

Care and infection control measures in the intensive care unit with emphasis on nursing roles: narrative review

ABSTRACT

Healthcare-associated infections (HAIs), particularly those caused by antimicrobial-resistant pathogens, represent a significant global public health concern. The prevention of healthcare-associated infections (HAIs) remains a primary focus of health, safety and quality programmes. Despite the advances that have been made in the field of infection prevention, the impact of HAIs is particularly significant in the Intensive Care Unit (ICU). This narrative literature review aims to examine the care and infection control measures in the ICU, with an emphasis on the roles of nurses. HAIs represent a significant public health concern in Brazil and globally, with ICUs experiencing a higher incidence. Nursing plays a pivotal role in infection control within healthcare settings, particularly in the ICU context. A number of strategies have been proposed with the aim of enhancing patient safety protocol adherence. Among these, the use of technology is highlighted as a means of bolstering success in reducing infections in the ICU environment. Furthermore, it is imperative that ongoing health education be provided in order to achieve these goals. This should include the promotion of awareness among students regarding this topic by universities.

Keywords: Healthcare-associated infection; Intensive Care Unit; Nursing.

INTRODUCTION

Healthcare-associated infections (HAIs), particularly those caused by antimicrobial-resistant pathogens, represent a significant global public health concern. The World Health Organization (WHO) estimates that HAIs are the most frequent adverse events occurring in healthcare systems worldwide, regardless of available resources. There is compelling evidence that many HAIs are preventable, resulting in prolonged hospitalisation and patient suffering [1].

Healthcare-associated infections (HAIs) remain a primary focus of health, safety, and quality programs. Despite the advances in the science of infection prevention, the impact of HAIs remains significant [2].

In high-income countries, between 4 and 8% of hospitalised patients develop healthcare-associated infections (HAIs). The transmission of multidrug-resistant organisms in a hospital setting contributes significantly to antimicrobial resistance and the associated healthcare costs. It is estimated that between 35% and 55% of HAI could be prevented with effective control measures, although the effectiveness of these measures varies considerably.

The failure to implement hospital-acquired infection prevention and control practices in high-income countries has resulted in the occurrence of severe outbreaks of emerging infections, including SARS in Toronto in 2003 and MERS in Seoul in 2015. These outbreaks have resulted in preventable deaths and have had a significant impact on society and the economy [3].

Despite the best efforts of all involved, a review indicated that hospital-acquired infections remain a significant source of morbidity and sometimes mortality. It is worth noting that the severity of the illness and the excessive workload can potentially contribute to the development of secondary infections, such as bloodstream infections and pneumonia, particularly in cases of COVID-19. It is worth noting that the proportion of preventable hospital infections can vary depending on a number of factors, including the patient population, adherence to prevention measures and the type of infection. For instance, it is possible to prevent catheter-related infections effectively with evidence-based measures. Chlorhexidine-impregnated wipes can reduce the risk of Gram-positive bacteraemia, but their use may increase the resistance of Gram-negative bacteria. Therefore, it may be advisable to use them mainly in outbreaks. It would be prudent to restrict the use of chlorhexidine in oral hygiene to groups of patients with evidence-based indications, given its possible relationship with mortality [4].

Hand hygiene is a fundamental infection control practice, widely acknowledged for its immediate effectiveness and accessibility. Nevertheless, the use of hand hygiene as a singular indicator of infection control and the moral judgement of non-adherence have generated controversy, particularly in light of questions regarding auditing methods and adherence goals. Despite the existence of significant variations, physicians' adherence to infection control policies is often lower than that of other healthcare workers. This is of significant importance, as physicians' attitudes and behaviours can influence the compliance of other hospital staff, despite their often overestimated compliance levels [3,5,6].

Healthcare-associated infections (HAIs) occur in approximately one in ten hospitalized patients from 48 hours after hospital admission to 3 days after discharge. These infections result in substantial costs, estimated at approximately \$1 billion for the National Health Service. In intensive care units across Europe, the prevalence of healthcare-associated infections (HAIs) is notably high, with an estimated incidence of approximately 20.6%. A significant proportion of these infections are associated with the use of invasive devices, including endotracheal tubes and catheters. A significant proportion of these infections can be prevented [7].

Nosocomial infections in the ICU have been demonstrated to increase mortality, morbidity, and length of stay. Furthermore, antimicrobial resistance is high due to patient severity, frequent antibiotic use, and variations in infection control. The most prevalent are ventilator-associated pneumonia, central line bloodstream infection, urinary catheter infection, and surgical site infection. The early diagnosis and proper management of nosocomial infections can improve outcomes. However, the prevention of transmission is crucial, including the implementation of hand hygiene, antimicrobial stewardship, and the establishment of standardised care protocols [8].

In light of the aforementioned issues, the objective of this study is to conduct a narrative review of the literature on care and infection control measures in the intensive care unit, with a particular focus on the performance of nurses.

LITERATURE REVIEW

It is estimated that healthcare-associated infections are a common occurrence among patients admitted to hospital, according to the World Health Organization. Annually in Europe, more than 2.5 million cases are recorded, resulting in more than 90,000 deaths attributed to six main types of healthcare-associated infections (HAIs). The acquisition of these infections is associated with an increased mortality rate and elevated treatment costs, particularly in the case of multidrug-resistant isolates. Evidence-based surveillance and prevention strategies have the potential to reduce the incidence of HAIs by up to 70% by encouraging improvements in infection control policies, which can be supported by technological advances [9].

Intensive care units (ICUs) present a specific scenario in which healthcare-associated infections (HAIs) are acquired at a higher rate and have higher mortality. In Serbia, isolated reports from single ICU centres were published and analysed the neonatal population, risk factors for acquisition in trauma patients, and patterns of antimicrobial resistance of specific isolates [10].

The most effective method of preventing and controlling healthcare-associated infections (HAIs) is the identification and reporting of cases through the use of a standardised classification system. This is crucial for the effective surveillance of HAIs. This process is of the utmost importance in the effective implementation of infection control programmes,

which are designed to provide quality data for the monitoring and alerting of preventable infections. The process of HAI surveillance is cyclical, encompassing the recognition of events, the collection of data, the analysis, interpretation and dissemination of results. Conventional surveillance techniques are costly, reliant on manual data collection, and prone to inconsistency in quality [11].

A study was conducted with the aim of assessing the prevalence of HAIs in medical ICUs, identifying the risk factors for these infections and determining the predominant infecting organisms in Tunisia. A total of 103 patients were selected from 15 medical ICUs in Tunisia for inclusion in the study. We may therefore infer that the prevalence of HAIs was approximately 25.2% (95% CI [15-35]). It would seem that the most frequent HAIs were hospital-acquired pneumonia in 19 cases (59%) and catheter-related infection in 5 cases (15%). The results suggest that there may be an association between the occurrence of HAIs and two factors: a SAPSII score of 33 or above (with an OR of 1.047; 95% CI [1.015-1.077], $p=0.003$) and recent hospitalisation (with an OR of 4.14; 95% CI [1.235-13.889], $p=0.021$). The most frequently reported microorganisms in the ICU environment, previous colonization, and HAIs of the patients examined were non-fermenting pathogens. HAIs are a significant concern in medical ICUs in Tunisia, underscoring the need for targeted surveillance and infection control measures for critically ill patients. Establishing a national HAI monitoring system could be a valuable public health initiative in Tunisia [12].

Urinary tract infection (UTI) and Gram-negative bloodstream infection represent significant causes of healthcare-associated infections (HAIs). The insertion of urinary catheters is often undertaken without a clear indication and with the catheter in situ for extended periods, increasing the risk of infection and contributing to the burden of healthcare-associated infections (HAIs) [13].

A multitude of bacterial pathogens, including Methicillin-Resistant *Staphylococcus Aureus* (MRSA), *Klebsiella*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Acinetobacterbaumannii*, and *Enterococcus*, are associated with nosocomial infections in intensive care units (ICUs). MRSA, which is particularly prevalent in developing countries, can persist for weeks on dry hospital surfaces. The increasing prevalence of this pathogen in ICUs, even in locations with rigorous infection control measures, is a cause for concern. The rate of contamination varies between hospitals due to a number of factors, including the configuration of wards, the implementation of hand hygiene protocols, and the prevalence of carriers among staff. MRSA infections in the ICU are associated with prolonged hospital

stays, adverse outcomes, and high mortality rates. Among affected patients, approximately 20% die [14].

It has been observed that frequently touched surfaces, instruments, and objects, including bed rails, floors, stethoscopes, and doorknobs, are more likely to be contaminated with bacterial agents. The microbes involved tend to be more challenging to eradicate, largely due to the high prevalence of antibiotic resistance. The objective of this study was to evaluate the prevalence and extent of bacterial contamination on inanimate objects that are frequently touched in intensive care units. Despite the increased incidence of hospital-acquired infections in intensive care units, there is a paucity of data regarding contamination in Nepalese hospitals. A bacteriological examination of frequently touched sites and the identification of areas colonised by potential pathogens would facilitate the formulation of effective cleaning and disinfection strategies in intensive care units, with the aim of minimising the incidence of nosocomial infections [15,16].

A substantial body of research has demonstrated that mobile phones serve as a reservoir for nosocomial infections. In addition to serving as a reservoir for HAIs, these bacteria can also exhibit multidrug resistance. In addition, respiratory epidemic viruses with a potential known nosocomial association can survive on surfaces for days or even months. These surfaces include the mobile phone. Babies admitted to the neonatal intensive care unit (NICU) often have an immature immune system, rendering them susceptible to infection. It is well established that infections can result in poor outcomes in newborns, including neurodevelopmental impairment and death. In healthcare settings, the extensive literature indicates that healthcare workers play a pivotal role in the transmission of infections. The bacteria are transmitted from healthcare workers to patients via contaminated hands. Nosocomial infections result in prolonged hospital stays, increased resistance of microorganisms to antibiotics, and long-term disability on a daily basis. Furthermore, this results in increased costs for the healthcare system, for patients and their families, and even in deaths that could have been prevented [17].

A research study was conducted to examine the implementation of measures by nurses in the intensive care units of a university hospital in Istanbul to prevent infections acquired during hospital stays. The study focused on a number of key areas, including procedures such as intravenous and urinary catheterisation, the prevention of ventilator-associated infections, and the management of surgical site infections. The findings indicated that a mere 8.2% of nurses consistently adhered to all recommended preventive measures against hospital-acquired infections. Compliance rates differed across different practices. The

findings revealed that 67.1% of nurses consistently adhered to the recommended preventive measures against surgical site infections, 72.9% for catheter-related urinary tract infections, 27.1% for ventilator-associated infections, 29.4% for isolation protocols, and 62.5% for device sterilisation or disinfection. The study concludes that updated guidelines and ongoing training are essential to enhance adherence to effective infection prevention practices in intensive care unit settings [18].

A study was conducted to examine the familiarity and adherence of Chinese ICU nurses to evidence-based guidelines aimed at preventing Central Line-Associated Bloodstream Infections (CLABSI), as outlined by the U.S. Centers for Disease Control and Prevention and the U.K. Department of Health. The scores of individual participants on these guidelines were found to be significantly influenced by a number of variables, including gender, years of experience in ICU nursing, educational attainment, professional rank, type of healthcare facility, hospital classification, and the incidence of CLABI within the ICU where the participant worked. It is noteworthy that the findings revealed that only 43% of nurses consistently employed maximum-barrier precautions, 14% never utilised chlorhexidine gluconate, 2% for site antisepsis during catheter insertion, only 40% adhered to recommendations for prompt catheter removal when no longer necessary, and 33% routinely exchanged catheters even without suspected infection. These findings highlight a significant discrepancy between the knowledge and adherence to evidence-based guidelines among ICU nurses in Guangdong province regarding the prevention of CLABI. It is recommended that national health authorities implement policies aimed at enhancing training for ICU nurses in order to mitigate the incidence of CLABI effectively [19].

Another study was conducted with the objective of elucidating key concepts and knowledge gaps in the field of technology in nursing and in the area of infectious diseases and infection control. The study identified five major trends in nursing and infectious disease technology: artificial intelligence, the Internet of Things, information and communication technology, simulation technology, and e-learning. These findings indicate the most promising trend, given the numerous positive effects validated in the majority of the studies reviewed. The application of technology in healthcare has facilitated the automation of daily clinical practice and clinical processes, including the use of electronic medical records and health information technology. The utilisation of bulk data logging enables hospitals to develop efficient clinical workflows and facilitate decision-making processes, thereby improving patient safety [20].

One study investigated the adherence of neonatal intensive care unit nurses to standard infection control precautions, utilising the Standard Precautions Compliance Scale (ECCPP) in the Arabic version. The overall compliance rate was suboptimal, with 66.7% of participants demonstrating inadequate adherence. This was observed to be higher for the disposal of sharps in appropriate boxes (86.2%) and lower for the correct disposal of boxes (27.6%). Those with more clinical experience demonstrated superior adherence to protection and disposal practices ($P=0.024$ and $P=0.003$, respectively), indicating that educational experience and qualifications are crucial in influencing adherence to infection control practices. The study recommends the implementation of evidence-based continuing education to integrate theoretical knowledge with clinical practice. This should emphasise the importance of accurate implementation of infection prevention and control precautions [21].

A further study examined the impact of a virtual reality simulation programme on the knowledge, self-efficacy and satisfaction of Korean nursing students. The experimental group demonstrated significantly greater improvements in self-efficacy of high-risk neonatal infection control performance ($t = -2.16$, $p = 0.018$) and student satisfaction ($t = -5.59$, $p < 0.001$) in comparison to the control group. The virtual reality simulation programme offers nursing students the opportunity to gain hands-on experience in a safe virtual environment, which in turn enhances their performance self-efficacy and learning satisfaction [22].

A survey was conducted to evaluate the practice of hand hygiene in the neonatal ICU of the Benha University Hospital. The results revealed that 7.1% of nurses followed the recommended practices with precision (class A), while 75% generally followed standard practices (class B) and 17.9% required additional training and monitoring (class C). A significant association was observed between educational background and previous courses in infection control and the practice of adequate hand hygiene ($P < 0.05$). The research findings underscore the pressing necessity for enhanced educational and training initiatives to enhance adherence to hand hygiene among healthcare workers in that setting [23].

Another study addressed the use of scales as a tool for work, developing a scale to measure the competence of nurses in Neonatal Intensive Care Units (NICU) in the management of high-risk neonatal infections. The scale was designed to measure high-risk neonatal infection control competence in terms of performance and knowledge. The former was addressed by 42 items, while the latter was addressed by 54 items. The scale was initially subjected to content validity testing by a panel of neonatal nursing experts. The items were divided into five factors. The scale comprises five domains: (1) basic care, (2) skin care, (3) food management, (4) medications and invasive procedures, and (5) environmental

management. The panel of neonatal nursing experts concluded that the scale could be used to assess performance and knowledge in relation to infection control competence among neonatal nurses. Furthermore, they suggested that its application could support the strengthening of infection control education for nurses with low performance scores and knowledge competence [24].

One study indicated that there may be value in considering ways to strengthen the foundation of sepsis education and training programmes, as well as the implementation of sepsis screening tools and care packages. This could potentially enhance nurses' knowledge and confidence in recognising and treating patients with sepsis [25].

A systematic review identified six articles that examined nurses' adherence to patient safety principles during clinical interventions. The studies encompassed a diverse range of practices, including catheter management, surgical hand hygiene, double-checking medications, transferring nursing between wards, cardiac monitoring, and infection precautions. A number of factors were identified as influencing adherence, including patient participation, the knowledge and attitudes of health professionals, collaboration among nurses, the use of appropriate electronic equipment, education, regular feedback, and standardisation of care. The findings of the research indicate a need for further studies to enhance the understanding and implementation of patient safety practices among nurses [26].

The Norwegian study sought to elucidate the perspectives of intensive care nurses on the utilisation of a standardised procedure for central venous catheter access with the objective of preventing bacterial contamination. Three main themes emerged from the analysis: varying levels of knowledge and commitment to the procedure among nurses, risk desensitisation due to routine catheter use and acute situations, and the positive impact of professional work culture on adherence to safety protocols. These findings emphasise the multifaceted nature of the factors influencing nurse behaviour in critical care settings, underscoring the necessity for enhanced education and supportive workplace interactions to enhance patient safety [27].

Nurses possess a comprehensive understanding of hospital infection control and undergo regular training to maintain their expertise in this field. The environment represents a potential risk factor for infection, given the vulnerabilities of patients. The adult ICU is a closed environment with restricted access, equipped with air conditioning, and the temperature is conducive to the proliferation of microorganisms, which increases the risk of infections. Furthermore, the utilisation of invasive procedures that facilitate the ingress of pathogens. The prolonged use of broad-spectrum antibiotics in patients can lead to the

development of antimicrobial resistance. Furthermore, the rotation of different healthcare professionals introduces an additional risk factor. Correct hand hygiene is a fundamental measure in reducing this problem. It is recommended that all professional categories receive ongoing education, as well as that they assume joint responsibility for the care provided. The following five classes of infection control are of particular importance: frequent hand washing, adherence to contact precautions, use and PPE, and following the institution's cleaning and disinfection protocols. Additionally, it is crucial to understand how to sterilize materials after each use [28].

It is essential to consider all potential strategies that could facilitate changes in the current scenario. Nurses must possess knowledge about the methods to inhibit the spread of pathogens, which will contribute to the delivery of high-quality patient care. They must also implement guidelines and continuous actions to prevent, control, reduce and eliminate risks, through appropriate work routines and by maintaining constant vigilance and adhering to hand hygiene protocols [29].

Conclusion

HAI represent a significant public health concern in Brazil and globally, with ICU-related cases being particularly prevalent. Nursing plays a pivotal role in the control of infections associated with health services in the ICU context. A number of strategies have been employed to enhance adherence to patient safety protocols. However, the use of technologies to enhance the process and facilitate the reduction of infections in the ICU environment has been identified as a particularly promising approach.

In addition to the necessity of continuing education in health to achieve this goal, it is also important to promote education in universities among university students on the subject.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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