be ascribed to dispensers used at the patient bedside which require the user to pour an amount in his/her palm. Additionally, observer bias may have affected these results as it was not possible to accurately measure how much alcohol rub a healthcare worker poured into his/her palm. However, this should still be noted as an important shortcoming as an insufficient amount of alcohol rub may result in an inadequate effect against pathogenic organisms (Boyce and Pittet, 2002).

Although the ICAT offers a systematic and fairly comprehensive method of assessing infection control practice, we found numerous aspects that could be improved. The ICAT in its current format is not ideal for comparisons between ICUs as it requires too much revision for it to be standardised across ICUs. This shortcoming was noted when trying to compare the scores between the public and private sector ICUs. The differences in scores between these sectors did not necessarily reflect better or worse infection control practices. In the public sector, some ICUs lost points in areas pertaining to infrastructure such as not having sufficient hand wash basins or isolation rooms. In the study that used the ICAT to compare infection control in healthcare facilities across six countries, the researchers removed questions that were not applicable to a site, reported on the scores for each site and provided reasons for low scores, but also did not make conclusions on whether infection control was better at a site based on the score achieved (Weinshal et al., 2015).

Many of the recommendations are not aligned to current infection control guidelines and the ICAT therefore requires an update with input from a multidisciplinary team including nurses, clinicians, microbiologists and hospital management. A noticeable deficiency in the ICAT is the lack of assessment of whether ICUs collect data on HCAIs and how these data are used to direct infection prevention activities within the ICU. This is an integral component that can be used to improve the quality of care of patients and is included in the CDC Infection Control Assessment for Acute Care Hospitals (CDC, 2016).

One of the limitations of this study is the observation of practices in the ICUs during the day shift only. Research has shown that the quality and safety of nursing care differed between nurses working the day shift, night shift and a rotating shift, with better quality and safety being reported during the day shift (Gómez-García et al., 2016). While the small sample size is a limitation, infection control is likely to be similar in other ICUs in KZN. This deduction is supported by anecdotal information from clinicians and nurses that work in both the public and private sectors.

Conclusion

We identified important deficiencies in the use of the ICAT in South African ICUs and a more appropriate tool is required in our healthcare setting. Infection control is an evolving area and guidelines and tools must be updated regularly to ensure that patients are being provided with a standard of care that minimises their risk of acquiring a HCAI.

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