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Nurses Perception of Contact Precaution in Preventing Multi-Drug Resistance *Acinetobacter baumanii* Outbreak in ICU

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Abstract The escalating rates of multidrug-resistant *Acinetobacter baumanii* (MDR-AB) outbreaks in Intensive Care Units (ICUs) globally are a pressing healthcare challenge. The present study assesses the nurse's perception on efficacy of contact precautions in inhibiting such outbreaks and the compliance of ICU nursing staff to these precautions. Assuming that effective training, reinforcement, and implementation of contact precautions are key to combating MDR-AB outbreaks, a cross-sectional observational study was conducted using a hybrid structured survey administered among ICU nursing staff (n = 130) in four major hospitals in the Hail region with 102 nurses responded for the study garnering 0.78%. The results underscored the crucial role of age, gender, and recent training in influencing healthcare professionals' compliance. Female and younger professionals (30 years or below) demonstrated significantly higher compliance rates. The universal use of personal protective equipment (PPE), a cornerstone of contact precautions, was also highlighted across all demographic and professional groups. The study concluded that while high compliance rates provide a promising outlook for preventing MDR-AB outbreaks, institutional support, resource allocation, and continuous training are paramount. Implementing the proposed recommendations, including enhanced education and training, effective resource allocation, and strong safety culture, could significantly enhance the effectiveness of contact precautions. The findings thus advocate for a comprehensive approach, integrating individual compliance and institutional support, to combat MDR-AB outbreaks in ICU settings.

Keywords: *multidrug-resistant Acinetobacter baumanii, contact precautions, nurses, Intensive Care Units, personal protective equipment*

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1. Introduction

Leading hospital boast high quality of care and outmost patient safety, but even the leading hospitals have holes in implementation of standard protocols for infection outbreak. Contact Precautions are intended to prevent transmission of infectious agents, including epidemiologically important microorganisms, which are spread by direct or indirect contact with the patient or the patient's environment. (MDRO Management | Guidelines Library | Infection Control | CDC, 2015)[1]

It has made common infections increasingly difficult or impossible to treat, and leads to higher medical costs, prolonged hospital stays and increased mortality. Infection rates due to multidrug-resistant organisms (MDRO) are increasing globally [2]. The term 'contact precautions' was first used by the Healthcare Infection Control Practices Advisory Committee (HICPAC) in a guideline on isolation precautions published in 1996. In applying these principles in the care of all patients, it enabled many diseases or conditions to be managed without additional precautions.

Despite high-quality care in leading hospitals, gaps remain in implementing infection outbreak protocols. Contact precautions, which prevent the transmission of infectious agents, have been adopted globally due to increasing rates of multidrug-resistant organisms (MDRO). However, outbreaks still occur, signifying the need for improved implementation strategies. This research focuses on the effectiveness of contact precautions in mitigating Multi-Drug Resistance Acinetobacter Baumani (MDR-AB) outbreaks in intensive care units (ICUs), with a particular emphasis on nurse compliance. Hospitals, particularly in the Hail region, are vulnerable to these outbreaks, highlighting a pressing need for enhanced infection control practices. The study aims to assess the nurse's

perception on effective, evidence-based approaches to halt such outbreaks, thereby improving patient outcomes, promoting compliance, and optimizing infection control resources.

2. Review of Literature

The widespread nosocomial Acinetobacter Baumanii (MDR-AB) is multidrug-resistant and can cause life-threatening infections in hospitalized patients [3]. ICUs have been identified as high-risk environments for MDR-AB transmission [4]. According to Bearman and Stevens [5], contact precautions are one such measure, which entails keeping infected patients isolated, practicing hand sanitation, and using personal protective equipment (PPE). On one hand, the effectiveness of contact precautions, which have been used in many healthcare settings to stop the spread of MDR-AB, is still up for discussion [6]. Nevertheless, the spread of MDR-AB is a significant problem in hospital settings, and outbreak prevention depends heavily on applying efficient infection control procedures.

The significance of infection control methods increased after the COVID-19 pandemic. Healthcare professionals have been working to halt the spread of the virus since the healthcare sector has been at the forefront of the struggle against the outbreak [7]. Contact precautions are essential to infection control techniques in hospitals, clinics, and other healthcare facilities. The importance of PPE usage, hand hygiene, and the isolation of sick patients has increased.

Even though contact precautions have been routinely used in hospital settings to stop the spread of MDR-AB, Dhar et al. [8] claimed that there are still concerns regarding their possible downsides and restrictions because adherence varies to some extent and various healthcare personnel practices when high patient influx arises alongside understaffing problems. By comparing and contrasting research, this literature review sought to determine the efficacy of contact precautions among nurses in preventing MDR-AB outbreaks in the ICU.

2.1. Efficacy of Contact Precautions in ICU MDR-AB Outbreaks

According to Morgan et al. [9], to stop the spread of infectious diseases and resistant pathogens, contact precautions that often include hand washing and putting on protective gear may lower the potential for Acinetobacter Baumanii to spread from patient to patient or via contaminated surfaces. He also emphasized the importance of proper hand hygiene techniques and an efficient method of donning and discarding PPEs during and after every nursing care execution for patients with complex or contagious diseases in the ICU settings.

Similarly, as shown by Bentivegna et al. [10], maintaining a high level of preventative measures such as contact precaution techniques is likely the most effective approach for dealing with issues such as the spread of MDR-AB in ICU patients and the predominance of MDR-AB in general. In another trial, Tawney et al. [11] observed that contact precautions successfully contained an MDR-AB outbreak in the ICU by segregating patients and enforcing stringent hand hygiene standards. Additionally, according to Goyal and Chaudhry [12], contact precautions require that healthcare professionals wash their hands before and after patient interaction. This can increase healthcare workers' adherence to hand hygiene practices, which is essential for limiting the spread of Acinetobacter Baumanii.

Additionally, maintaining good hand cleanliness is essential for contact precautions in the ICU to prevent the transmission of Acinetobacter Baumanii [13]. Toney-Butler et al. [14] collectively determined that hand hygiene must be practiced before and after touching contaminated surfaces or tools. He added that hand hygiene may be performed using soap and water or alcohol-based hand sanitizers.

Hovi et al. [15] used and promoted reverse isolation to prevent healthcare-associated infections. Personal protective equipment and the isolation of infectious patients were found to be helpful in prior trials. They also stressed the need to teach healthcare providers to reverse isolation procedures and provide frequent training and feedback. This research advised using reverse isolation techniques to reduce infectious disease transmission in hospital settings. In addition, reverse isolation protects immunocompromised individuals, such as cancer patients, from dangerous pathogens.

Habboush and Guzman [16] underlined the Infection control procedures for preventing foreign microorganisms from entering the patient's surroundings. These precautions may include hand sanitation, gowns, gloves, masks, and restricted patient room visits. Reverse isolation works best when healthcare personnel, visitors, and patients follow infection-control protocols. When properly administered, it can considerably lower the risk of infection in immunocompromised individuals.

Moreover, Rutala and Weber [17] claimed that healthcare institutions should have cleaning and disinfection practices and protocols, including cleaning and disinfecting patient rooms following discharge or handover. Consequently, the danger of Acinetobacter Baumanii transmission can be reduced, and outbreaks can be avoided by keeping the surroundings clean and disinfected.

Regarding patient outcomes, Yamamoto et al. [18] demonstrated that reduced hospital stays for patients with Acinetobacter baumanii infections have been linked to contact precautions. Similarly, Croft et al. [19] perceived that in addition to improving patient outcomes, this could save healthcare expenses. Using contact precautions to limit the spread of A. Baumanii in the ICU helps patients recover and lowers healthcare costs.

Correspondingly, the study conducted by Arriero et al. [20] showed that contact precautions minimize healthcare-associated infections and hospital stays for patients with Acinetobacter baumanii infections. In acute hospital settings, contact precautions can also limit the transmission and spread of drug-resistant pathogens, which O'Hara et al. [21] claim as difficult and expensive to cure.

2.2. Contradictory Findings on the Effectiveness of Contact Precautions in Preventing MDR-AB Transmission

Several studies have shown conflicting results even though contact precautions are helpful. Tacconelli et al. [22] and Furuya et al. [23] found that contact precautions did not significantly prevent the prevalence of MDR-AB in intensive care unit (ICU) patients but, at large, reduced the prevalence of other healthcare-associated illnesses.

Nevertheless, Harrod et al. [24] also claimed that healthcare workers need more time and effort to execute contact precautions due to donning and doffing personal protective equipment, sanitizing tools, and checking patient compliance. As a result, the quality of care for patients may suffer from an increased workload and limited availability.

The systematic review results corroborated those of Harrod et al. [24]. This study aimed to assess the effect of contact precautions on healthcare providers and their patients in urgent and critical care settings. The study indicated that it might raise the burden and anxiety of healthcare personnel due to the extra time and effort required to implement contact precautions. The study also indicated that contact precautions, including PPE and isolation measures, may reduce patient satisfaction and hinder dialogue and rapport between healthcare providers and patients.

Contact precautions rely on cooperation between healthcare personnel and patients [20]. Nonetheless, Brooks et al. [25] emphasized that non-compliance and breaches might occur owing to causes such as fatigue, lack of training and adherence to implementations, and insufficient resources to carry out the protocols effectively. Eventually, this can undermine the effectiveness of contact precautions and raise the risk of Acinetobacter Baumanii transmission. Furthermore, contact limits may negatively impact patients, such as feelings of loneliness, stress, and isolation. Baubie et al. (2019)[26] say this may affect patient satisfaction and the overall state.

2.3. Synthesis of the Literature

According to the reviewed studies, contact precautions may decrease the spread of Acinetobacter Baumanii in the ICU. ICU staff must disinfect their hands, wear PPE, and sterilize high-touch surfaces to prevent the spread of infection. Contact precautions minimize Acinetobacter Baumanii infections, standardize hand hygiene of healthcare workers, and decrease patient hospitalization duration. Contact precautions also reduce healthcare expenditure and improve patient outcomes by preventing drug-resistant infections.

However, contact precautions have drawbacks, as demonstrated in the literature. This may increase the burden and stress of ICU staff nurses, particularly in emergency and critical care, limit patient participation and communication, and impair treatment quality. Healthcare organizations must assess the pros and cons of contact precautions when adopting and implementing protocols. Organizations also require adequate resources and support to succeed without compromising patient care.

The examined literature has limitations that must be acknowledged. Several studies have employed retrospective data analysis, which may have added bias and confounding variables. Second, the studies were conducted in various hospital settings with varying levels of adherence to contact precautions, which may have affected the results. Finally, the absence of standard guidelines for contact precautions may have led to disparities in their implementation. In settings with limited resources, it is essential to analyze the in-depth cost-effectiveness of contact precautions, which has not been scrupulously assessed in some studies.

3. Methods

3.1. Aim of the Study

The central aim of this research was to assess the nurse's perception on the effectiveness of contact precautions in curbing the outbreak and spread MDR-AB within the context of ICUs across hospitals. The knowledge garnered from this research endeavor aimed to offer actionable recommendations to enhance patient safety, enrich healthcare outcomes, and elevate the overall standard of care within ICU settings.

3.2. Study Design/Population

The research employed an observational cross-sectional study design, focusing on ICU nursing staff from four major hospitals in Hail City, known for its vulnerability to MDR-AB infection outbreaks.

3.3. Study Sample Size and Technique

The sample size was determined by voluntary response sampling among the ICU nurses who were willing to participate in the study. While this non-probability technique might introduce some bias, it enabled the efficient data collection from 78% of the targeted staff members (n = 102).

3.4. Research Tools

Data collection was facilitated through a hybrid structured survey, distributed via QR codes, which the ICU nursing staff accessed online. The survey covered demographic details of the participants and evaluated the perception of nurse's on the effectiveness and compliance with contact precautions. The tool was divided into two parts – First, is the demographic data (Age, Gender, Years working in the institution, Years working in ICU and Specialty in training. The second part which covered the 3 dimensions that explores the factors that affect the effectiveness of contact precaution with 25 items listed. The research instrument was structured around three principal constructs. The first construct, "Use of Protective Device", concentrated on the practices related to the use of Personal Protective Equipment (PPE). It comprised an array of questions that probed the availability of PPE in the unit and specific usage practices. For instance, queries are made concerning the use of goggles during splash-prone procedures and protective aprons and masks when

there's a risk of exposure to bodily fluids. Furthermore, the construct delves into safe PPE removal, sharing, and reusing practices. The second construct, "Prevention of Cross Infection", centered on hygiene practices and strategies to prevent contamination. The questions in this construct aimed to evaluate several facets of hand hygiene including the frequency of hand hygiene performance at different intervals during patient care, the practice of wound or lesion covering before patient contact, and the use of alternative hand rubs when hands are not visibly dirty. In addition, the questions investigated the use of gloves, including avoiding the reuse of the same pair for multiple patients, and the isolation measures for patients with diseases that spread through contact. The third and final construct, "Infection Prevention and Control", evaluated participants' experiences with and perceptions of infection outbreaks and control measures. It aimed to gauge the perceived preparedness of the hospital in case of an outbreak, adherence of the staff to infection control policies, the staff's ability to differentiate between various isolation protocols, and any training the respondents have received on infection prevention and control. The tool was reviewed by panel of expert from infection control nurse, nursing and quality. The pilot study was done with 15 participants that was also excluded from the final study. Their recommendation was taken all in consideration. The pilot study was done to test the feasibility and clarity of the tool to be used in the larger scale. The final tool attribute to marked using a 5-point Likert Scale (5 points: Always to 1 point: Never). The instrument reliability measure using Cronbach's alpha was 0.80, an acceptable level.

3.5. Data Collection and Procedure

The study collected data using a web-based survey, designed to assess the efficacy of and adherence to contact precautions among the participants. The researchers distributed a QR code for accessing the survey among the ICU nursing staff.

3.6. Statistical Analysis

Data collected from the survey was analyzed using the Statistical Package for the Social Sciences (SPSS) version 29. The effectiveness and compliance questions were reported as frequencies, with the percentage score calculated from the total achieved scores and the total maximum scores.

4. Results

4.1. Demographics

Of the 102 participants in this study, 70.6% were female, 29.4% were male, 58.8% were 30 years of age or younger, and 41.2% were over 30. Half (50%) had five years of experience or less, 14.7% had six years or less, 7.8% had seven years or less, and 27.5% had eight years of experience or more. Years working in the institution varied, with 69.6% working five years or less, 13.7% six years or less, 3.9% seven years or less, and 12.7% eight years or more. Over three-quarters (75.5%) worked in the ICU for five years or less, while 10.8% worked six years or less, 3.9% seven years or less, and 9.8% worked in the ICU for eight years or more.

4.2. Use of Protective Devices

The use of protective devices was comprised of nine questions designed to ascertain the PPE habits of the participants. The mean use of protective devices score was 4.03 (SD = 0.39), ranging from 2.56 to 5.00. There were no statistically significant differences in the use of protective devices by age, gender, years of experience, years working in the institution, years working in the ICU, or specialty in training, $p > .05$.

4.3. Prevention of Cross-Infection

Prevention of cross-infection was comprised of 11 questions with a mean score of 4.36 (SD = 0.54), ranging from 1.60 to 5.00. Females scored higher in the prevention of cross infection (M = 4.46, SD = 0.42) than males (M = 4.13, SD = 0.70), a statistically significant difference, M = 0.33, 95% CI [0.11, 0.56], $t(100) = 2.952$, $p = .004$. There were no statistically significant differences in the prevention of cross-infection by age, years of experience, years working in the institution, years working in the ICU, and specialty in training, $p > .05$.

4.4. Infection Prevention and Control

Infection prevention and control was comprised of five questions with a mean score of 3.94 (SD = 0.65), ranging from 2.20 to 5.00. Infection prevention and control was higher for those 30 years of age or under (M = 4.06, SD = 0.66) versus those that were over the age of 30 (M = 3.76, SD = 0.61), a statistically significant difference, M = 0.30, 95% CI [0.05, 0.56], $t(100) = 2.351$, $p = .021$. Infection prevention and control was highest for those falling under the 'other' category (M = 4.20, SD = 0.49), followed by specialists (M = 4.03, SD = 0.61), those with a master's degree (M = 3.60, SD = 0.54), those with a doctorate (M = 3.50, SD = 1.56), senior specialists (M = 3.49, SD = 0.83), and technicians (M = 3.43, SD = 0.50), $F(5, 96) = 2.414$, $p = .042$. There were no statistically significant differences in infection prevention and control by gender, years of experience, years working in the institution, or years working in the ICU, $p > .05$.

4.5. Overall Contact Precautions

Out of a possible score of 25, the mean overall score was 15.91 (SD = 5.42), ranging from one to 24. Overall scores were higher for males (M = 4.03, SD = 0.75) as compared to females (M = 3.90, SD = 0.61), a statistically significant difference, M = 3.04, 95% CI [0.77, 5.31], $t(100) = 2.655$, $p = .009$ (Figure 1).

Overall scores were highest for those that fell under the 'other' category (M = 18.75, SD = 4.03), followed by specialists (M = 16.57, SD = 5.19), senior specialists (M = 14.57, SD = 5.16), technicians (M = 13.33, SD = 6.35), and those with a doctorate (M = 7.00, SD = 8.49), $F(5, 96) = 2.853$, $p = .019$ (Figure 2).

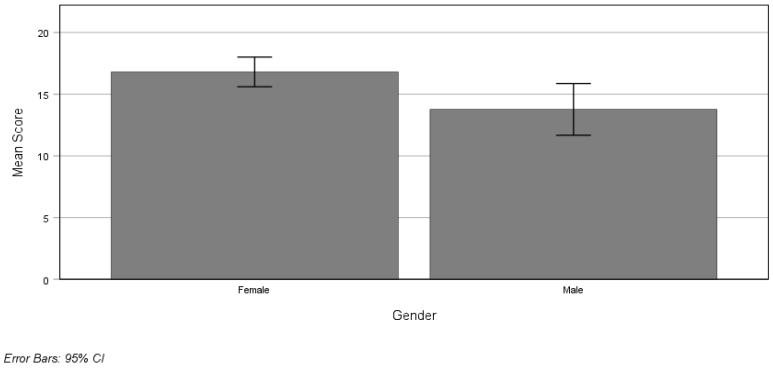

Figure 1. Overall Score by Gender

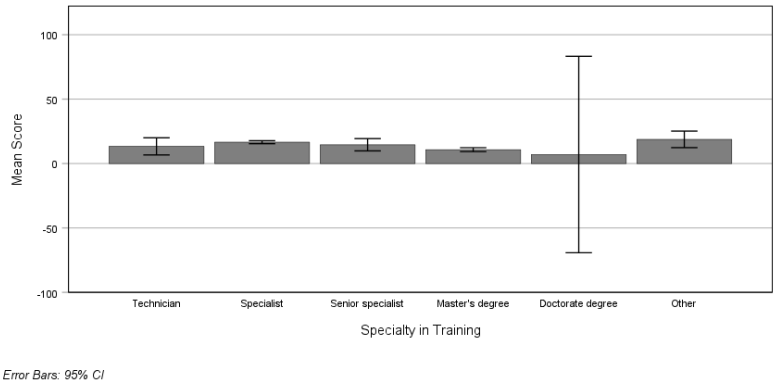

Figure 2. Overall Score by Specialty in Training

Table 1. Summary of Scores by Demographic Characteristics

Variable	Total Score M (SD)	Use of Protective Device M (SD)	Prevention of Cross Infection M (SD)	Infection Prevention and Control M (SD)
Age				
≤ 30	16.35 (5.77)	4.06 (0.41)	4.35 (0.49)	4.06 (0.66)
> 30	15.29 (4.88)	3.99 (0.36)	4.39 (0.60)	3.76 (0.61)
Gender				
Female	16.81 (5.12)	4.04 (0.37)	4.46 (0.42)	3.90 (0.61)
Male	13.77 (5.61)	4.00 (0.44)	4.13 (0.70)	4.03 (0.75)
Years of Experience				
≤ 5 yrs.	16.65 (4.91)	4.01 (0.37)	4.31 (0.58)	4.00 (0.67)
≤ 6 yrs.	13.93 (6.24)	4.04 (0.36)	4.33 (0.63)	3.99 (0.61)
≤ 7 yrs.	17.75 (4.06)	4.13 (0.52)	4.68 (0.31)	4.13 (0.66)
> 8 yrs.	15.11 (6.01)	4.02 (0.43)	4.40 (0.43)	3.76 (0.64)
Years working in Institution				
≤ 5 yrs.	16.77 (5.13)	4.02 (0.38)	4.36 (0.57)	3.95 (0.63)
≤ 6 yrs.	14.14 (6.21)	4.06 (0.50)	4.32 (0.56)	3.97 (0.75)
≤ 7 yrs.	14.00 (7.79)	3.81 (0.38)	4.53 (0.36)	4.30 (0.66)
>8 yrs.	13.69 (4.73)	4.11 (0.35)	4.40 (0.37)	3.72 (0.65)
Years working in ICU				
≤ 5 yrs.	16.38 (5.22)	4.05 (0.39)	4.36 (0.58)	3.97 (0.64)
≤ 6 yrs.	13.45 (6.98)	3.91 (0.33)	4.34 (0.48)	3.93 (0.66)
≤ 7 yrs.	16.50 (4.51)	4.22 (0.80)	4.60 (0.46)	3.90 (0.76)
> 8 yrs.	14.80 (5.35)	3.94 (0.22)	4.37 (0.30)	3.76 (0.75)
Specialty in Training				
Technician	13.33 (6.35)	4.15 (0.37)	4.53 (0.42)	3.43 (0.50)
Specialist	16.57 (5.19)	4.06 (0.34)	4.37 (0.56)	4.03 (0.61)
Senior Specialist	14.57 (5.16)	3.84 (0.57)	4.47 (0.29)	3.49 (0.83)
Master's degree	10.75 (0.96)	3.75 (0.37)	4.15 (0.50)	3.60 (0.54)
Doctorate	7.00 (8.49)	3.67 (1.57)	3.45 (0.64)	3.50 (1.56)
Other	18.75 (4.03)	4.00 (0.16)	4.53 (0.34)	4.20 (0.49)

There were no statistically significant differences by age group, years of experience, years working in the institution, or years working in the ICU, $p > .05$. A summary of all scores by demographic characteristics can be viewed below in Table 1.

5. Discussion

The current study aimed to assess the nurse's perception on effectiveness of contact precautions in preventing MDR-AB outbreaks in the Intensive Care Unit (ICU) setting. The prevention of MDR-AB, an increasingly prevalent nosocomial infection, remains a global healthcare challenge [3]. By scrutinizing the literature and conducting our research, we gathered essential insights to enhance current understanding and practices.

The study results unveiled the role of gender and age in influencing the prevention of cross-infection and infection prevention and control, respectively. Females displayed a statistically significantly higher score in cross-infection prevention than their male counterparts. These findings align with a study by Bearman and Stevens [5] that suggested that female healthcare professionals might comply more with contact precaution protocols due to a heightened sense of empathy and responsibility. However, caution is required when interpreting such differences, as societal and cultural norms may also contribute to these gender-based differences in compliance.

Regarding age, younger healthcare professionals (30 years of age or under) displayed significantly higher infection prevention and control scores than those over 30. These results might be attributed to recent training and exposure to infection control education and procedures in their formal nursing education. As suggested by Hsieh et al. [27], newly graduated nurses are likely to be more compliant with infection control procedures as they have recently received training and are more likely to recall the consequences of non-compliance.

The widespread use of protective devices (PPE) was high, without significant differences observed across gender, age, years of experience, and specialization. This suggests that PPE usage is considered essential by the healthcare workforce regardless of their demographic and professional attributes. The universal use of PPE underlines its significance as an integral part of contact precautions, echoing previous studies [11,27].

However, the results of this study should not obscure the challenges and drawbacks associated with the implementation of contact precautions. Some studies suggested potential downsides, including increased workload, reduced patient satisfaction, increased anxiety among healthcare providers, and financial implications (Livorsi et al., 2019.)[29] Healthcare settings should strike a balance between maintaining high-quality care and strictly adhering to contact precautions.

The high compliance rates seen in this study provide a positive outlook for preventing MDR-AB outbreaks. Nevertheless, preventing such outbreaks does not lie solely with individual healthcare providers. Institutions must provide continuous training, sufficient supplies of PPE, and foster a culture of safety. The role of institutions in enforcing compliance, ensuring adequate staffing, and providing necessary resources is crucial [2].

Despite the high levels of compliance observed in this study, it is important to note that these results may not be universally representative. The study was limited to a specific region (Hail) and four specific tertiary hospitals. Therefore, the outcomes may vary across different regions and hospital types. Further studies should be conducted to analyze the situation in different settings.

Finally, this study underlines the importance of routine assessment of healthcare practices and updating protocols based on the latest research findings. Healthcare institutions must remain vigilant and proactive as pathogens evolve and develop resistance. This study also highlights the importance of an ongoing commitment to improve and update knowledge and practices related to contact precautions. By doing so, we can ensure that our healthcare systems are better prepared to halt outbreaks and improve patient safety.

6. Conclusion

Universal use of PPE was found across all demographics, accentuating its crucial role in infection control. However, the study, primarily focused on a specific region and four hospitals, posing limitations in the generalizability of findings. The study underscores the institutional role in resource provision, compliance enforcement, and fostering safety culture, not just individual healthcare providers. This research encourages regular assessments, protocol updates, and adherence to the proposed recommendations for more effective contact precautions. It emphasizes continuous commitment to improving practices, thereby ensuring that healthcare systems can halt outbreaks and improve patient safety.

7. Recommendations

Enhancing ICU healthcare professionals' education and training, particularly regarding the critical implementation of contact precautions, is essential to infection prevention. Regular reinforcement sessions are necessary to maintain proficiency and combat complacency. Institutional infection control policies should be strengthened, focusing on contact precautions to avoid MDR-AB outbreaks. Effective resource allocation is essential to consistently implement precautions, ensuring adequate PPE supply, staffing, and isolation facilities. Encouraging a safety culture and shared responsibility within the healthcare setting can enhance adherence. Given the psychological impact of contact precautions on patients, healthcare providers should be trained to provide empathetic communication and emotional support.

Compliance with Ethical Standards

Ethics approval and consent to participate

The participation in this research was entirely voluntary, with each participant providing informed consent, and given the autonomy to withdraw from the study at any

stage without any repercussions. To protect the confidentiality of the participants, all data collected were anonymized, with no identifying information collected in the survey. This study, geared towards the improvement of infection control practices, aimed to pose no harm to the participants and instead aimed to significantly enhance patient safety and healthcare outcomes in the ICU. Ethical approval was obtained from the institutional review board of Hail number 2023-45.

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Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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