International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 3, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Assessing the Effectiveness of Infection Control Practices in Reducing Hospital-Acquired Infections

Fayz Khalaf Almutairi[1], Fahad sager almutairi[2], Waleed Mohammed Alruwaili[3], Njoud Khalaf Almoutiri[4], Abdullah Mabar Yahya Alribhi[5], Amro Yahya Abdullah Alshablan[6], Fayez Ghanam Alharbi[7], Awatef Rabee Alanazi[8], Shatha Mohammed Saad Al Jumai[9], Bashayer Ibrahim Alenazi[10], Teflah Hamad Aldawsary[11]

[1]Nursing technician, Sulaymaniyah Health Center,Saudi, Email: Fkalmutiri@moh.gov.sa
[2]Nursing technician,Sulaymaniyah Health Center,Saudi Arabia, Email: eFsalmutairi@moh.gov.sa
[3]Nursing Specialist,Sulaymaniyah Health Center,Saudi Arabia, Email: Wamoalruwaili@moh.gov.sa
[4]Nurse,Al Uraija Al Wusta,phc,Saudi Arabia, Email: nalmoutiri@moh.gov.sa
[5]Nursing Specialist,Riyadh First Health Cluster,Saudi Arabia, Email: Aezzedeen@moh.gov.sa
[6]Nurse,Riyadh third health cluster,Saudi Arabia, Email: amyalqahtani@moh.gov.sa.
[7]Nurse,Third health cluster,Saudi Arabia, Email: faghalharbi@moh.gov.sa
[8]Nurse,Al Naseem Middle Health center city riyadh,Saudi Arabia.
[9]Nursing Specialist,Sulaymaniyah Health Center,Saudi Arabia, Email: Saljumai@moh.gov.sa
[10]Nursing Specialist,Sulaymaniyah Health Center,Saudi Arabia, Email: Bialenazi@moh.gov.sa
[11]Nursing technician, Alzhraa Primary Health Center, Email: taldawsary@moh.gov.sa

Received: 19.08.2024 Revised: 25.09.2024 Accepted: 27.10.2024

ABSTRACT
Hospital-acquired infections (HAIs) are a major global healthcare challenge, contributing to increased morbidity, mortality, and healthcare costs. Despite advancements in infection prevention and control (IPC), these infections remain prevalent, particularly in resource-limited settings. This article explores the burden of HAIs, the role of infection control teams (ICTs), key IPC practices, challenges and barriers to implementation, and actionable recommendations to improve outcomes. Effective IPC relies on evidence-based practices such as hand hygiene, antimicrobial stewardship, environmental cleaning, and adherence to standard precautions. Infection control teams play a pivotal role in developing policies, conducting surveillance, managing outbreaks, and fostering a culture of safety within healthcare facilities. However, barriers such as resource limitations, poor compliance, antimicrobial resistance, and organizational challenges hinder the consistent application of IPC measures. Recommendations to address these issues include strengthening surveillance systems, investing in education and training, enhancing resource availability, promoting antimicrobial stewardship, and leveraging innovative technologies. By addressing these challenges and prioritizing infection control, healthcare facilities can reduce the burden of HAIs, improve patient outcomes, and combat the growing threat of antimicrobial resistance. This comprehensive approach underscores the importance of collaboration, accountability, and sustained commitment to infection prevention efforts globally.

Keywords: challenge, morbidity, mortality, technologies.

INTRODUCTION

Hospital-acquired infections (HAIs), also known as healthcare-associated infections, are a significant global challenge in public health. These infections occur during the provision of healthcare in hospitals or other healthcare settings and are not present at the time of admission (World Health Organization [WHO], 2011). HAIs result in substantial morbidity, mortality, and financial burden, with the World Health Organization (2018) estimating that hundreds of millions of patients worldwide are affected annually. Common types of HAIs include catheter-associated urinary tract infections (CAUTIs), central line-associated bloodstream infections (CLABSIs), surgical site infections (SSIs), ventilator-associated pneumonia (VAP), and infections caused by multidrug-resistant organisms (MDROs) (Office of Disease Prevention and Health, n.d.).

Despite their prevalence, many HAIs are preventable through effective infection control (IC) practices. These practices include hand hygiene, antimicrobial stewardship, environmental cleaning, and adherence to evidence-based guidelines for patient care procedures (Umscheid et al., 2011). Research has demonstrated that well-implemented infection prevention and control (IPC) programs can significantly reduce the incidence of HAIs, thereby improving patient outcomes and reducing healthcare costs (Schreiber et al., 2018).

This article examines the effectiveness of infection control practices in mitigating HAIs. It explores the role of standardized guidelines, the contributions of infection control teams (ICTs), the impact of hand hygiene and antimicrobial stewardship, and the importance of education and training for healthcare workers. Furthermore, the challenges and barriers to implementing these practices are discussed, along with recommendations for improving compliance and achieving sustainable reductions in HAIs.

The Burden of Hospital-Acquired Infections

Hospital-acquired infections (HAIs), also referred to as healthcare-associated infections, are a major public health challenge globally. These infections are acquired during the course of medical care and are not present at the time of admission. According to the World Health Organization (WHO), HAIs affect hundreds of millions of patients worldwide each year, with a prevalence ranging from 5% to 10% in high-income countries and exceeding 25% in low- and middle-income countries (WHO, 2011). This disparity reflects differences in healthcare infrastructure, resources, and adherence to infection control practices.

The consequences of HAIs are severe and multifaceted, impacting patients, healthcare systems, and public health. For patients, HAIs often result in prolonged hospital stays, increased morbidity, and higher mortality rates. For example, infections such as ventilator-associated pneumonia (VAP) and central line-associated bloodstream infections (CLABSIs) are associated with significant clinical complications and high fatality rates. Surgical site infections (SSIs) can lead to long-term disability, delayed recovery, and additional surgeries, while catheter-associated urinary tract infections (CAUTIs) increase the risk of sepsis and other systemic complications. Moreover, the rise of multidrug-resistant organisms (MDROs), which are commonly implicated in HAIs, further complicates treatment and worsens patient outcomes (Mazzeffi et al., 2021).

The burden of HAIs extends beyond individual patients, placing immense strain on healthcare systems. HAIs contribute to increased healthcare costs, both directly and indirectly. Direct costs include expenses related to extended hospital stays, additional diagnostic tests, and the use of more expensive antimicrobial therapies to treat resistant infections. Indirect costs include the loss of productivity due to prolonged recovery times and the emotional toll on patients and their families. Umscheid et al. (2011) estimated that approximately 35% to 55% of HAIs could be prevented with appropriate infection control practices, suggesting that billions of dollars in healthcare expenses could be avoided annually with better prevention efforts.

HAIs also have a broader societal impact, as they contribute to the growing issue of antimicrobial resistance (AMR). The frequent use of antibiotics to treat HAIs drives the emergence of resistant strains of bacteria, undermining the effectiveness of existing treatments. This has far-reaching consequences for public health, as AMR threatens the success of modern medicine, including surgeries, cancer treatments, and organ transplants, all of which rely on effective infection control and antibiotics.

The psychological impact of HAIs on patients and healthcare workers cannot be overlooked. Patients who acquire infections during care often feel a loss of trust in the healthcare system and may experience anxiety, depression, or post-traumatic stress. For healthcare workers, HAIs can lead to moral distress, as they may feel responsible for preventable infections, particularly when they are linked to lapses in infection control practices.

Infection Control Guidelines and Standards

Effective infection control (IC) guidelines and standards are critical for reducing the prevalence of hospital-acquired infections (HAIs). Over the years, global organizations such as the World Health Organization (WHO) and national health agencies have developed evidence-based frameworks to guide healthcare facilities in implementing infection prevention and control (IPC) practices. These guidelines are designed to address the multifaceted nature of HAIs and provide a structured approach to improving patient safety.

The WHO's guidelines on core components of IPC programs, first introduced in 2016 and updated in subsequent years, emphasize a multimodal strategy to reduce HAIs across various healthcare settings (WHO, 2018). This approach integrates several key elements, including system changes, staff education, process monitoring, and patient engagement. The primary components of IC guidelines include:

Hand Hygiene

Hand hygiene is widely regarded as the cornerstone of infection prevention. The WHO's "My Five Moments for Hand Hygiene" framework outlines critical moments during patient care when hand hygiene must be performed: before patient contact, before aseptic tasks, after body fluid exposure, after patient contact, and after contact with the patient's surroundings. Effective hand hygiene practices, such as washing hands with soap and water or using alcohol-based hand rubs, significantly reduce the transmission of pathogens. Despite its simplicity, compliance with hand hygiene practices remains a challenge, often requiring cultural changes, regular training, and leadership support to improve adherence (Ali-Brandmeyer et al., 2021).

Environmental Cleaning and Disinfection
Thorough cleaning and disinfection of healthcare environments are essential to prevent the spread of pathogens. Surfaces, equipment, and high-touch areas such as bed rails, doorknobs, and medical devices can harbor infectious agents. Standardized cleaning protocols, combined with the use of appropriate disinfectants, help minimize the risk of cross-contamination. Environmental cleaning is particularly crucial in high-risk areas, such as operating rooms and intensive care units (ICUs), where patients are more vulnerable to infections.

Antimicrobial Stewardship
Antimicrobial resistance (AMR) is a significant global threat, and inappropriate antibiotic use is a major driver of this problem. Antimicrobial stewardship programs (ASPs) are vital components of IC guidelines, as they focus on optimizing antibiotic use to treat infections while minimizing the risk of resistance. These programs promote appropriate prescribing practices, monitor antibiotic usage, and provide education to healthcare workers on the prudent use of antimicrobials (Rummukainen et al., 2012).

Standard Precautions
Standard precautions form the foundation of IPC practices and are applied universally to all patients, regardless of their infection status. These precautions include the use of personal protective equipment (PPE), such as gloves, gowns, masks, and eye protection, as well as safe injection practices, respiratory hygiene, and proper handling of medical waste. Adherence to standard precautions helps protect both patients and healthcare workers from the transmission of pathogens.

Surveillance and Monitoring
A crucial element of IC guidelines is the establishment of robust surveillance systems to monitor infection rates, identify outbreaks, and evaluate the effectiveness of IPC interventions. Surveillance data provide valuable insights into trends, risk factors, and the overall burden of HAIs, enabling healthcare facilities to implement targeted measures for improvement. Feedback mechanisms, such as performance audits and regular reporting, are also essential for fostering a culture of accountability and continuous improvement (Harbarth et al., 2003).

Education and Training
Education and training for healthcare workers are central to the success of IPC programs. Guidelines emphasize the importance of equipping staff with the knowledge and skills needed to implement infection control measures effectively. Training programs should be tailored to specific roles and responsibilities, with a focus on practical applications and real-world scenarios. Regular refresher courses help reinforce best practices and keep staff informed about emerging threats, such as multidrug-resistant organisms (Jenner & Wilson, 2000).

Patient and Family Engagement
IC guidelines also recognize the importance of involving patients and their families in infection prevention efforts. Educating patients about hand hygiene, wound care, and other preventive measures empowers them to play an active role in their care and reduces the risk of infections.

The Role of Infection Control Teams
Infection control teams (ICTs) are central to reducing hospital-acquired infections (HAIs) and ensuring the successful implementation of infection prevention and control (IPC) programs. These multidisciplinary teams are responsible for establishing, maintaining, and evaluating IPC policies and practices in healthcare facilities. Their role extends beyond simply enforcing guidelines; they also play a key role in education, surveillance, outbreak management, and fostering a culture of safety and accountability within healthcare settings (Hale et al., 2015).

Structure and Composition of Infection Control Teams
ICTs typically consist of healthcare professionals with expertise in infection prevention, including infection control practitioners (ICPs), microbiologists, infectious disease specialists, hospital epidemiologists, and public health professionals. Nurses, particularly those trained as infection control link nurses, often serve as liaisons between frontline staff and the ICT, ensuring that IPC practices are implemented effectively at the unit level (Dekker et al., 2019). Administrative support and collaboration from hospital leadership are also critical to the success of ICTs, as they provide the resources and authority needed to enforce IPC measures.
Core Responsibilities of Infection Control Teams

1. **Policy Development and Implementation:**
   ICTs are tasked with developing evidence-based IPC guidelines tailored to the specific needs of their healthcare facility. These policies align with national and international standards, such as those provided

by the World Health Organization (WHO). ICTs ensure these guidelines are effectively communicated to staff and integrated into daily operations.

2. **Surveillance and Data Analysis:**
   Surveillance is one of the primary responsibilities of ICTs. Teams monitor infection rates, identify trends, and investigate outbreaks. Surveillance data not only guide the implementation of targeted interventions but also provide measurable outcomes to evaluate the effectiveness of IPC programs. For example, tracking the incidence of catheter-associated urinary tract infections (CAUTIs) or central line-associated bloodstream infections (CLABSIs) can help ICTs identify areas for improvement (Thandar et al., 2021).
3. **Education and Training:**
   ICTs conduct regular training sessions to ensure that healthcare workers are well-versed in infection prevention practices, such as hand hygiene, proper use of personal protective equipment (PPE), and environmental cleaning. Training is tailored to the needs of different staff groups, including clinical and non-clinical personnel. Studies have shown that education programs significantly improve compliance with IPC practices, leading to reduced HAIs (Baldwin et al., 2010).
4. **Outbreak Management and Response:**
   ICTs play a critical role in managing infectious disease outbreaks within healthcare facilities. They conduct investigations to identify the source of the outbreak, implement control measures to contain its spread, and provide recommendations to prevent future occurrences. For example, during the COVID-19 pandemic, ICTs were instrumental in managing outbreaks and ensuring updated guidelines were followed in real-time (Psevdos et al., 2021).
5. **Promoting a Culture of Safety:**
   ICTs foster a culture of safety and accountability by engaging staff at all levels in infection prevention efforts. This includes promoting teamwork, encouraging open communication about IPC challenges, and recognizing staff for adhering to best practices. The involvement of link nurses is particularly effective in bridging communication gaps and fostering collaboration between ICTs and clinical staff (Peter et al., 2018).
6. **Antimicrobial Stewardship:**
   ICTs often collaborate with antimicrobial stewardship programs (ASPs) to promote the rational use of antibiotics. By monitoring antibiotic prescribing patterns and providing guidance on appropriate treatments, ICTs help reduce the emergence of antimicrobial-resistant organisms, a critical factor in the fight against HAIs (Mazzeffi et al., 2021).

The Role of Link Nurses

Link nurses are a vital extension of the ICT, acting as intermediaries between the team and frontline staff. They ensure that IPC policies are implemented in their respective units and provide real-time education and support to colleagues. Dekker et al. (2019) emphasized the effectiveness of link nurses in promoting compliance with IPC guidelines, particularly in acute care hospitals. Their ability to build trust and address staff concerns makes them an invaluable asset to ICTs.

Challenges Faced by Infection Control Teams

Despite their critical role, ICTs face numerous challenges. Resource limitations, including insufficient staffing and funding, can hinder their ability to implement comprehensive IPC programs, particularly in low- and middle-income countries (WHO, 2011). Resistance to change from healthcare workers, a lack of training opportunities, and inconsistent compliance with IPC practices further complicate their efforts. Additionally, the emergence of multidrug-resistant organisms (MDROs) places an increasing burden on ICTs, requiring them to adapt their strategies continuously.

Key Infection Control Practices

Effective infection control practices are essential for preventing hospital-acquired infections (HAIs) and safeguarding patient and healthcare worker safety. These practices are grounded in evidence-based guidelines and designed to address the primary modes of transmission of infectious pathogens in healthcare settings. From hand hygiene to antimicrobial stewardship, the consistent application of these interventions has been shown to reduce the incidence of HAIs significantly and improve patient outcomes (Umscheid et al., 2011). Below, we explore the most critical infection control practices in detail.

Hand Hygiene

Hand hygiene is universally recognized as the cornerstone of infection prevention and control (IPC). The transmission of pathogens via contaminated hands is one of the most common causes of HAIs. The World Health Organization (WHO) has developed the “My Five Moments for Hand Hygiene” framework, which outlines the critical moments when healthcare workers should perform hand hygiene:

1. Before touching a patient.

2. Before performing aseptic procedures.
3. After exposure to body fluids.
4. After touching a patient.
5. After touching a patient's surroundings.

Proper hand hygiene involves washing hands with soap and water for at least 20 seconds or using alcohol-based hand rubs when hands are not visibly soiled. However, compliance with hand hygiene remains suboptimal in many healthcare settings due to time constraints, lack of accessibility to hand hygiene stations, and behavioral barriers (Ali-Brandmeyer et al., 2021). Strategies to improve adherence include education campaigns, regular audits with feedback, and the placement of hand hygiene stations in high-traffic areas.

Antimicrobial Stewardship

Antimicrobial resistance (AMR) is a growing global threat, and inappropriate antibiotic use is a primary driver of this issue in healthcare settings. Antimicrobial stewardship programs (ASPs) are critical components of IPC and aim to ensure the appropriate selection, dosage, and duration of antibiotic therapy. These programs involve collaboration between infectious disease specialists, pharmacists, and healthcare providers to optimize antibiotic use while minimizing the development of resistant organisms. Research shows that ASPs not only reduce the incidence of multidrug-resistant organisms (MDROs) but also improve patient outcomes and lower healthcare costs (Mazzeffi et al., 2021).

Environmental Cleaning and Disinfection

The healthcare environment plays a significant role in the transmission of pathogens. Surfaces and equipment that come into contact with patients, such as bed rails, doorknobs, and medical devices, can harbor infectious agents if not cleaned properly. Routine cleaning and disinfection of these high-touch areas are critical to preventing cross-contamination. Effective cleaning protocols include the use of disinfectants with proven efficacy against common healthcare-associated pathogens, including *Clostridioides difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA). Monitoring and auditing cleaning practices ensure that standards are consistently met.

Standard Precautions

Standard precautions are a fundamental element of IPC and are applied universally to all patients, regardless of their infection status. These precautions aim to prevent the transmission of infectious agents through contact with blood, body fluids, non-intact skin, or mucous membranes. Key elements of standard precautions include:

- Use of personal protective equipment (PPE), such as gloves, gowns, masks, and eye protection.
- Safe injection practices, including the use of sterile equipment and proper disposal of sharps.
- Respiratory hygiene and cough etiquette, particularly in the context of airborne and droplet-transmissible diseases.

Adherence to standard precautions protects both patients and healthcare workers from the spread of infections.

Education and Training

Education and training are critical for ensuring that healthcare workers understand and consistently apply infection control practices. Training programs should be tailored to the specific roles of staff members and focus on practical, hands-on applications. Regular refresher courses and competency assessments help healthcare workers stay up-to-date with best practices and emerging threats, such as new multidrug-resistant pathogens or pandemics like COVID-19. Baldwin et al. (2010) demonstrated that targeted education programs could significantly reduce infection rates, such as those caused by MRSA, in healthcare settings.

Surveillance and Feedback

Surveillance systems are essential for monitoring infection rates, identifying outbreaks, and assessing the effectiveness of IPC interventions. Real-time data collection and analysis allow healthcare facilities to implement targeted measures to address specific challenges. Feedback mechanisms, such as sharing infection rate data with staff and providing performance audits, are effective tools for encouraging compliance and fostering a culture of accountability.

Patient and Family Engagement

Involving patients and their families in IPC efforts is increasingly recognized as an important strategy for reducing HAIs. Educating patients about hand hygiene, wound care, and other preventive measures empowers them to play an active role in their care. Additionally, family members who are informed about infection control practices can support adherence and help identify potential lapses in care.

Challenges and Barriers

Despite the availability of evidence-based infection prevention and control (IPC) guidelines, healthcare facilities face numerous challenges and barriers in implementing these practices effectively. These obstacles include resource limitations, compliance issues, and systemic challenges that hinder the consistent application of infection control measures.

Resource Constraints
One of the most significant challenges, particularly in low- and middle-income countries, is the lack of adequate resources. Many healthcare facilities struggle with insufficient staffing, limited access to personal protective equipment (PPE), and inadequate infrastructure, such as handwashing stations or environmental cleaning supplies (WHO, 2011). These constraints make it difficult to maintain high standards of infection prevention and control, leaving patients and healthcare workers vulnerable to hospital-acquired infections (HAIs).

Staff Compliance and Behavioral Barriers
Even when resources are available, achieving consistent compliance with IPC practices can be challenging. Factors such as time constraints, staff burnout, and a lack of awareness about the importance of IPC measures contribute to poor adherence. For example, hand hygiene compliance often remains below optimal levels due to behavioral barriers, such as the perception that it is time-consuming or unnecessary (Ali-Brandmeyer et al., 2021).

Antimicrobial Resistance
The growing prevalence of multidrug-resistant organisms (MDROs) presents a significant barrier to infection control. These organisms complicate the treatment of HAIs, requiring more robust IPC strategies and limiting the effectiveness of standard antibiotic therapies (Mazzeffi et al., 2021).

Inconsistent Surveillance and Data Limitations
Effective IPC programs rely on robust surveillance systems to monitor infection rates and identify outbreaks. However, many healthcare facilities lack the infrastructure or expertise to collect and analyze data effectively. This limitation hinders the ability to evaluate the impact of IPC measures and implement targeted interventions.

Cultural and Organizational Challenges
Creating a culture of safety and accountability is critical for the success of IPC programs, but resistance to change, hierarchical structures, and poor communication can undermine these efforts. Healthcare workers may perceive IPC measures as burdensome or unnecessary, particularly when leadership does not prioritize infection prevention.

Recommendations
To effectively reduce hospital-acquired infections (HAIs) and address the challenges associated with infection prevention and control (IPC), healthcare facilities must adopt a comprehensive and multifaceted approach. The following recommendations outline key strategies for improving IPC practices and achieving sustainable reductions in HAIs:

Strengthen Surveillance Systems
Robust surveillance systems are critical for monitoring infection rates, identifying outbreaks, and evaluating the effectiveness of IPC interventions. Facilities should invest in electronic surveillance tools to collect real-time data and analyze trends. Sharing this data with healthcare workers through regular feedback mechanisms can foster accountability and drive improvements in compliance with infection control practices.

Invest in Education and Training
Education and training programs tailored to the specific roles of healthcare workers are essential for building awareness and competency in IPC practices. Regular refresher sessions, hands-on workshops, and scenario-based training can reinforce best practices such as hand hygiene, proper use of personal protective equipment (PPE), and antimicrobial stewardship. Leadership should ensure that training is ongoing and includes updates on emerging threats, such as multidrug-resistant organisms (MDROs).

Foster a Culture of Safety and Accountability
Creating a culture of safety requires strong leadership and active engagement from all staff levels. Leaders should prioritize IPC as a core aspect of patient safety, allocate adequate resources, and recognize staff who demonstrate exemplary adherence to IPC measures. Open communication and teamwork are critical for overcoming resistance to change and ensuring consistent implementation of IPC guidelines.

Enhance Resource Availability
Resource constraints are a significant barrier to effective IPC practices, particularly in low- and middle-income countries. Governments and healthcare organizations should allocate funding to improve infrastructure, such as handwashing stations and environmental cleaning supplies. Additionally, ensuring a consistent supply of PPE and disinfectants is essential for maintaining high standards of infection control.

Promote Antimicrobial Stewardship
Antimicrobial stewardship programs (ASPs) should be integrated into IPC efforts to optimize the use of antibiotics and reduce the risk of antimicrobial resistance. Collaboration between infectious disease specialists, pharmacists, and clinicians is crucial to ensure appropriate prescribing practices and minimize unnecessary antibiotic use.

Leverage Technology and Innovation
Innovative solutions, such as electronic hand hygiene monitoring systems, automated cleaning devices, and diagnostic tools for rapid pathogen detection, can enhance the efficiency and effectiveness of IPC programs. Facilities should explore the adoption of these technologies to address key challenges and improve outcomes.

CONCLUSION

Hospital-acquired infections (HAIs) remain a significant challenge in global healthcare, contributing to patient morbidity, mortality, and financial burdens on healthcare systems. However, the majority of these infections are preventable through the consistent implementation of evidence-based infection prevention and control (IPC) practices. By prioritizing key measures such as hand hygiene, antimicrobial stewardship, environmental cleaning, and education and training, healthcare facilities can significantly reduce the prevalence of HAIs and improve patient outcomes.

Infection control teams (ICTs) play a central role in driving these efforts, from developing policies and conducting surveillance to managing outbreaks and fostering a culture of safety. Despite their critical importance, challenges such as resource limitations, poor compliance, and antimicrobial resistance can hinder IPC efforts. Addressing these barriers requires a multifaceted approach that includes investment in resources, robust surveillance systems, leadership commitment, and stakeholder engagement at all levels.

By adopting innovative solutions, enhancing training programs, and promoting collaboration, healthcare organizations can create sustainable improvements in IPC practices. Reducing HAIs is not only a matter of improving patient care but also a crucial step toward minimizing healthcare costs, combating antimicrobial resistance, and building safer healthcare systems worldwide.

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