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Research Article

The Role of Nurses in Preventing Hospital-Acquired Infections

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Abstract:

Nurses play a pivotal role in preventing hospital-acquired infections (HAIs), a critical concern in patient care settings. As the most accessible healthcare providers, they are often the first line of defense in implementing infection control protocols. Nurses are responsible for adhering to strict hygiene practices, such as hand hygiene, and ensuring the proper use of personal protective equipment (PPE). By educating patients and their families about the importance of infection prevention, nurses foster a culture of safety and awareness that extends beyond the hospital walls. Their routine surveillance of at-risk patients and their proactive involvement in infection control committees significantly contribute to reducing HAIs, highlighting their essential role in maintaining patient safety. In addition to direct patient care, nurses also engage in data collection and monitoring of infection rates within healthcare facilities. By analyzing trends and identifying potential outbreaks, nurses can implement targeted interventions and advocate for necessary policy changes. Collaboration with interdisciplinary teams allows nurses to share insights and best practices for infection prevention, ensuring comprehensive strategies are in place. Furthermore, their engagement in continuing education empowers nurses to stay updated on the latest evidence-based practices, thus

enhancing their ability to combat HAIs. Overall, the multifaceted role of nurses in infection prevention is instrumental in safeguarding patient health and promoting a cleaner, safer healthcare environment.

1. Introduction

Hospital-Acquired Infections (HAIs), also known as nosocomial infections, represent a formidable challenge to modern healthcare systems worldwide. These infections, which patients acquire during the course of receiving treatment for other conditions within a healthcare setting, are not only a significant source of patient morbidity and mortality but also impose a substantial financial burden on healthcare institutions and economies [1]. The World Health Organization (WHO) estimates that hundreds of millions of patients are affected by HAIs annually across the globe, with prevalence being significantly higher in low- and middle-income countries. In developed nations, despite advanced medical technologies, HAIs remain a leading cause of death, complicating patient recovery, prolonging hospital stays, and contributing to the alarming rise of antimicrobial resistance [2].

The spectrum of HAIs is diverse, encompassing infections such as central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), surgical site infections (SSI), and ventilator-associated pneumonia (VAP). Each of these infections is associated with specific medical interventions, yet they share a common thread: a significant proportion are preventable through consistent and evidence-based practices [3]. The pursuit of patient safety has, therefore, placed the prevention and control of HAIs at the forefront of quality improvement initiatives in hospitals around the world. This has led to the development of extensive guidelines and protocols from bodies like the Centers for Disease Control and Prevention (CDC) and the WHO, which outline core strategies for breaking the chain of infection.

Within this complex ecosystem of patient care, the nursing profession emerges as the undisputed cornerstone of HAI prevention. Nurses constitute the largest segment of the healthcare workforce and are the providers who maintain a constant, 24-hour presence at the patient's bedside [4]. This unique position affords them a pivotal role that extends far beyond the traditional boundaries of patient care. They are the frontline guardians of patient safety, the executors of preventive protocols, the educators for patients and families, and the vigilant monitors of the patient's condition. Their responsibilities are integral to every step of the infection prevention and control (IPC) process, making their role not just important, but indispensable in the fight against nosocomial infections.

The role of the nurse in HAI prevention is multifaceted, encompassing direct clinical actions, patient advocacy, and environmental vigilance. At the most fundamental level is the adherence to basic hand hygiene practices. While seemingly simple, hand hygiene is universally recognized as the single most effective measure to prevent the transmission of pathogens [5]. Nurses, who have the most frequent patient contact, are the primary agents of this practice. Their consistent compliance with the "Five Moments for Hand Hygiene" – before touching a patient, before clean/aseptic procedures, after body fluid exposure risk, after touching a patient, and after touching patient surroundings – serves as a critical barrier to cross-contamination. However, compliance is not merely an individual choice; it is influenced by a complex interplay of factors including workload, access to sinks and alcohol-based rubs, and the prevailing safety culture within the unit, all of which require proactive nursing management and advocacy [6].

Beyond hand hygiene, nurses are the principal operators and caretakers of many medical devices that are common portals of entry for infections. The proper insertion, maintenance, and timely removal of urinary catheters, for instance, are direct nursing responsibilities that directly impact CAUTI rates. Similarly, meticulous care of central venous catheters, including aseptic technique during dressing changes and port access, is crucial for preventing CLABSI [7]. For patients on mechanical ventilation, nurses are at the heart of VAP prevention bundles, which include practices like maintaining the head of the bed at 30-45 degrees, providing regular oral care with chlorhexidine, and performing subglottic suctioning [8]. The successful implementation of these evidence-based "bundles of care" relies almost entirely on the knowledge, skill, and consistency of the nursing staff.

Furthermore, nurses act as the first line of defense in identifying early signs of infection. Through continuous patient assessment, they are often the first to notice subtle changes in vital signs, mental status, or the appearance of a wound that may indicate the onset of an HAI. This surveillance function is critical for triggering early diagnostic tests and interventions, thereby containing potential outbreaks before they escalate [9]. The nursing role also extends to patient and family education, empowering them to understand infection risks, ask

questions about their care (such as inquiring about the necessity of a catheter), and participate in hand hygiene practices, thereby creating a collaborative safety partnership [10].

Despite the clear protocols and the critical nature of their role, nurses face significant barriers in their efforts to prevent HAIs. Chronic understaffing and high nurse-to-patient ratios have been consistently linked to increased HAI rates. A heavy workload can lead to task-shifting, shortcuts in aseptic techniques, and lapses in the consistent application of preventive measures, even among the most dedicated professionals [11]. Additionally, gaps in knowledge or the lack of ongoing, hands-on training in the latest IPC guidelines can hinder effective practice. The rapid evolution of multidrug-resistant organisms (MDROs) also presents an ever-changing battlefield, requiring nurses to be continuously updated on isolation precautions and specific containment strategies [12].

The organizational and cultural context of the healthcare institution plays an equally decisive role. A positive safety culture, where nurses feel empowered to speak up about breaches in protocol without fear of reprisal and where hospital leadership actively supports and resources IPC initiatives, is a powerful predictor of success. When nurses are involved in the development and refinement of IPC policies, their ownership and compliance increase significantly [13]. Therefore, the challenge of HAI prevention is not solely a clinical one; it is also a managerial and cultural imperative.

2. Nursing Roles and Responsibilities in Infection Prevention

The responsibility of nurses in preventing Hospital-Acquired Infections (HAIs) is not a singular task but a complex, integrated competency that permeates every aspect of patient care. This role can be systematically categorized into several key domains: direct clinical practice, surveillance and assessment, patient education and advocacy, and environmental hygiene. At the core of direct clinical practice lies the unwavering adherence to standard precautions, which are the fundamental protocols designed to reduce the risk of transmission of pathogens from both recognized and unrecognized sources of infection [14]. Central to these precautions is hand hygiene, a practice so critical that its effective execution is a barometer for the overall infection control culture of a unit. Nurses are responsible for performing hand hygiene not only according to the World Health Organization's "Five Moments" but also as a role model for other healthcare workers, patients, and visitors, thereby championing a culture of safety [15].

Beyond hand hygiene, the consistent and correct use of personal protective equipment (PPE) is a vital nursing responsibility. The decision to don gloves, gowns, masks, and eye protection is based on a dynamic risk assessment performed by the nurse before every patient interaction. This is particularly crucial in the context of transmission-based precautions, such as contact, droplet, or airborne precautions, which are implemented for patients with known or suspected infections. The nurse must not only correctly apply and remove PPE to avoid self-contamination but also ensure that all personnel entering the room comply with the established protocols, acting as a gatekeeper for patient safety [16]. Furthermore, nurses hold primary responsibility for the aseptic management of invasive devices, which are common sources of infection. This includes the meticulous sterile technique during the insertion of urinary catheters, the daily care and maintenance of vascular access sites to prevent phlebitis and bloodstream infections, and the diligent respiratory care for ventilated patients to prevent ventilator-associated pneumonia. Each of these procedures requires a deep understanding of aseptic principles and a disciplined, consistent approach to break the chain of infection at its most vulnerable links [17].

A second critical domain of the nurse's role is that of a vigilant surveillance officer and clinical assessor. Nurses are in a unique position to conduct continuous, real-time surveillance for early signs of infection. This goes beyond simply checking a box on a chart; it involves a sophisticated process of clinical judgment. Through systematic patient assessment—palpating for tenderness, inspecting wounds for redness or discharge, monitoring vital signs for a subtle fever or tachycardia, and noting changes in cognitive status—the nurse acts as an early warning system [18]. This constant monitoring is essential for the early detection of HAIs, allowing for prompt intervention, such as ordering diagnostic tests, initiating antibiotic therapy as per protocol, or implementing isolation precautions, thereby preventing the progression of the infection and its potential spread to other patients. The documentation of these findings is equally important, as it creates a legal and clinical record that facilitates communication among the healthcare team and tracks the patient's trajectory, providing valuable data for infection control committees [19].

In addition to being clinicians and surveillants, nurses serve as pivotal educators and patient advocates. Patient and family education is a

powerful tool in HAI prevention that is uniquely deployed by the nursing staff. Nurses educate patients on the importance of hand hygiene, instruct them on how to care for their indwelling devices (like a central line or urinary catheter) if they are being discharged with one, and explain the purpose of isolation precautions, which helps to alleviate anxiety and promote compliance [20]. Perhaps one of the most empowering aspects of their educational role is encouraging patients and their families to be active participants in their care. This is embodied in initiatives such as "Speak Up," where nurses explicitly empower patients to ask questions like, "Have you washed your hands?" or "Is this catheter still necessary?" This advocacy role is crucial; nurses often serve as the patient's voice in multidisciplinary rounds, questioning the continued need for invasive devices and advocating for their timely removal, which is a primary strategy in reducing CAUTI and CLABSI rates [21]. The nurse's advocacy extends to ensuring that all members of the healthcare team, from physicians to ancillary staff, adhere to the established infection prevention protocols, thereby upholding a unified standard of care.

The final domain encompasses the nurse's responsibility in maintaining environmental hygiene and contributing to a culture of safety. The patient's immediate environment is a frequent reservoir for pathogens. Therefore, nurses play a key role in ensuring that the patient's room and equipment are properly cleaned and disinfected. This includes routine cleaning of high-touch surfaces (bed rails, bedside tables, call buttons) and ensuring that shared medical equipment, such as blood pressure cuffs and stethoscopes, are disinfected between each patient use [22]. While housekeeping staff perform the terminal cleaning, the nurse is responsible for ongoing maintenance and for promptly reporting any breaches in cleanliness. This environmental vigilance is a non-negotiable component of comprehensive patient care.

Ultimately, all these responsibilities are executed within the context of an organizational safety culture, to which nurses are both contributors and beneficiaries. A positive safety culture, characterized by strong leadership support, open communication, and non-punitive reporting of errors, directly enhances nurses' ability to prevent infections. In such environments, nurses feel empowered to report near-misses, such as a lapse in aseptic technique, without fear of blame, allowing the system to learn and improve [23]. Furthermore, nurses have a professional responsibility to engage in continuous professional development, staying abreast of the latest evidence-based guidelines from authorities like the CDC and WHO regarding infection prevention. They are also often involved in quality improvement projects, such as implementing and auditing compliance with care bundles for CLABSI or CAUTI, thereby moving from being mere implementers of policy to active architects of a safer healthcare system [24].

3. Evidence-Based Practices in Hand Hygiene and Compliance

Hand hygiene is universally acknowledged as the cornerstone of infection prevention and control, representing the most fundamental and effective measure to prevent the transmission of pathogens in healthcare settings. The scientific evidence supporting its efficacy is overwhelming; consistent and correct hand hygiene can significantly reduce the incidence of Hospital-Acquired Infections (HAIs), including those caused by multidrug-resistant organisms [25]. The World Health Organization (WHO) has championed this cause globally, establishing a comprehensive framework for hand hygiene that outlines the "Five Moments for Hand Hygiene." This evidence-based model dictates that healthcare workers, with nurses at the forefront, must perform hand hygiene: 1) before touching a patient, 2) before clean/aseptic procedures, 3) after body fluid exposure risk, 4) after touching a patient, and 5) after touching patient surroundings [26]. This model is not arbitrary; it is strategically designed to break the chain of infection at key points of transmission, protecting the patient from colonization by harmful germs and preventing the healthcare worker and the environment from becoming vectors for cross-contamination.

The evidence base extends beyond the "when" to the "how" of hand hygiene, delineating clear guidelines for technique and product use. The two primary methods are handwashing with soap and water and hand rubbing with an alcohol-based hand rub (ABHR). ABHR is now considered the gold standard for routine hand decontamination in most clinical situations, provided hands are not visibly soiled. The evidence favors ABHR due to its superior microbiocidal efficacy, faster application time, better skin tolerance, and the convenience of being available at the point of care [27]. The recommended technique for both methods is precise: for hand rubbing, applying a palmful of ABHR and covering all surfaces of the hands, rubbing until dry, which typically takes 20-30 seconds. For handwashing, the process involves wetting hands, applying soap, and vigorously rubbing all surfaces for a minimum of 40-60 seconds, followed by thorough drying with a

single-use towel [28]. This mechanical action, combined with the chemical efficacy of the agent, is critical for removing and destroying transient flora.

Despite the irrefutable evidence and clear guidelines, achieving and sustaining high levels of hand hygiene compliance among healthcare workers remains a persistent and complex challenge. Compliance rates are often suboptimal, and numerous studies have investigated the multifaceted barriers that impede this fundamental practice. These barriers can be categorized into individual, environmental, and systemic factors. On an individual level, factors include skin irritation and dryness caused by frequent cleaning, a lack of knowledge or awareness of the guidelines, a perceived high workload and urgency of care, and the simple human tendency to forget or become complacent, especially in low-risk-appearing situations [29]. Furthermore, the "invisible" nature of microbes can lead to a false sense of security, where caregivers do not perceive their hands as contaminated after certain activities, such as touching a patient's chart or bed rail.

The physical environment plays a crucial role in facilitating or hindering compliance. A significant evidence-based finding is that accessibility to hand hygiene resources is a primary determinant of compliance. If sinks are inconveniently located, or ABHR dispensers are not readily available at the point of care (e.g., at the bedside, at the room entrance), compliance drops dramatically [30]. Nurses, who move rapidly between tasks and patients, cannot be expected to walk long distances to perform hand hygiene between each activity. Other environmental barriers include dispensers that are frequently empty or malfunctioning, a lack of single-use towels, and overcrowded patient rooms that make accessing sinks or dispensers physically difficult. These environmental failures represent a systemic problem that individual healthcare workers cannot overcome through willpower alone.

At the systemic level, the most profound barrier is often the underlying safety culture of the healthcare institution. In a culture with low psychological safety, nurses may fear reprisal for speaking up about non-compliance observed in colleagues, particularly those in senior positions. A punitive approach to non-compliance, rather than a supportive and educational one, can drive the underreporting of errors and create a climate of fear rather than one of collective responsibility [31]. Additionally, chronic nursing understaffing and high patient-to-nurse ratios create a time-pressured environment where hand hygiene is perceived as a task that can be sacrificed to address more immediate patient needs, despite the long-term risks this poses [32].

In response to these challenges, a robust body of evidence has emerged supporting the effectiveness of multimodal improvement strategies for enhancing hand hygiene compliance. The WHO's "Multimodal Hand Hygiene Improvement Strategy" is the most widely adopted and validated framework. This strategy recognizes that no single intervention is sufficient and that a combined, sustained approach is necessary for success [33]. The five key components of this strategy are: 1) **System Change**: ensuring that the necessary infrastructure is in place, including reliable access to ABHR, sinks, and single-use towels at the point of care. 2) **Education and Training**: providing regular, interactive training on the "Five Moments," proper technique, and the rationale behind the guidelines for all staff levels. 3) **Evaluation and Feedback**: monitoring compliance through direct observation (by trained auditors) or product consumption data and providing timely, unit-specific feedback to healthcare workers, making the data visible and actionable [34]. 4) **Reminders in the Workplace**: placing posters, slogans, and other visual cues in strategic locations to keep hand hygiene at the forefront of everyone's mind. 5) **Institutional Safety Climate**: fostering a culture where hand hygiene is a shared priority endorsed and modeled by hospital leadership, and where staff feel empowered to remind each other to perform hand hygiene without confrontation.

The role of nursing leadership in championing these evidence-based practices is indispensable. Nurse managers and infection prevention nurses are critical for driving system change, allocating resources, and creating a unit-based culture of accountability. They can implement practical solutions such as providing pocket-sized ABHR for staff, ensuring supply chain reliability for dispensers, and integrating hand hygiene compliance data into regular staff meetings. Moreover, empowering staff nurses to become "hand hygiene champions" has proven to be a highly effective peer-to-peer model for promoting positive behavior change and sustaining long-term compliance [35].

4. Aseptic Techniques:

Aseptic technique is a fundamental concept in clinical practice, encompassing a set of specific practices and procedures designed to minimize the risk of introducing pathogenic microorganisms into susceptible body sites during invasive clinical procedures. For nurses, who are primary performers of many such procedures, mastering aseptic

technique is not merely a skill but a critical component of their professional responsibility in preventing Hospital-Acquired Infections (HAIs). The underlying principle of asepsis is to create and maintain a "sterile field," an environment free from viable microorganisms, for the duration of an invasive intervention. This practice is paramount during procedures such as wound dressing changes, insertion and care of central venous catheters, urinary catheterization, and surgical site preparation [36]. The consequences of a breach in aseptic technique can be severe, leading to localized infections, systemic bacteremia, increased patient morbidity and mortality, and prolonged hospital stays. Therefore, a comprehensive understanding and meticulous application of aseptic principles in managing the procedural space, equipment, and tools are non-negotiable for ensuring patient safety.

The management of the physical space, or the "aseptic field," is the first critical element in establishing and maintaining asepsis. Before initiating any sterile procedure, the nurse must perform a risk assessment of the immediate environment. This involves selecting an appropriate location, ideally a treatment room, but more commonly, the patient's bedside. The key is to prepare the space to minimize air turbulence and the risk of contamination. This includes cleaning all surfaces, such as the over-bed table, with a disinfectant wipe, ensuring adequate lighting to see the field clearly, and adjusting the room's ventilation if possible to reduce air currents [37]. Furthermore, the nurse must control the human traffic in the area; this means closing the room door or bed curtain, informing other staff and visitors about the procedure to prevent unnecessary interruptions, and ensuring that the patient is positioned comfortably and safely to avoid sudden movements that could contaminate the sterile field. The creation of a designated "clean zone" around the procedure site is essential for segregating sterile from non-sterile items and personnel.

The second pillar of aseptic technique is the meticulous management of equipment and tools. This process begins with the selection of the correct sterilization method for the items to be used. Nurses must understand the distinction between critical items (which enter sterile tissue or the vascular system and must be *sterile*), semi-critical items (which contact mucous membranes or non-intact skin and require at least high-level disinfection), and non-critical items (which contact intact skin and require low-level disinfection) [38]. For sterile procedures, all critical items, such as suture kits, central line dressing change kits, and urinary catheterization trays, are typically single-use and come commercially pre-sterilized. The nurse's responsibility is to inspect the packaging for integrity, checking the expiration date, and looking for any signs of damage or moisture that would indicate a breach in sterility.

The actual execution of opening sterile supplies and establishing a sterile field is a deliberate and standardized process. When opening a sterile pack, the nurse must do so in a manner that does not contaminate the contents. This often involves pealing open the outer wrapper away from the body, then using the cuffs of the inner wrapper to create a sterile field by flipping them back without touching the inner surface. Pouring sterile solutions, such as saline, requires a specific technique: the lid is placed with the inner surface up, the solution is poured without touching the bottle to the sterile basin, and any remaining solution in the bottle is discarded, as it is considered contaminated once the bottle has been opened [39]. The management of sterile gloves is another crucial skill. The nurse must don the gloves using a technique that ensures the outside of the gloves remains sterile, without touching the skin or non-sterile surfaces. Throughout the procedure, the principle of "sterile-to-sterile" contact must be strictly maintained, meaning that only sterile items can touch other sterile items or the key parts of the device being inserted (e.g., the catheter tip). If any doubt arises about the sterility of an item or if a breach occurs (e.g., a sterile glove touches a non-sterile surface), the item must be discarded immediately and replaced [40].

The final, and perhaps most dynamic, aspect of aseptic management involves the continuous vigilance and technique of the nurse throughout the procedure. This is where knowledge is translated into consistent, safe practice. A core concept here is the management of "key parts" and "key sites." Key parts are the critical components of the equipment that must remain sterile, such as the catheter tip, the syringe hub, or the inner surface of a wound dressing. Key sites are the portals of entry on the patient, such as a wound, an intravenous access port, or the urethral meatus [41]. The nurse's hands, even if gloved, must avoid touching these key parts directly. Using forceps or a pre-packaged sterile device is often the safest approach.

The role of Non-Touch Aseptic Technique (ANTT) has become a widely adopted and evidence-based framework to standardize this practice. ANTT is a core nursing competency that focuses on protecting key parts and key sites from contamination by ensuring they are not touched, either directly or indirectly, throughout the procedure [42]. This model provides a clear, logical methodology for nurses to follow, reducing variation in practice and enhancing patient safety. Furthermore, the

management of tools extends to their disposal. Proper sharps disposal in puncture-proof containers is vital for staff safety, while the correct segregation of other clinical waste prevents environmental contamination [43].

Barriers to perfect aseptic technique persist, often related to system and human factors. Emergency situations, high workload, and interruptions can lead to shortcuts and lapses in concentration. Inadequate availability of equipment or workspace can also compromise the nurse's ability to maintain an optimal aseptic field [44]. Therefore, ongoing education and competency assessment are essential. Simulation-based training has been shown to be highly effective in reinforcing these critical psychomotor skills and clinical judgments in a risk-free environment [45].

5. Surveillance and Reporting: Nurses as Frontline Monitors

Beyond the direct execution of preventive protocols, the nursing role in infection prevention is profoundly defined by their function as the primary agents of surveillance and reporting. This role transforms nurses from passive implementers of guidelines into active, sentinel observers who form the foundational intelligence network of a hospital's infection prevention and control (IPC) program. Surveillance, in the context of HAIs, is defined as the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding the occurrence of infections in a defined patient population [46]. While infection control professionals (ICPs) manage the overarching surveillance system, it is the nurse at the bedside who generates the raw, real-time data that makes this system possible. Their unique, continuous presence allows for the detection of subtle clinical changes that may signify the earliest onset of an HAI, long before laboratory confirmation is available. This frontline monitoring is therefore not a peripheral duty but a core clinical competency that directly triggers early intervention and containment strategies, ultimately safeguarding both individual patients and the broader hospital community from the spread of infectious agents.

The process of nursing surveillance is a sophisticated exercise in clinical judgment, beginning with meticulous and continuous patient assessment. This involves a systematic approach to detecting deviations from a patient's baseline condition. Nurses are trained to recognize the cardinal signs of infection, which may manifest subtly or overtly. Key monitoring activities include tracking core body temperature for the development of fever or hypothermia; assessing for tachycardia and tachypnea, which can be early indicators of systemic inflammatory response; and monitoring white blood cell counts for leukocytosis or a left shift [47]. However, nursing surveillance extends far beyond vital signs. It includes the vigilant inspection of invasive device sites for local signs of infection such as erythema, warmth, swelling, tenderness, or purulent discharge at a central line insertion site or a surgical wound. For patients with urinary catheters, nurses monitor for new-onset cloudy, foul-smelling urine or suprapubic tenderness. In ventilated patients, they note changes in the color, consistency, or volume of pulmonary secretions [48]. This holistic, integrated assessment allows the nurse to synthesize disparate pieces of clinical information into a coherent suspicion of an HAI.

The critical next step, following astute observation, is the accurate and timely documentation and reporting of these findings. A clinical observation holds limited power if it remains confined to a single caregiver's knowledge. Therefore, nursing documentation in the patient's electronic health record (EHR) is the essential mechanism for formalizing surveillance data. This includes charting specific, objective assessments (e.g., "2cm area of erythema noted around PICC site; no purulent drainage"), vital signs, and the patient's subjective reports (e.g., "patient reports new pain at surgical site") [49]. This creates a legal and clinical timeline that is indispensable for tracking the patient's status and for any subsequent epidemiological investigation. Furthermore, nurses are responsible for communicating their concerns proactively within the healthcare team. This involves reporting specific findings directly to the attending physician or advanced practice provider to advocate for necessary diagnostic tests, such as cultures, imaging, or laboratory studies, and to discuss the potential initiation or adjustment of antimicrobial therapy or the need for isolation precautions.

A crucial and formal aspect of the nurse's reporting role is the initiation of infection control protocols upon suspicion of a specific HAI or the identification of a multidrug-resistant organism (MDRO). For instance, when a nurse identifies signs suggestive of a possible *Clostridioides difficile* infection (e.g., new-onset watery diarrhea in a patient on antibiotics), their immediate action to place the patient on contact precautions and initiate specific environmental cleaning protocols is a direct infection control intervention [50]. Similarly, the identification of a patient colonized or infected with an MDRO like Methicillin-resistant *Staphylococcus aureus* (MRSA) or Vancomycin-resistant *Enterococci* (VRE) triggers

immediate isolation procedures, and the nurse is often the first to flag this based on lab results or clinical presentation. This rapid response, driven by nursing vigilance, is the primary firewall against cross-transmission within a healthcare facility. Nurses also play a vital role in outbreak detection. By recognizing unusual clusters of symptoms or a sudden increase in specific infections on a unit, they can alert the IPC team, enabling a rapid epidemiological investigation and the implementation of containment measures [51].

Despite its critical importance, effective nursing surveillance faces significant barriers that can impede its success. High patient-to-nurse ratios and excessive workload are among the most formidable challenges. When nurses are responsible for too many patients, the time available for thorough, individualized assessment diminishes, increasing the risk of missing subtle early warning signs of infection [52]. This "task saturation" can lead to surveillance being relegated to a secondary priority behind more immediate, life-sustaining tasks. Documentation burden can also be a barrier; if EHR systems are cumbersome or require redundant data entry, it can detract from time spent on direct patient observation and critical thinking.

The culture of the healthcare institution plays a paramount role in either enabling or hindering effective surveillance and reporting. A positive safety culture, characterized by strong nursing leadership and non-punitive responses to error reporting, is essential. Nurses must feel psychologically safe to report their own potential breaches in technique or to voice concerns about a colleague's practices without fear of reprisal [53]. When the culture is punitive, underreporting becomes rampant, and opportunities for system improvement are lost. Furthermore, a lack of specific education on the principles of surveillance and the nuances of HAI identification can leave nurses unsure of what to look for or when to escalate their concerns [54].

To overcome these challenges, targeted strategies are necessary. Ongoing education that moves beyond generic protocols to include case-based learning on recognizing early sepsis, device-related infections, and the epidemiology of common HAIs can significantly enhance surveillance acuity [55]. Empowering nurses through formal roles, such as designating "Unit-Based Infection Prevention Champions," has proven effective. These champions serve as on-the-ground experts, resources for their peers, and liaisons with the central IPC department, thereby strengthening the surveillance network and fostering a sense of ownership [56]. Finally, leveraging technology, such as clinical decision support systems integrated into the EHR that flag early warning scores (EWS) or prompt for specific assessments in high-risk patients, can augment the nurse's surveillance capabilities.

6. Antibiotic Stewardship:

The global crisis of antimicrobial resistance (AMR) poses one of the most significant threats to modern medicine, rendering life-saving antibiotics ineffective and escalating the risks associated with common medical procedures. At the heart of the response to this crisis lies Antimicrobial Stewardship (AMS) — a systematic approach to promoting the judicious use of antimicrobials to preserve their future efficacy, improve patient outcomes, and reduce the emergence of resistant organisms. Traditionally viewed as the domain of infectious disease physicians and clinical pharmacists, it is now unequivocally recognized that the effective implementation of AMS programs is impossible without the full integration and collaboration of the nursing profession [57]. Nurses, as the constant caregivers at the patient's bedside, serve as the critical link between stewardship policies and patient-centered care. Their role in AMS is multifaceted, encompassing vigilant monitoring, patient advocacy, accurate documentation, and direct collaboration with the broader healthcare team, making them indispensable agents in the responsible management of antimicrobial therapy and the broader fight against Hospital-Acquired Infections (HAIs).

The foundation of the nurse's role in AMS is built upon their unique position for continuous patient assessment and monitoring of therapeutic response. Once a physician has prescribed an antibiotic, the nurse becomes the primary executor and evaluator of the therapy. This involves administering the correct antibiotic at the right dose, route, and time, while simultaneously monitoring the patient for both its efficacy and potential adverse effects [58]. Nurses are the first to observe subtle clinical changes that indicate whether a treatment is working, such as a reduction in fever, improved vital signs, decreased purulent drainage from a wound, or the patient's subjective report of feeling better. This real-time, frontline data is invaluable for the stewardship team. Conversely, nurses are also the first line of defense in identifying signs of treatment failure, which may manifest as a lack of clinical improvement or a worsening of symptoms, potentially signaling an infection caused by a resistant pathogen that requires a change in therapy [59]. This ongoing assessment provides the essential clinical evidence that informs decisions to

continue, de-escalate, or change an antimicrobial regimen.

A critical and proactive nursing function within AMS is the meticulous management of specimen collection. The accuracy of microbiological data is the cornerstone of effective stewardship, guiding the transition from broad-spectrum empirical therapy to targeted, narrow-spectrum treatment. Nurses are almost exclusively responsible for obtaining high-quality clinical specimens for culture, such as blood, urine, sputum, and wound swabs. The technique used in this process is paramount; a poorly collected specimen can lead to contaminated results or false negatives, which in turn can lead to misinterpretation by clinicians, inappropriate antibiotic use, and delayed effective treatment [60]. For example, drawing blood cultures without proper skin antisepsis can introduce skin flora, leading to a false-positive result and unnecessary antibiotic treatment. Similarly, collecting a urine sample from a catheter bag instead of the sampling port can yield unreliable results. Therefore, the nurse's adherence to evidence-based procedures for specimen collection is not just a technical task but a direct stewardship intervention that ensures the integrity of the data guiding antimicrobial decisions.

Beyond monitoring and specimen collection, nurses play a vital role in ensuring adherence to prescribed antimicrobial regimens, a concept known as antibiotic "time-out." This involves a proactive review of the therapy at a predefined point (e.g., 48-72 hours after initiation) to reassess the continuing need and choice of antibiotic based on available clinical and laboratory data [61]. While often led by pharmacists or physicians, nurses are essential collaborators in this process. They can initiate conversations by providing updated clinical findings: "The patient's blood cultures are still negative after 48 hours, and his white blood cell count has normalized. Should we re-evaluate the need for vancomycin?" Furthermore, nurses are responsible for ensuring timely and accurate administration of antibiotics. Delayed or missed doses can not only compromise clinical outcomes but also contribute to the development of resistance by exposing bacteria to sub-therapeutic drug levels [62]. This logistical management, coupled with their clinical oversight, ensures that the intended stewardship plan is executed correctly at the point of care. Nurses also serve as key communicators and educators for patients and their families, explaining the purpose of the antibiotics, the importance of completing the full course (and conversely, the rationale for stopping a drug when it is no longer needed), and the dangers of antimicrobial resistance, thereby fostering understanding and adherence [63].

Despite their pivotal position, several barriers can hinder nurses from fully embracing their stewardship role. A lack of specific education and training on the principles of AMR and AMS can leave nurses feeling ill-equipped to engage in stewardship discussions or question prescribing practices [64]. Hierarchical structures in healthcare can also be a significant impediment, where a nurse may feel unable to challenge a physician's decision regarding antibiotic therapy, even when concerns exist about its necessity or duration. High workloads and competing clinical priorities can further relegate stewardship activities to a secondary concern, overshadowed by more immediate patient care demands [65].

To fully leverage the power of the nursing workforce in AMS, targeted strategies are required. First and foremost is the integration of formal AMS education into both nursing curricula and ongoing hospital-based professional development. This education should move beyond pharmacology to include the principles of resistance, the goals of stewardship, and training in effective communication and interprofessional collaboration [66]. Empowering nurses through clear institutional policies that define and support their role in stewardship is crucial. This includes creating structured communication tools, such as checklists or electronic health record prompts, that facilitate nurse-driven initiatives like prompting for antibiotic time-outs or ensuring cultures are drawn before the first dose of antibiotics is administered [67]. Furthermore, involving nurses in the development and implementation of unit-specific or hospital-wide AMS initiatives fosters a sense of ownership and validates their expertise. The creation of "Nursing Antimicrobial Stewardship Champions" has emerged as a highly effective model, where designated staff nurses receive advanced training and act as role models, educators, and resources for their peers, thereby strengthening the stewardship infrastructure at the grassroots level [68].

7. Education and Training:

The prevention of Hospital-Acquired Infections (HAIs) is fundamentally dependent on the consistent application of evidence-based practices by all healthcare workers, with nurses at the forefront. However, knowledge alone is insufficient; it must be translated into sustained behavioral change. This complex process of transforming practice is the central goal of targeted education and training programs. Effective infection prevention and control (IPC) education

moves beyond one-time lectures to become a continuous, integrated, and multifaceted strategy designed to enhance the core competencies of the nursing workforce. Its aim is threefold: to build a robust foundation of *knowledge* regarding the "what" and "why" of IPC; to shape positive *attitudes* and a sense of professional responsibility; and to hone the practical *skills* necessary for flawless execution at the bedside [69]. In an era of evolving pathogens and advancing medical technology, ongoing education is not a luxury but a non-negotiable component of patient safety, ensuring that nursing practice remains aligned with the latest evidence and that nurses are empowered as confident, competent guardians against iatrogenic harm.

The first pillar of this educational framework is the establishment of a solid knowledge base. Nurses must understand the fundamental principles of microbiology, the chain of infection, and the epidemiology of common HAIs, including central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), and surgical site infections (SSI). This foundational knowledge provides the "why" behind the protocols, fostering intellectual buy-in rather than rote compliance [70]. Furthermore, education must be specific and detailed, covering the precise steps of evidence-based guidelines, such as the WHO's "Five Moments for Hand Hygiene," the components of a VAP prevention bundle, or the principles of the Aseptic Non-Touch Technique (ANTT). This also includes updated information on emerging threats, such as multidrug-resistant organisms (MDROs) and their associated isolation precautions, and the critical role of nurses in antimicrobial stewardship programs. Knowledge dissemination can occur through various channels, including mandatory online modules, interactive workshops, and accessible reference materials posted in clinical areas. However, for knowledge to be retained and applied, it must be relevant, practical, and regularly reinforced [71].

While knowledge is the necessary starting point, it does not automatically translate into practice. A critical, and often overlooked, component of IPC education is the focus on shaping attitudes and cultivating a positive safety culture. A nurse may know the hand hygiene protocol perfectly but may not feel personally accountable or empowered to adhere to it consistently under pressure. Effective training, therefore, must address the psychological and social factors that influence behavior. This involves moving from a blame-oriented approach to one that emphasizes shared responsibility and the intrinsic motivation of "first, do no harm." Training sessions should include discussions on the very real consequences of HAIs—using patient stories and data on morbidity, mortality, and increased healthcare costs—to create an emotional connection to the material and strengthen professional ethics [72]. Role-playing and scenario-based training can be particularly effective in building confidence and skills for speaking up when a breach in protocol is observed, whether it involves a peer, a physician, or a visitor. By fostering a culture of psychological safety, where questions are encouraged and errors are viewed as learning opportunities, education helps to transform IPC from a set of rules into a core professional value [73].

The third pillar, and the one that most directly bridges the gap between knowing and doing, is the development of practical psychomotor skills through hands-on, simulation-based training. It is one thing to read about ANTT in a manual and entirely another to successfully set up a sterile field in a busy, unpredictable patient room. Simulation-based education provides a risk-free environment for nurses to practice complex procedures, such as central line dressing changes, urinary catheterization, or donning and doffing PPE for high-consequence pathogens, without jeopardizing patient safety [74]. This method allows for deliberate practice, immediate feedback, and the correction of technical errors before they become ingrained bad habits. For instance, using fluorescent gels during hand hygiene simulation can visually demonstrate areas of the hands that are frequently missed, providing powerful, immediate feedback that lectures cannot. Similarly, low-fidelity simulations for preparing a sterile field can reveal common breaches in technique. This type of experiential learning is highly effective for improving skill competency, building muscle memory, and increasing confidence, thereby ensuring that nurses are not only knowledgeable but also technically proficient in executing the procedures that prevent HAIs [75].

Implementing a successful and sustainable education program requires a strategic, multimodal approach that acknowledges various learning styles and the constraints of the clinical environment. The "see one, do one, teach one" model is outdated and insufficient for modern IPC. Instead, education must be continuous and integrated into the daily workflow. This can be achieved through brief, focused "huddles" at the start of a shift to review a key IPC point, competency validation fairs where nurses can practice skills and receive instant feedback, and the use of unit-based champions who provide just-in-time coaching and serve as ongoing resources for their colleagues [76]. Furthermore, education cannot exist in a vacuum; it must be strongly supported by the organizational culture

and leadership. When nurse managers and hospital executives visibly champion IPC education, participate in training, and allocate dedicated time for staff to attend, it sends a powerful message about its institutional priority.

Measuring the impact of education is also crucial. The ultimate goal is not simply to hold a training session but to improve patient outcomes. Therefore, evaluation must move beyond measuring attendance (output) to assessing its true effect. This includes evaluating changes in *knowledge* through pre- and post-training tests, assessing improvements in *skills* through direct observation and simulation assessments, and, most importantly, tracking changes in *behavior* and *clinical outcomes* [77]. The most meaningful metrics are those that reflect a reduction in HAIs, improved adherence to hand hygiene and care bundles, and a positive shift in staff perceptions of the safety culture.

8. Conclusion

In conclusion, the evidence presented throughout this research unequivocally establishes the nurse as the linchpin in the prevention of Hospital-Acquired Infections. Their role is not confined to a single task but is a complex, integrated competency that spans direct clinical care, vigilant surveillance, patient advocacy, and active participation in antimicrobial stewardship. From the fundamental practice of hand hygiene to the sophisticated application of aseptic technique and the critical thinking required for early infection detection, nurses operate as the constant guardians of patient safety at the bedside. However, their effectiveness is not solely determined by individual commitment. It is profoundly influenced by the organizational environment, including adequate staffing, a non-punitive safety culture, and accessible resources. Therefore, the path forward requires a dual commitment: first, from healthcare institutions to invest in and sustain a culture that prioritizes and empowers nurses as leaders in infection prevention; and second, from the nursing profession to embrace continuous learning and uphold the highest standards of evidence-based practice. By fortifying this partnership, healthcare systems can fully leverage the indispensable role of the nurse, transforming the battle against HAIs from a reactive challenge into a proactive, sustainable model of care that ensures safer outcomes for all patients.

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References

1. Burns N, Grove KS. Saunders. Philadelfia: 1999. Understanding nursing Research. [Google Scholar]
2. McFarland LV, Mulligan ME, Kwok RYY, Stamm WE. Nosocomial acquisition of Clostridium difficile infection. New Engl J Med. 1999;320:204–208. doi: 10.1056/NEJM198901263200402. [DOI] [PubMed] [Google Scholar]
3. Pirttet D. Hand hygiene: Improved standards and practice for hospital care. Curr Opin Infect Dis. 2003;16:327. doi: 10.1097/00001432-200308000-00004. [DOI] [PubMed] [Google Scholar]
4. Nishimura S, Kagehira M, Kono F, Nishimura M, Taenaka N. Handwashing before entering the intensive care unit: What we learned from continuous video-camera surveillance. Am J Infect Control. 2014;27:367–369. doi: 10.1016/S0196-6553(99)70058-1. [DOI] [PubMed] [Google Scholar]
5. NHS Estates. Infection Control in the Built Environment - Design and Planning (2nd edition) 2002.
6. Guid e to the Control and Prevention of Hospital Infections Ministry of Health of Albania, National Center for Quality, Safety and Accreditation of Health Institutions. 2011. Nr.522.
7. Internacional Federation of Infection Control (IFIC) Kontrolli i infeksioneve: Parimet themelore dhe edukimi. 2004.
8. Udhëzime Praktike per Kontrollin e Infeksioneve ne Institucionet e Kujdesit Shëndetësor, Organizata Botërore e Shëndetësisë. 2003. Dhjetor.
9. Udhëzimet e OBSH-se për larjen e duarve në kujdesin shëndetësor. Prill. 2006.
10. Won SP, et al. Handwashing program for the prevention of nosocomial infections in aneonatal intensive care unit. Infection Control and Hospital Epidemiology. 2004;25:742–746. doi:

10.1086/502470. [DOI] [PubMed] [Google Scholar]
11. Camp 2. 2.Circulation for disinfection and sterilization in healthcare facilities. [Nov, 2008]. from: http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection.
12. French GL, Otter JA, Shannon KP, Adams NM, Watling D, Parks MJ. Tackling contamination of the hospital environment by methicillin-resistant Staphylococcus aureus (MRSA): A comparison between conventional terminal cleaning and hydrogen peroxide vapour decontamination. J Hosp Infect. 2004;57:31–37. doi: 10.1016/j.jhin.2004.03.006. [DOI] [PubMed] [Google Scholar]
13. Raport Nr: WHO/WPI/QPS/05.2.Pu International Society of Infectious Diseases. www.isid.org John Hopkins University-Infectious Diseases, http: // www. hopkins. 2008.
14. Raka L, et al. Higjiena e duarve në kujdesin shëndetësor. Prishtinë. 2010.
15. National Action Plan to prevent Health Care. Associated Infections: Road Map to Elimination. 2013. Apr,
16. Circulation for disinfection and sterilization in healthcare facilities. [Nov, 2008]. from: http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection.
17. Internet references: Health Authority, Acute Care Infection Prevention and Control Manual. [Google Scholar]
18. Adams JM, Djukic M, Gregas M, et al. (2018) Influence of nurse leader practice characteristics on patient outcomes: results from a multi-state study. Nursing Economics 36(6): 259–267.
19. Conger JA, Kanungo RN. (1988) The empowerment process: integrating theory and practice. Academy of Management Review 13(3): 471–482. DOI: 10.5465/amr.1988.4306983.
20. Allegranzi B, Nejad SB, Combescure C, et al. (2011) The burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. The Lancet 377(9761): 228–241. DOI: 10.1016/S0140-6736(10)61458-4.
21. Al-Tawfiq JA, Tambyah PA. (2014) Healthcare-associated infections (HAI) perspectives. Journal of Infection and Public Health 7(4): 339–344. DOI: 10.1016/j.jiph.2014.04.003.
22. Aromataris E, Munn Z. (2020) JBI Manual for evidence synthesis. In: Comprehensive Systematic Review for Advanced Practice Nursing. New York: Springer Publishing Company, 295–349. DOI: 10.1891/9780826152268.0012.
23. Asif M, Jameel A, Hussain A, et al. (2019) Linking transformational leadership with nurse-assessed adverse patient outcomes and the quality of care: assessing the role of job satisfaction and structural empowerment. International Journal of Environmental Research and Public Health 16(13): 2381. DOI: 10.3390/ijerph16132381. [DOI] [PMC free article] [PubMed] [Google Scholar]
24. Boamah SA, Spence Laschinger HK, Wong C, et al. (2018) Effect of transformational leadership on job satisfaction and patient safety outcomes. Nursing Outlook 66(2): 180–189. DOI: 10.1016/j.outlook.2017.10.004. [DOI] [PubMed] [Google Scholar]
25. Chen Y, Zhao JY, Shan X, et al. (2017) A point-prevalence survey of healthcare-associated infection in fifty-two Chinese hospitals. Journal of Hospital Infection 95(1): 105–111. DOI: 10.1016/j.jhin.2016.08.010. [DOI] [PubMed] [Google Scholar]
26. Cziraki K, Wong C, Kerr M, et al. (2020) Leader empowering behaviour: relationships with nurse and patient outcomes. Leadership in Health Services 33(4): 397–415. DOI: 10.1108/LHS-04-2020-0019. [DOI] [PubMed] [Google Scholar]
27. Ferreira TDM, Mesquita GR, Melo GC, et al. (2022) The influence of nursing leadership styles on the outcomes of patients, professionals and institutions: an integrative review. Journal of Nursing Management 30(4): 936–953. DOI: 10.1111/jonm.13592. [DOI] [PubMed] [Google Scholar]
28. Fisher (2019) Magnet vs . non-Magnet hospitals Leadership practices. 49(10), 26–31. [DOI] [PubMed] [Google Scholar]
29. Giuliani E, Lionte G, Ferri P, et al. (2018) The burden of not-weighted factors – nursing workload in a medical intensive care unit. Intensive and Critical Care Nursing 47: 98–101. DOI: 10.1016/j.iccn.2018.02.009.
30. Granqvist K, Ahlstrom L, Karlsson J, et al. (2024) Central aspects when implementing an electronic monitoring system for assessing hand hygiene in clinical settings: a grounded theory study. Journal of Infection Prevention 25: 51–58. DOI: 10.1177/17571774241230678. [DOI] [PMC free article] [PubMed] [Google Scholar]
31. Hackman R, Oldham GR. (1976) Motivation through the design of work: test of a theory. Organizational Behavior & Human Performance 16: 250–279. DOI: 10.1016/0378-1119(95)00438-C. [DOI] [Google Scholar]
32. Hegarty J, Murphy S, Creedon S, et al. (2019) Leadership perspective on the implementation of guidelines on healthcare-associated infections. BMJ Leader 3(2): 43–51. DOI: 10.1136/leader-2018-000111. [DOI] [Google Scholar]
33. Kliger J, Singer SJ, Hoffman FH. (2015) Using the integrated nurse leadership program to reduce sepsis mortality. Joint Commission Journal on Quality and Patient Safety 41(6): 264. DOI: 10.1016/S1553-7250(15)41036-0.
34. Kouzes JM, Posner BZ. (2017) The leadership challenge: how to make extraordinary things happen in organizations. The Canadian Journal of Physician Leadership 2(1): 1–28. [Google Scholar]
35. Labrague LJ. (2020) Influence of nurse managers' toxic leadership behaviours on nurse-reported adverse events and quality of care. Journal of Nursing Management 29: 855–863. [DOI] [PubMed] [Google Scholar]

36. Labrague, Al Sabei SD, AbuAlRub RF, et al. (2021) Authentic leadership, nurse-assessed adverse patient events and quality of care: the mediating role of nurses' safety actions. Journal of Nursing Management 29: 2152–2162. [DOI] [PubMed] [Google Scholar]
37. Landerfelt PE, Lewis A, Li Y, et al. (2020) Nursing leadership and the reduction of catheter-associated urinary tract infection. American Journal of Infection Control 48(12): 1546–1548. DOI: 10.1016/j.ajic.2020.07.018. [DOI] [PubMed] [Google Scholar]
38. Laschinger S, Leiter HK, MP. (2006) The impact of nursing work environments on patient safety outcomes. The Journal of Nursing Administration: The Journal of Nursing Administration 36(5): 259–267. DOI: 10.1097/00005110-200605000-00019. [DOI] [PubMed] [Google Scholar]
39. Lega F, Prenestini A, Rosso M. (2017) Leadership research in healthcare: a realist review. Health Services Management Research 30(2): 94–104. DOI: 10.1177/0951484817708915. [DOI] [PubMed] [Google Scholar]
40. Methley AM, Campbell S, Chew-Graham C, et al. (2014) PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. BMC Health Services Research 14(1): 579. DOI: 10.1186/s12913-014-0579-0. [DOI] [PMC free article] [PubMed] [Google Scholar]
41. Mitchell BG, Gardner A, Stone PW, et al. (2018) Hospital staffing and health care–associated infections: a systematic review of the literature. Joint Commission Journal on Quality and Patient Safety 44(10): 613–622. DOI: 10.1016/j.jcjq.2018.02.002. [DOI] [PubMed] [Google Scholar]
42. Neuman B., Fawcett J. Neuman Systems Model. 5th ed. Prentice Hall, Inc.; Boston, MA, USA: 2011. [Google Scholar]
43. World Health Organization Global Report on Infection Prevention and Control-Executive Summary. 2022. [(accessed on 6 February 2024)]. Available online: [URL removed].
44. JoAnna Briggs Institute. Critical Appraisal Tools. JBI; Adelaide, Australia: 2020. [(accessed on 10 February 2024)]. Available online: [URL removed]. [Google Scholar]
45. European Centre for Disease Prevention and Control . Surveillance of Healthcare-Associated Infections and Prevention Indicators in European Intensive Care Units-HAI-Net ICU Protocol Version 2.2. European Centre for Disease Prevention and Control; Solna, Sweden: 2017. [Google Scholar]
46. World Health Organization Core Competencies for Infection Prevention and Control Professionals. 2020. [(accessed on 7 February 2024)]. Available online: [URL removed].
47. Antonioli P., Bolognesi N., Valpiani G., Morotti C., Bernardini D., Bravi F., Di Ruscio E., Stefanati A., Gabutti G. A 2-year point-prevalence surveillance of healthcare-associated infections and antimicrobial use in Ferrara University Hospital, Italy. BMC Infect. Dis. 2020;20:75. doi: 10.1186/s12879-020-4791-8. [DOI] [PMC free article] [PubMed] [Google Scholar]
48. World Health Organization . Report on the Burden of Endemic Healthcare-Associated Infection Worldwide. World Health Organization; Geneva, Switzerland: 2011. WHO Library Cataloguing-in-Publication Data. [Google Scholar]
49. World Health Organization World Health Statistics 2016: Monitoring Health for the SDGs, Sustainable Development Goals. 2016. [(accessed on 5 February 2024)]. Available online: [URL removed].
50. Puro V., Coppola N., Frasca A., Gentile I., Luzzaro F., Peghetti A., Sganga G. Pillars for prevention and control of healthcare-associated infections: An Italian expert opinion statement. Antimicrob. Resist. Infect. Control. 2022;11:87. doi: 10.1186/s13756-022-01125-8. [DOI] [PMC free article] [PubMed] [Google Scholar]
51. Ferreira E., Pina E., Sousa-Uva M., Sousa-Uva A. Risk factors for health care–associated infections: From better knowledge to better prevention. Am. J. Infect. Control. 2017;45:e103–e107. doi: 10.1016/j.ajic.2017.03.036. [DOI] [PubMed] [Google Scholar]
52. Alnadawy O.H., Alfahmi M.S.S., Takroni A.A.E., Haqwi N.M., Albogami N.F., Dowaid E.A.A. Nursing Interventions for Preventing Hospital-Acquired Infections. Int. J. Sci. Res. Manag. 2024;12:1292–1300. doi: 10.18535/ijsrm/v12i11.mp03. [DOI] [Google Scholar]
53. Lastinger L.M., Alvarez C.R., Kofman A., Konnor R.Y., Kuhar D.T., Nkwata A., Patel P.R., Pattabiraman V., Xu S.Y., Dudeck M.A. Continued increases in the incidence of healthcare-associated infection (HAI) during the second year of the coronavirus disease 2019 (COVID-19) pandemic. Infect. Control Hosp. Epidemiol. 2023;44:997–1001. doi: 10.1017/ice.2022.116. [DOI] [PMC free article] [PubMed] [Google Scholar]
54. Schwendimann R., Blatter C., Dhaini S., Simon M., Ausserhofer D. The occurrence, types, consequences and preventability of in-hospital adverse events—A scoping review. BMC Health Serv. Res. 2018;18:521. doi: 10.1186/s12913-018-3335-z. [DOI] [PMC free article] [PubMed] [Google Scholar]
55. World Health Organization . Infection Prevention and Control Guidance to Action Tools. World Health Organization; Geneva, Switzerland: 2021.
56. World Health Organization (2009) WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care Is Safer Care. Geneva, Switzerland: WHO. *PubMed Google Scholar*
57. Suetens C, Latour K, Kärki T, et al. (2018) Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European

point prevalence surveys, 2016 to 2017. Euro Surveillance 23(46): 1–17. DOI: 10.2807/1560-7917.ES.2018.23.46.1800516. *DOI PMC free article PubMed Google Scholar*

58. van Buijtene A, Foster D. (2019) Does a hospital culture influence adherence to infection prevention and control and rates of healthcare associated infection? A literature review. Journal of Infection Prevention 20(1): 5–17. DOI: 10.1177/1757177418805833. *DOI PMC free article PubMed Google Scholar*
59. World Health Organization (2020) Core competencies for infection prevention and control. *Available online Google Scholar*
60. Storr J, Twyman A, Zingg W, et al. (2017) Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. Antimicrobial Resistance and Infection Control 6(1): 6. DOI: 10.1186/s13756-016-0149-9. *DOI PMC free article PubMed Google Scholar*
61. Zimlichman E, Henderson D, Tamir O, et al. (2013) Health care–associated infections. JAMA Internal Medicine 173(22): 2039. DOI: 10.1001/jamainternmed.2013.9763. *DOI PubMed Google Scholar*
62. Walumbwa FO, Avolio BJ, Gardner WL, et al. (2008) Authentic leadership: development and validation of a theory-based measure. Journal of Management 34(1): 89–126. DOI: 10.1177/0149206307308913. *DOI Google Scholar*
63. Wong C, Giallonardo L. (2013) Authentic leadership and nurse-assessed adverse patient outcomes. Journal of Nursing Management 21(5): 740–752. DOI: 10.1111/jonm.12075. *DOI PubMed Google Scholar*
64. Sochalski J. (2001) Quality of care, nurse staffing, and patient outcomes. Policy, Politics, and Nursing Practice 2(1): 9–18. DOI: 10.1177/152715440100200103. *DOI Google Scholar*
65. Northouse PG. (2016) Leadership: Theory and Practice (7th edition). Thousand Oaks, CA: Sage. Journal of Educational Administration, 46, 91–94. *Google Scholar*
66. Warshawsky NE. (2020) A complexity-informed model to guide nurse manager practice. Nursing Administration Quarterly 44(3): 198–204. DOI: 10.1097/NAQ.0000000000000424. *DOI PubMed Google Scholar*
67. World Health Organization Global Report on Infection Prevention and Control-Executive Summary. 2022. *(accessed on 6 February 2024)*. Available online: *URL removed*.
68. Zaghini F, Biagioli V, Proietti M, et al. (2020) The role of occupational stress in the association between emotional labor and burnout in nurses: a cross-sectional study. Applied Nursing Research 54: 151277. DOI: 10.1016/j.apnr.2020.151277. *DOI PubMed Google Scholar*
69. Zingg W, Holmes A, Dettenkofer M, et al. (2015) Hospital organisation, management, and structure for prevention of health-care-associated infection: a systematic review and expert consensus. The Lancet Infectious Diseases 15(2): 212–224. DOI: 10.1016/S1473-3099(14)70854-0. *DOI PubMed Google Scholar*
70. Webster J., Osborne S., Rickard C.M., Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Cochrane Database Syst. Rev. 2019;2019:CD007798. doi: 10.1002/14651858.CD007798.pub5. [DOI] [PMC free article] [PubMed] [Google Scholar]
71. Ullman A.J., Cooke M.L., Mitchell M., Lin F., New K., Long D.A., Mihala G., Rickard C.M. Dressings and securement devices for central venous catheters (CVC) Cochrane Database Syst. Rev. 2015;2019:CD010367. doi: 10.1002/14651858.CD010367.pub2. [DOI] [PMC free article] [PubMed] [Google Scholar]
72. Zingg W, Holmes A, Dettenkofer M, et al. (2015) Hospital organisation, management, and structure for prevention of health-care-associated infection: a systematic review and expert consensus. The Lancet Infectious Diseases 15(2): 212–224. DOI: 10.1016/S1473-3099(14)70854-0. [DOI] [PubMed] [Google Scholar]
73. Zimlichman E, Henderson D, Tamir O, et al. (2013) Health care–associated infections. JAMA Internal Medicine 173(22): 2039. DOI: 10.1001/jamainternmed.2013.9763. [DOI] [PubMed] [Google Scholar]
74. Srigley J.A., Furness C.D., Gardam M. Interventions to improve patient hand hygiene: A systematic review. J. Hosp. Infect. 2016;94:23–29. doi: 10.1016/j.jhin.2016.04.018. [DOI] [PubMed] [Google Scholar]
75. Suetens C, Latour K, Kärki T, et al. (2018) Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European point prevalence surveys, 2016 to 2017. Euro Surveillance 23(46): 1–17. DOI: 10.2807/1560-7917.ES.2018.23.46.1800516. [DOI] [PMC free article] [PubMed] [Google Scholar]
76. Warshawsky NE. (2020) A complexity-informed model to guide nurse manager practice. Nursing Administration Quarterly 44(3): 198–204. DOI: 10.1097/NAQ.0000000000000424. [DOI] [PubMed] [Google Scholar]
77. O'Horo J.C., Silva G.L.M., Munoz-Price L.S., Safdar N. The Efficacy of Daily Bathing with Chlorhexidine for Reducing Healthcare-Associated Bloodstream Infections: A Meta-analysis. Infect. Control Hosp. Epidemiol. 2012;33:257–267. doi: 10.1086/664496. [DOI] [PubMed] [Google Scholar]