

The Role of Nurses and Sterilization in Healthcare: A Theoretical Approach to Infection Prevention Strategies

**Seham Salem Saeed Baalkhuyur
Eiman Ali Baokbah
Iman Abdulrahman Al Makki
Kawthar Mohammad Ramzi Khayat
Haneen Ahmed Al Beshy
Ghadir Abdulsatar Miezi
Halima Ali Al Gubesh
Roaya Ahmad Bugis
Khaled Abdullah Al Ofi
Amal Zolan Al Darbi
Abrar Ahmed A Atiah Allah
Dalia Mohammed Kousah**

Abstract

Keeping patients safe and lowering the likelihood of healthcare-associated infections (HAIs) are two of the most important goals of infection prevention, which is an essential component of healthcare systems. The purpose of this theoretical study is to investigate the ways in which nurses and sterilization specialists provide complementary responsibilities to infection control measures. In this work, the authors draw on past research to emphasize the importance of adherence to hygiene practices by nurses, as well as the essential role that sterilization plays in reducing the spread of pathogens. Despite the fact that there is widespread agreement regarding the significance of these jobs, difficulties such as noncompliance, resource constraints, and operational inefficiencies continue to be widespread situations. In order to maximize the effectiveness of infection prevention strategies, the findings highlight the importance of fostering collaboration between nursing and sterilization teams, enhancing training, and making systemic improvements. The findings of this study contribute to a more in-depth knowledge of the ways in which theoretical frameworks might direct integrated approaches to infection control in facilities that provide medical treatment (Kammoun et al., 2021).

Keywords

Infection Prevention, Healthcare-Associated Infections (HAIs), Nurses' Roles, Sterilization Practices, Infection Control Strategies, Patient Safety, Aseptic Techniques, Theoretical Approaches.

المخلص

إن الحفاظ على سلامة المرضى وخفض احتمالات الإصابة بالعدوى المرتبطة بالرعاية الصحية هما من أهم أهداف الوقاية من العدوى، والتي تعد عنصراً أساسياً في أنظمة الرعاية الصحية. والغرض من هذه الدراسة النظرية هو التحقيق في الطرق التي توفر بها الممرضات وأخصائيو التعقيم مسؤوليات تكملية لتدابير مكافحة العدوى. في هذا العمل، يستعين المؤلفون بالبحوث السابقة للتأكيد على أهمية الالتزام بممارسات النظافة من قبل الممرضات، فضلاً عن الدور الأساسي الذي يلعبه التعقيم في الحد من انتشار مسببات الأمراض. وعلى الرغم من وجود اتفاق واسع النطاق بشأن أهمية هذه الوظائف، إلا أن الصعوبات مثل عدم الامتثال، والقيود على الموارد، وعدم الكفاءة التشغيلية لا تزال تشكل مواقف واسعة النطاق. ومن أجل تعظيم فعالية استراتيجيات الوقاية من العدوى، تسلط النتائج الضوء على أهمية تعزيز التعاون بين فرق التمريض والتعقيم، وتعزيز التدريب، وإجراء تحسينات منهجية. تساهم نتائج هذه الدراسة في معرفة أكثر عمقاً بالطرق التي قد توجه بها الأطر النظرية النهج المتكاملة لمكافحة العدوى في المرافق التي تقدم العلاج الطبي.

الكلمات الرئيسية

الوقاية من العدوى، العدوى المرتبطة بالرعاية الصحية، أدوار الممرضات، ممارسات التعقيم، استراتيجيات مكافحة العدوى، سلامة المرضى، التقنيات المعقدة، المناهج النظرية.

Introduction

The prevention of infections is an essential component of contemporary medical treatment, as it has a direct influence on the results for patients and the overall quality of care. HAIs, which are infections that are related with healthcare, continue to be a serious problem all over the world, resulting in higher rates of morbidity and mortality as well as higher expenses for healthcare. Sterilisation specialists and nurses both play important roles in the fight against healthcare-associated infections (HAIs), and the joint efforts of these two groups are the foundation of infection prevention initiatives. Sterilisation professionals are primarily concerned with removing germs from medical equipment and settings, whereas nurses are accountable for ensuring that hygiene regulations are adhered to and providing safe patient care.

The success of these techniques is hindered by gaps in compliance, differences in resource allocation, and systemic inefficiencies, despite the fact that there have been breakthroughs in infection control practices. For the purpose of gaining a more in-depth comprehension of the roles that nursing and sterilisation play in the prevention of infections, theoretical frameworks provide a beneficial prism through which to evaluate the integration of nursing and sterilisation activities (West, 2021).

The purpose of this research is to investigate the theoretical contributions that were made by sterilisation professionals and nurses to the development of infection prevention measures. The purpose of this work is to identify areas of consensus and contention, assess obstacles, and recommend solutions to promote collaboration between these two fields. This is accomplished by evaluating and synthesising the available literature. These findings highlight how important it is for healthcare providers to take a theory-driven, holistic approach to infection prevention.

Problem Statement:

Infection prevention is a crucial aspect of healthcare, yet healthcare-associated infections (HAIs) continue to threaten patient safety, leading to significant morbidity, mortality, and financial burdens. Nurses and sterilization specialists play vital roles in mitigating these risks, but challenges such as noncompliance with protocols, inadequate training, and systemic inefficiencies hinder the effectiveness of infection prevention strategies.

Furthermore, the integration of nursing care and sterilization practices is often overlooked in infection control discussions, despite their synergistic potential. The lack of theoretical exploration of these roles in tandem creates a gap in understanding how these professionals can collaboratively enhance infection prevention efforts.

This research seeks to address this gap by exploring the theoretical contributions of nurses and sterilization practices to infection prevention strategies. It aims to highlight areas of consensus, identify challenges, and propose solutions to improve collaboration and efficiency in infection control practices within healthcare systems.

Research Definitions

Infection Prevention:

The application of measures designed to prevent the spread of infections within healthcare settings, including hygiene protocols, sterilization of equipment, and patient care practices.

Healthcare-Associated Infections (HAIs):

Infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting, often resulting from lapses in infection control practices.

Nurses' Roles in Infection Control:

The responsibilities of nurses in preventing infections through adherence to hygiene protocols, proper patient care, and identifying and mitigating infection risks.

Sterilization:

The process of eliminating all forms of microbial life, including bacteria, viruses, and fungi, from medical instruments, tools, and environments to ensure patient safety.

Aseptic Techniques:

Practices and procedures aimed at preventing contamination by pathogens during medical interventions or the handling of sterile equipment.

Theoretical Approaches to Infection Prevention:

Frameworks and models used to guide and analyze infection control practices, focusing on the roles of healthcare professionals and systemic improvements in healthcare facilities.

Research Aim:

To explore the theoretical aspects of nursing and sterilization in preventing infections and ensuring patient safety.

Scope:

Focuses on healthcare settings, emphasizing strategies and their theoretical basis.

Literature review

The Role of Nurses in Infection Prevention

Responsibilities in Infection Control:

They are responsible for ensuring adherence to hygiene protocols (e.g., hand hygiene, personal protective equipment use). Administering care to minimize cross-contamination (e.g., catheter care, wound management). Infection prevention and control encompasses various domains within clinical or hospital environments, including patient management, personnel health, environmental controls, and facility maintenance. The individual designated to oversee infection prevention and control in an ophthalmic unit or medical facility must possess extensive experience and may require supplementary training to provide timely guidance. Flexibility and adaptation of guidelines to particular clinical circumstances are also necessary. The infection

prevention and control nurse may be required to provide decontamination guidance for new equipment, necessitating their ability to assess, evaluate evidence, and critically appraise cleaning and disinfection products (Henderson et al., 2021).

Frequently, ambiguities will arise in infection prevention and control. The infection prevention and control nurse will base their recommendations on risk assessments, informed by an understanding of the relevant pathogens, transmission pathways, and workflow within the specialty. The guidance may vary based on the circumstances and the level of risk the hospital, as an institution, is prepared to accept. In the event of an outbreak, it may be necessary to entirely close a ward or department to new admissions, suspend all scheduled surgeries, tests, and investigations, and impose visiting restrictions, among other measures. Regrettably, a lockdown also yields adverse effects, such as people failing to obtain timely diagnosis and treatment. Isolating a patient may also adversely affect individuals with mental health concerns, which should be considered. Consideration must also be given to individual ethnic and cultural variances and requirements; a pertinent example is the issue of facial hair, which is sometimes dictated by a person's religion or culture, in relation to FFP3 mask fit testing. An additional crucial quality is the ability to communicate effectively and remain accessible to offer continuous support. Visiting and conversing with individuals is the most effective method to gain recognition and understand the realities of therapeutic settings. The discussions one can engage in on issues and enquiries that may never have been addressed in a formal context are astonishing (Kammoun et al., 2021).

Challenges for Nurses:

High workload, insufficient training, and lack of resources in certain healthcare environments are some of the main challenges that effect on nurses. According to (Alhumaid et al., 2021), several factors were found to impact the implementation of the measures. The factors are classified into systematic, organizational, environmental and individual factors. Systematic factors include material and human resources issues and policies that affect the implementation of infection control measures. The organizational factors relate to managerial style and support, interprofessional relationships and budgetary factors. Environmental factors relate to features of the physical layout of the hospital, availability of isolation rooms and hand-wash basins. The individual or personal factors relate to the knowledge, attitudes and beliefs of the individual about infection control. Some healthcare workers were not wearing personal protective equipment (PPE) when dealing with suspected infectious patients, while some were using the same PPE (gowns and masks) with all patients. The lack of sufficient PPE, high workload and lack of management support on IPC were identified as the common causes of not implementing the IPC measures. (Rutala & Weber, 2018), attest that inadequate IPC in hospitals has been shown to have several consequences. These include increased bed occupancy and a strain on drugs and other scarce hospital resources, and AMR, thus lengthening the duration of patient stay in the hospital. Furthermore, this translates into high costs for the hospital and the patient and increased social suffering for the patient and family.

While other healthcare workers (including doctors, physiotherapists and occupational health therapists) are at risk of transmitting and acquiring HAIs, the study focused on nurses because they are at higher risk of contracting and transmitting HAIs if they do not implement the IPC measures. The nurses spend most of their time with patients as compared with other healthcare workers, and they form the most significant cadre of health workers (Coban, 2020). They are, therefore, expected to lead the IPC programme and practise the measures effectively. Hence, this study aimed to explore nurses' experiences and perceptions regarding the impediments to implementing the IPC measures at the hospitals in Tshwane District, Gauteng Province, South Africa. The study is imperative in developing strategies and guidelines to promote the implementation of IPC measures.

The Role of Sterilization in Healthcare

In 2010, the United States recorded around 51.4 million inpatient surgical procedures, with a greater number of invasive medical treatments. In 2009, about 6.9 million upper gastrointestinal (GI), 11.5 million lower GI, and 228,000 biliary endoscopies were conducted.² Each of these treatments entails interaction between a medical gadget or surgical equipment and the patients' sterile tissues or mucous membranes. A significant risk associated with these treatments is the introduction of harmful microorganisms, potentially resulting in infection. Inadequate disinfection or sterilisation of equipment may result in the transfer of pathogens through contaminated medical and surgical instruments (e.g., carbapenem-resistant Enterobacteriaceae [CRE]). Ensuring disinfection and sterilization via disinfectants and sterilization protocols is crucial to prevent the transmission of infectious germs from medical and surgical instruments to patients. Health care policy must determine if cleaning, disinfection, or sterilization is required for patient-care products based on their intended use, manufacturers' recommendations, and established criteria, as not all things necessitate sterilization (Gesser-Edelsburg et al., 2021).

Numerous investigations across various nations have recorded noncompliance with prescribed disinfection and sterilization criteria. Noncompliance with evidence-based guidelines has resulted in multiple outbreaks and patient exposures. Six, seven, eight Due to noncompliance with prescribed reprocessing protocols, the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) issued a health advisory in September 2015, notifying healthcare providers and facilities of the imperative to adequately maintain, clean, disinfect, and sterilize reusable medical devices (Abou Elazayem Bayumi et al., 2022).

Integration of Nursing and Sterilization Practices

Collaboration in Infection Prevention:

Ensuring patient safety necessitates teamwork among all members of the surgical team, including professionals in the sterile processing department. Due to the tight collaboration between the operating room and the sterile processing department, it is essential for staff in both areas to cooperate effectively. Minimizing errors and miscommunications can enhance connections between people in these two areas. Strategies must emphasize the reduction of instrument set errors, the cultivation of teamwork

and constructive relationships, the enhancement of interdepartmental communication, and the assurance of compliance with policies grounded in the most recent research available (Link, 2019).

Members of the OR and the SPD operate in high-pressure environments and often experience stress. This setting might instigate conflicts and misunderstandings, resulting in detrimental interdepartmental interactions. Conflicts may emerge not just from interpersonal concerns but also from mistakes. Errors are not solely attributable to an individual and frequently come from defective systems or procedures. In addition to addressing disagreements between the OR and the SPD, it is essential for personnel in these departments to cooperate in minimizing errors. Quality enhancement solutions may involve direct communication between staff in both departments regarding work issues, identifying patterns in error types and consistency, and allocating sufficient time for training and education (Fogliatto et al., 2020).

Human variables, like as communication patterns, institutional culture, and personnel configurations, are acknowledged as essential components for establishing a secure, collaborative operating room environment. The Joint Commission emphasizes that communication among team members is a crucial aspect.

In "Teamwork—nursing and the multidisciplinary team," Diane Doran, PhD, RN, asserts that excellent communication, coordination, and collaborative decision-making are essential components of a successful team. There is no immediate solution to the enduring problems between the Operating Room and the Sterile Processing Department. The healing process might commence with the eradication of operational silos.

A primary responsibility of all perioperative managers is to advocate for their patients and safeguard them from harm. A key aspect of this role is to ensure that staff members involved in the processing of surgical instruments has comprehensive knowledge of all reprocessing facets, are integrated into the perioperative team, and have access to the requisite resources to effectively execute their duties. Managers in surgical services possess the authority and capability to implement enhancements, even if the collaboration is suboptimal (Al Ruwaili et al., 2023).

The surgical team comprises more individuals than those physically present in the operating room, and ensuring patient safety necessitates collaboration among all team members. The working connection between professionals in the operating room and the sterile processing department can be difficult due to disagreements, errors, and insufficient collaboration; yet, cultivating interdisciplinary relationships can enhance patient safety (Rutala & Weber, 2016).

Infection Prevention Strategies

Education and Training:

Continuous professional development for nurses and sterilization staff. An infection contracted by patients during medical treatment is termed a "Healthcare-Associated Infection" or "Hospital-acquired Infection" (HAI). Alternative designations for this illness are hospital infection (HI) and nosocomial infection. HAI denotes infections acquired by patients during their hospitalisation.¹ Various subtypes of HAI can be classified based on factors such as infection location, pathogen type, and timing of infection. Infections resulting from a catheter in the urinary system are termed catheter-associated urinary tract infections (CAUTIs), hospital-acquired pneumonias are referred to as HAPs, bloodstream infections are designated as BSIs, and surgical site infections are identified as SSIs.² Moreover, HAIs can be categorized into two categories based on the timing of infection: those occurring during hospitalization or treatment within the hospital, and post discharge infections associated with treatment received after discharge (Garvey, 2023).

The global incidence rates of healthcare-associated infections (HAI) vary from 3.5% to 12.0% in developed nations and from 5.7% to 19.1% in low-income and middle-income nations. The World Health Organization's (WHO) inaugural infection prevention and control (IPC) report indicates that the Western Pacific Region, encompassing China, has an estimated healthcare-associated infection (HAI) incidence rate of 9%.⁵ The incidence of healthcare-associated infections (HAI) in low-income and middle-income regions markedly surpasses the reported proportions due to insufficient detection data in these areas.⁶ HAI constitutes a substantial complication of contemporary medical treatment.

The WHO asserts that no nation or healthcare system, irrespective of its intricacy, can assert immunity from HAIs.

Healthcare-associated infections (HAIs) represent a global public health concern directly linked to diverse medical practices and healthcare activities. The attributes of HAI have evolved alongside advancements in diagnostic and therapeutic methodologies, modifications in healthcare facilities, and the progression of medical technologies. Over the past century, medical professionals have increasingly emphasized the significance of HAI, leading to the implementation of HAI management practices worldwide to mitigate the economic and health damages caused by HAIs. One of the most effective approaches is cultivating and establishing management teams. However, implementing IPC measures is contingent upon health-care workers receiving adequate training and demonstrating competence (Herwaldt & Rutala, 1998).

Challenges and Limitations

Notwithstanding breakthroughs in medical technology and therapies, there has been a worldwide increase in the incidence of hospital-acquired infections (HAIs). The World Health Organization (WHO) reports that the prevalence of healthcare-associated infections (HAIs) in hospital environments globally varies from 6% to 19.5%. Recent studies indicate a prevalence rate of 3.5% for HAIs in the United States. Nevertheless, low-resource nations endure a more significant burden of healthcare-associated infections (HAIs) in comparison to high-income countries (Panta et al., 2022).

A systematic assessment by the WHO revealed that the prevalence of healthcare-associated infections (HAIs) is roughly 7.5% in high-income countries and 15.6% in low- and middle-income countries. Healthcare-associated infections (HAIs) lead to prolonged hospitalizations, elevated death rates, and increased healthcare costs, imposing a financial burden on people, communities, and nations. The prevention and control of HAIs have become critical public health priority. The primary causes of hospital-acquired infections (HAIs) are the contaminated hands of healthcare workers (HCWs) and medical supplies. Inadequate handwashing between patient encounters may facilitate the transmission of microorganisms responsible

for healthcare-associated infections (HAIs) from one patient to another. The incidence rates of healthcare-associated infections (HAIs) varies among various clinical departments, with intensive care units (ICUs) exhibiting the highest infection rates, succeeded by infant and burn units, according to a study conducted in Norway. The World Health Organization (WHO) delineates several factors that contribute to hospital-acquired infections (HAIs), such as inadequate environmental sanitation, improper waste management, insufficient equipment and personnel, overcrowded accommodations, lack of national protocols, limited understanding and poor compliance with fundamental infection control practices, and deficient infrastructure (Balila et al., 2022).

Aseptic procedures, formulated by the Centers for Disease Control and Prevention (CDC), include certain measures vital for preventing the spread of pathogenic agents and thereby reducing the occurrence of healthcare-associated infections (HAIs). Compliance with standard precautions, encompassing practices such as hand hygiene, donning protective gowns, adequate sanitization of equipment, use of facial protection (masks and goggles), safe disposal of sharp objects, appropriate management of medical waste, and proper coughing techniques, must always be maintained. Heavy workloads, protracted clinical procedures, and dermatological disorders have been recognized as substantial impediments to adherence to hand hygiene guidelines. Therefore, it is crucial to analyze the knowledge, attitudes, and practices (KAP) of healthcare workers (HCWs) to understand the variables leading to noncompliance and to devise strategies for improving infection control measures and reducing healthcare-associated infections (HAIs). The objective of this study is to assess the knowledge level and identify the obstacles encountered by nursing personnel in the application of aseptic procedures (Mubaraki et al., 2024).

Previous studies

Following (Henderson et al., 2021), the study aims to evaluate the differing perspectives of nurses specializing in infection control and general ward nurses regarding the infection control actions that are overlooked and the underlying causes for their omission. Background Infection prevention measures are regarded as crucial for mitigating health care-acquired infections (HAIs), although their implementation is frequently inadequate. Data were gathered via the Missed Nursing Care Infection Prevention and Control (MNCIPC) Survey administered to 500 Australian nurses before to the COVID-19 pandemic. Substantial disparities were observed in the mean scores between infection control nurses and their counterparts across eleven items. In eight instances, five concerning hand hygiene, infection control specialists perceived the practice as more prone to oversight. The factors identified as significantly contributing to the neglect of infection control measures include: 'Patients sharing restrooms', 'Urgent patient circumstances', and 'Unanticipated increases in patient volume and/or acuity on the ward/unit'. Infection control nurses were more inclined to emphasize the significance of organizational and managerial elements in facilitating efficient infection control. The variability in responses across nurses indicates that ward nurses may underestimate the degree of neglect about infection control precautions. Infection control professionals are more adept at recognizing organizational impediments to successful infection control compared to other nurses. Work obligations stemming from pandemic management may lead to lapses in infection control measures.

In accordance with (Alhumaid et al., 2021), familiarity with infection prevention and control (IPC) protocols among healthcare workers (HCWs) is essential for efficient IPC. Adherence to IPC procedures is essential for the safety of healthcare workers, the protection of patients, and the integrity of the care environment. To examine the existing literature on healthcare workers' understanding of infection prevention and control and to identify relevant factors that may affect adherence to IPC protocols. A comprehensive evaluation. A protocol was established in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] declaration. Electronic databases (PubMed, CINAHL, Embase, Proquest, Wiley Online Library, Medline, and Nature) were queried from 1 January 2006 to 31 January 2021 in English, utilizing the following keywords individually or in conjunction: knowledge, awareness, healthcare workers, infection, compliance, comply, control, prevention, factors. A total of 3,417 papers were discovered, of which 30 were included in the review. The overall understanding of healthcare workers regarding infection prevention and control is deemed adequate, good, or high in relation to routine precautions, hand hygiene, and urinary catheter management. Acceptable levels of knowledge were also observed concerning IPC procedures for specific diseases, including TB, MRSA, MERS-CoV, COVID-19, and Ebola. Nonetheless, deficiencies were recognized in the knowledge of various healthcare workers on occupational vaccinations, routes of transmission of infectious illnesses, and the risk of infection associated with needle stick and sharps injuries. Various variables contributing to noncompliance with IPC requirements are examined, along with suggestions for enhancing adherence to these guidelines. A multimodal strategy to enhancing IPC intervention tactics is strongly recommended. Enhancing compliance among healthcare workers with infection prevention and control methods is essential. In accordance with (Rutala & Weber, 2018), every intrusive operation requires that a medical device or surgical instrument come into touch with the mucous membranes or sterile tissue of a patient. One of the most significant dangers associated with any of these operations is the introduction of harmful bacteria, which could result in infection. The failure to effectively disinfect or sterilize reusable medical equipment poses a risk of breaching the host barriers, which can lead to the spread of infectious diseases. Critical items, such as surgical instruments, which come into contact with sterile tissue, semi critical items, such as endoscopes, which come into contact with mucous membranes, and noncritical items, such as stethoscopes, which only come into contact with intact skin, require sterilization, high-level disinfection, and low-level disinfection, respectively. The level of disinfection or sterilization that is required for an object is determined by the intended use of the object. High-level disinfection and sterilization must always come after cleaning that has been completed. Whenever users are selecting a disinfection or sterilization technique, they are need to take into consideration the benefits and drawbacks associated with several methods. By adhering to these suggestions, health care facilities should be able to enhance their disinfection and sterilization methods, which will ultimately lead to a reduction in the number of diseases that are related with contaminated patient-care products.

Following (Panta, Richardson, & Shaw, 2019), in order to avoid the spread of pathogens during invasive clinical procedures like surgery, medical devices are sterilized before they are used. Because improper sterilization of medical devices poses a risk of healthcare-associated illnesses, it is important to take precautions. It has been suggested by various studies and publications that one of the factors contributing to a higher incidence of healthcare-associated infections in developing nations is the fact that medical devices are not effectively sterilized. Steam sterilization, also known as autoclaving, is the method of sterilization that is utilized the most frequently. It is frequently regarded as the approach that is both the most reliable and the most cost-effective for sterilizing medical devices. Biological indicators can be utilized in order to evaluate the efficacy of steam sterilization. In order to gain a better understanding of the efficacy of autoclaving in sterilizing reusable medical devices at healthcare institutions all over the world, a literature search was conducted. It was possible to collect research that utilized biological indicators for the purpose of determining how successful autoclaving is. Failures of steam sterilization procedures were found and discussed as a means of finding factors that might be related with the ineffectiveness of steam sterilization practices in different nations. This investigation was carried out in order to identify potential reasons. The number of research that have been conducted to measure the efficacy of steam sterilization is rather low, and even fewer studies have evaluated the efficacy of steam sterilization in developing nations. When compared to dental facilities, there are less research that have been conducted on higher level healthcare institutions. However, the findings imply that there are deficiencies in autoclave protocols and operator education. Although additional evidence regarding the efficacy of autoclaving in healthcare facilities is required to draw definitive conclusions, the data suggest that there are deficiencies. Following (Coban, 2020), through our research, we investigate the scheduling issues that arise in operating rooms (ORs) as well as the sterilization of reusable medical devices (RMDs). RMDs are the instruments that need to be sterilized before they can be used again in subsequent surgical procedures. RMDs are batch-processed and reprocessed extensively by sterilization equipment while they are being sterilized in order to reduce the risk of nosocomial infections. In contrast to other renewable resources, such as nurses or anesthesiologists, registered massage therapists (RMDs) do not become accessible for subsequent procedures immediately following the completion of the surgery in which they were utilized. An insufficient quantity of RMDs results in the postponement of surgical procedures or delays in the beginning times of some surgical procedures. In order to investigate the impact that scheduling multiple operating rooms has on the schedule for sterilizing RMDs, we use a mixed integer linear programming model to integrate the scheduling of ORs and the sterilization of RMDs. Our goal is to minimize the total cost, which includes the costs of sterilization, postponement of surgeries, and makespan. To begin, we solve the provided model in order to compute the best answer that can be discovered within the allotted amount of time for computing. Then, we address disaggregated versions of the problem: the first step seeks to schedule surgeries without taking RMDs into consideration, and the second step aims to schedule RMD sterilization given the computed surgical schedule that is utilized as the earliest time surgeries may begin. According to the first disaggregated version, additional surgery postponements are not allowed during the second phase (within the RMD sterilization schedule). On the other hand, in the second disaggregated version, additional operation postponements are allowed. We also suggest a batch-based heuristic, in which the problem is broken down into two stages: first, a mixed integer linear programming model is used to allocate surgeries to operating rooms and batches; second, an iterative approach is used to schedule surgeries based on the assignments determined by the previous stage. In addition, we also model the real-world practice of utilizing fixed sterilization periods, and we also offer a rule-of-thumb based on sorting with regard to RMD requirements and operation lengths. Both of these things are done while modelling the real-world practice. Upon conducting an analysis of the performance of various approaches, we have arrived at the conclusion that the integrated mixed integer linear programming model that we have suggested performs superiorly to the other ways in over 375 instances that involve a variety of operating rooms and surgical procedures. In the real world, the practice of scheduling sterilization with fixed time intervals results in an average gap of, whereas the first and second disaggregated techniques result in average gaps of and, respectively. Our computer results show that this is the case. In addition, the first disaggregated technique was unable to solve 311 out of 375 instances, which is a significant number. It has been established that the integration of the OR scheduling problem and the sterilization of RMDs is advantageous. Furthermore, it has been demonstrated that hospital administrations can not only reduce their overall expenses but also minimize delays that are caused by an insufficient number of RMDs that are required by their surgeries.

According to (Gesser-Edelsburg et al., 2021), the research on healthcare-associated infections (HAI) identifies two primary issues regarding adherence to infection prevention and control (IPC) standards among healthcare professionals (HP). There exists a mismatch between healthcare professionals' behavioral objectives and their practical implementation. The other pertains to the manner in which HPs sustain these behaviors following the conclusion of the intervention phase. This study proposes a technique that addresses both difficulties by employing the Positive Deviance (PD) approach to concentrate on the distribution phase of interventions. The project aims to provide a methodology for distributing 27 professional development practices to 135 healthcare professionals, including nurses, nurse assistants, and physicians, to aid them in adhering to infection prevention and control recommendations, gather feedback on the dissemination process, and assess the impact of the dissemination phase on behavioral modifications.

The theoretical framework for this qualitative research was the Recognition-Primed Decision (RPD) model, which we applied to the domain of healthcare-associated infections (HAIs). Additionally, we employed the Discovery & Action Dialogue (DAD) and Think Aloud (TA) methodologies to elucidate the procedural advancement of simulations for healthcare professionals (HPs). The feedback from the HP demonstrators was subjected to content analysis, and descriptive statistics were employed to delineate behavioral changes.

The information processing of healthcare professionals about infection prevention transitions from peripheral and automatic

processing to intuitive and analytical central processing, thereby transforming professional development practices into positive norms. The HPs directly encountered a solution and made numerous changes till they surmounted the obstacles. A majority of the HPs (69.4%) indicated that the practices were comprehensively executed, along with supplementary practices. The execution of the distribution phase suggests that healthcare professionals must engage in more than just observation of simulations to effectively integrate and assimilate procedures not included in the official guidelines. Each staff member must individually execute the procedures.

Discussion

This section examines the concordance and discrepancies of data from the cited research concerning the roles of nurses and sterilisation in infection prevention measures. It emphasizes areas of agreement and disagreement, elucidating the implications for healthcare procedures. Agreement on the Function of Nurses and Sterilization in Infection Control. Numerous studies highlight the essential function of nursing and sterilization in upholding infection prevention standards. Henderson et al. (2021) emphasize the importance of rectifying deficiencies in infection control protocols, especially within nursing. Their research, utilizing the Missed Nursing Care Infection Prevention and Control (MNCIPC) Survey, illustrates that both infection control specialists and ward nurses acknowledge the adverse effects of neglected infection prevention measures, indicating a mutual comprehension of the necessity for uniformity in infection control protocols. This corresponds with Gesser-Edelsburg et al. (2021), who contend that incentivizing healthcare staff, especially nurses, to adopt novel infection prevention techniques is essential for fostering good norms that diminish healthcare-associated infections (HAIs). Sterilisation methods are universally recognized as essential, as demonstrated by Rutala and Weber (2018), who offer an extensive overview of disinfection and sterilisation protocols in healthcare settings. Their findings underscore the necessity of complying with set rules to efficiently eradicate dangerous infections. Panta et al. (2019) affirm the efficacy of autoclaving as a sterilization technique, highlighting its essential function in safeguarding the safety of reusable medical instruments in healthcare settings.

Divergent Perspectives on Compliance and Efficacy

Although there is widespread consensus on the significance of infection prevention, certain studies indicate discrepancies in adherence and efficacy. Alhumaid et al. (2021) emphasize that deficiencies in knowledge and no adherence to infection prevention methods continue to pose substantial issues for healthcare professionals. The comprehensive review highlights variables including insufficient training, poor resources, and cultural obstacles as significant causes to inconsistent adherence. This differs with Gesser-Edelsburg et al. (2021), who propose that enhancing intrinsic motivation via Positive Deviance can promote adherence to and incorporation of optimal practices in routine care.

Coban (2020) offers a distinctive viewpoint by analyzing the operational difficulties related to sterilization. The research indicates that scheduling inefficiencies in the sterilization of reusable medical devices can adversely affect infection control measures. This discovery brings a logistical dimension to the discourse, indicating that even established sterilization methods, as detailed by Rutala and Weber (2018), may fail when confronted with systemic challenges like inadequate scheduling.

Concurrence and Dissent with Prior Research

The majority of research concur on the essential role of nursing and sterilization in infection prevention, highlighting the necessity for strict compliance with protocols. Henderson et al. (2021) and Alhumaid et al. (2021) both delineate issues in compliance, albeit from distinct viewpoints one emphasizing deficiencies in nursing care and the other addressing overarching systemic concerns affecting healthcare personnel' behaviours. Nonetheless, disputes emerge concerning the optimal strategies to tackle noncompliance. Alhumaid et al. (2021) urge for enhanced training and resource distribution, whilst Gesser-Edelsburg et al. (2021) underscore the importance of behavioral modification by promoting motivation and positive norms. Similarly contests the presumption of sterilization's infallibility, emphasizing practical obstacles that may undermine even the most effective methods.

Consequences for Healthcare Practices

These findings together underscore the intricacy of infection control, necessitating the synergistic operation of nursing and sterilization within an ecosystem encompassing education, resources, motivation, and operational efficiency. Addressing the deficiencies revealed in prior research necessitates a comprehensive approach that amalgamates technological expertise with behavioral and systemic enhancements.

Conclusion

In the context of infection prevention, the theoretical investigation of the roles that nurses and sterilization specialists play shows the vital contributions that these professionals make to the safety of healthcare. As the first line of defence against infection, nurses are responsible for ensuring that hygiene procedures and patient care practices are adhered to in a stringent manner. On the other hand, sterilization specialists have the responsibility of protecting the integrity of medical instruments and settings. Both of these roles, when combined, provide a synergistic alliance that is necessary for the reduction of HAIs. The study demonstrates that there is a widespread agreement among researchers regarding the significance of infection prevention techniques; yet, it also identifies obstacles, such as noncompliance, limitations in training, and operational inefficiencies. The resolution of these problems calls for an approach that incorporates a variety of strategies, including behavioral modification, technological competence, and systemic enhancements. This research highlights the importance of teamwork, continual education, and motivation among healthcare personnel in order to improve infection prevention practices. It does so by integrating insights from theoretical frameworks and existing literature. In the future, efforts should be focused on bridging knowledge gaps, optimizing workflows, and cultivating a culture of safety in healthcare facilities in order to ensure that advancements in infection control are sustainable.

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