



Healthcare-Associated Infections: Emerging Challenges, Antimicrobial Resistance, and Strategies for Effective Infection Prevention and Control

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DOI: <https://doi.org/10.68050/JAMS.2026.589>

Received: 24 September 2026; Accepted: 30 September 2026; Published: 06 October 2026

ABSTRACT

Healthcare-associated infections (HAIs) are an important cause of preventable morbidity and mortality and remain a major challenge to patient safety and healthcare quality. These infections can develop during healthcare delivery and are associated with prolonged hospitalization, increased treatment costs, and additional pressure on healthcare resources. The burden is particularly significant in low- and middle-income countries, where limitations in infection prevention infrastructure, surveillance, trained personnel, and water, sanitation and hygiene services may increase the risk of transmission. The emergence and spread of antimicrobial-resistant (AMR) microorganisms further complicate the prevention and treatment of HAIs. This narrative review summarizes the major types of HAIs, commonly associated microorganisms, risk factors, antimicrobial resistance, diagnostic approaches, and surveillance practices. It also discusses essential infection prevention and control (IPC) measures, including hand hygiene, appropriate use of personal protective equipment, environmental cleaning, sterilization and disinfection, safe healthcare practices, isolation precautions, and antimicrobial stewardship. Particular attention is given to challenges in implementing effective HAI prevention and surveillance in India. Strengthening evidence-based IPC programmes, microbiological surveillance, healthcare-worker training, rational antimicrobial use, and institutional commitment is essential for reducing the burden of HAIs. An integrated approach combining infection prevention, early diagnosis, surveillance, and antimicrobial stewardship can contribute to safer healthcare delivery and help limit the spread of antimicrobial resistance. Keywords Healthcare-associated infections; Infection prevention and control; Antimicrobial resistance; Hospital-acquired infections; Infection surveillance; Antimicrobial stewardship; Patient safety

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Review Approach

This article is presented as a narrative review of healthcare-associated infections, antimicrobial resistance, diagnostic and surveillance approaches, and infection-prevention strategies, with emphasis on the Indian context. It synthesizes the guidance and studies listed in the reference section, including publications from the World Health Organization and the Centers for Disease Control and Prevention, together with Indian surveillance studies. No original patient data were collected, and no quantitative meta-analysis was performed. Because a reproducible database search strategy and formal study-selection process were not documented in the source manuscript, this review should not be interpreted as a systematic review.

INTRODUCTION

Healthcare-associated infections (HAIs) are infections acquired during the provision of healthcare and represent an important challenge to patient safety and quality of care. They may occur in hospitals and other healthcare settings and can result in increased morbidity, mortality, prolonged hospital stays and additional healthcare costs. HAIs remain among the most frequent adverse events associated with healthcare delivery, and no healthcare system is completely free from this problem.



The burden of HAIs is particularly important in low- and middle-income countries (LMICs). According to the World Health Organization (WHO), approximately 7 out of 100 patients in acute-care hospitals in high-income countries and 15 out of 100 patients in LMICs acquire at least one HAI during their hospital stay. Limited infection-prevention infrastructure, inadequate water, sanitation and hygiene (WASH) facilities, insufficient surveillance, and gaps in healthcare-worker training can contribute to increased infection risk.

HAIs may be caused by bacteria, viruses, fungi and other microorganisms. The risk is increased by factors such as invasive medical devices, surgical procedures, prolonged hospitalization, intensive-care admission, immunosuppression and inappropriate antimicrobial use. Healthcare environments can also facilitate transmission between patients, healthcare workers and contaminated equipment or surfaces.

Antimicrobial resistance (AMR) has further complicated the management of HAIs. Multidrug-resistant organisms can limit therapeutic options and increase the difficulty of controlling transmission. The WHO recognizes HAIs and AMR as closely interconnected problems requiring integrated infection prevention and control (IPC), surveillance and antimicrobial-stewardship approaches.

Effective IPC is therefore central to reducing HAIs. Measures such as hand hygiene, appropriate use of personal protective equipment, environmental cleaning, sterilization and disinfection, safe device management, isolation precautions and appropriate antimicrobial use can substantially reduce preventable infections. WHO also emphasizes that IPC programmes should be supported by adequate WASH infrastructure and sustained institutional commitment.

In India, strengthening systematic HAI surveillance and IPC programmes is particularly important. A multicentre surveillance network involving 26 tertiary hospitals demonstrated the feasibility of standardized surveillance for healthcare-associated bloodstream and urinary tract infections in Indian hospitals. Such surveillance can help identify infection patterns and gaps in prevention practices.

Therefore, this review focuses on the major types of HAIs, their causative microorganisms and risk factors, the contribution of antimicrobial resistance, diagnostic and surveillance approaches, and evidence-based strategies for prevention and control, with particular consideration of challenges relevant to India.

Types of Healthcare-Associated Infections and Epidemiology

Healthcare-associated infections can affect different organs and systems depending on the patient's condition, healthcare procedure, and exposure to invasive devices. The most commonly monitored HAIs include catheter-associated urinary tract infection (CAUTI), central-line-associated bloodstream infection (CLABSI), surgical-site infection (SSI), hospital-acquired pneumonia (HAP), and ventilator-associated pneumonia (VAP). Their occurrence varies according to the healthcare setting, patient population, procedures performed, and effectiveness of infection-prevention practices.

Catheter-Associated Urinary Tract Infection

CAUTI is a urinary tract infection associated with the use of an indwelling urinary catheter. Catheterization can facilitate the entry and colonization of microorganisms into the urinary tract, particularly when the catheter remains in place for a prolonged period. Common organisms include *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, *Enterococcus* spp., and *Candida* spp. Appropriate catheter insertion, maintenance of a closed drainage system, aseptic technique, and removal of unnecessary catheters are important preventive measures.

Central-Line-Associated Bloodstream Infection

CLABSI is a serious bloodstream infection occurring in patients with central venous catheters. Microorganisms may enter through the catheter insertion site, catheter hub, or contaminated equipment. Common causative organisms include *Staphylococcus aureus*, coagulase-negative *Staphylococcus*, *Enterococcus* spp., *Enterobacterales*, and *Candida* spp. Proper hand hygiene, aseptic catheter insertion,



appropriate skin antisepsis, catheter-site care, and timely removal of unnecessary lines are important preventive strategies.

Surgical-Site Infection

SSI occurs at or near a surgical incision following an operative procedure. It may involve the skin and subcutaneous tissue or extend to deeper tissues and organs. Risk factors include contamination of the surgical site, prolonged or complex surgery, inadequate aseptic practices, and patient-related factors. *S. aureus*, Enterobacterales, and other organisms may cause SSIs. Appropriate surgical hand preparation, aseptic technique, antimicrobial prophylaxis when indicated, and proper wound care help reduce the risk.

Hospital-Acquired and Ventilator-Associated Pneumonia

HAP develops during hospitalization and is not present or incubating at the time of admission. VAP is a form of pneumonia occurring in patients receiving mechanical ventilation. These infections are particularly important in intensive-care units (ICUs). Common pathogens include *P. aeruginosa*, *Acinetobacter baumannii*, Enterobacterales, and *S. aureus*. Prevention includes appropriate respiratory equipment handling, hand hygiene, oral care, appropriate positioning, and minimizing unnecessary mechanical ventilation.

Epidemiological Importance

The epidemiology of HAIs differs between countries and healthcare facilities. According to the WHO, approximately 7% of patients in acute-care hospitals in high-income countries and 15% in low- and middle-income countries acquire at least one HAI during hospitalization. The burden is influenced by healthcare infrastructure, patient characteristics, invasive procedures, antimicrobial use, and adherence to infection prevention and control (IPC) practices.

In India, systematic surveillance is increasingly being recognized as an important component of HAI prevention. Standardized surveillance enables hospitals to identify infection trends, compare infection rates, recognize outbreaks, and assess the effectiveness of preventive interventions.

Causative Microorganisms and Risk Factors

Healthcare-associated infections may be caused by a wide range of bacterial, viral and fungal pathogens. However, bacterial organisms are particularly important because of their ability to colonize patients, healthcare environments and medical devices, and because many healthcare-associated bacterial infections involve antimicrobial-resistant strains. Commonly reported organisms include *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* and *Enterococcus* spp. These organisms are also included among important antimicrobial-resistant bacterial pathogens of public-health concern.

Major Causative Microorganisms

Gram-positive bacteria: *S. aureus*, including methicillin-resistant *S. aureus* (MRSA), coagulase-negative *Staphylococcus* spp., and *Enterococcus* spp. Are frequently associated with bloodstream, surgical-site and device-associated infections.

Gram-negative bacteria: Enterobacterales such as *E. coli* and *K. pneumoniae*, along with *P. aeruginosa* and *A. baumannii*, are important causes of urinary tract, bloodstream, wound and respiratory infections. Their clinical importance is increased by the emergence of extended-spectrum β -lactamase (ESBL)-producing, carbapenem-resistant and other multidrug-resistant strains.

Fungi: *Candida* species can cause healthcare-associated infections, particularly bloodstream infections and infections in patients with invasive devices or prolonged hospitalization.



Viruses: Respiratory viruses such as influenza viruses, respiratory syncytial virus and SARS-CoV-2 can spread within healthcare facilities, particularly when infection-control precautions are inadequate.

Risk Factors

The development of HAIs generally results from an interaction between patient-related factors, healthcare procedures and environmental factors. Important patient-related factors include advanced age, severe underlying disease, immunosuppression, chronic illnesses, malnutrition and prolonged hospitalization. Patients requiring intensive care are particularly vulnerable because they frequently undergo invasive procedures and require complex medical support.

Healthcare-associated factors include the use of urinary and vascular catheters, mechanical ventilation, surgery, dialysis and other invasive procedures. Prolonged use of these devices can provide pathways for microorganisms to enter normally protected body sites. Inadequate hand hygiene, improper sterilization or disinfection, contaminated equipment, poor environmental cleaning and inappropriate use of personal protective equipment can further facilitate transmission.

Antimicrobial exposure is another important factor because inappropriate or prolonged antimicrobial use can select for resistant microorganisms. Longer hospital stays also increase the duration of exposure to healthcare environments, invasive devices and antimicrobial-resistant organisms. Evidence from systematic reviews has consistently identified invasive procedures, prolonged hospitalization, chronic disease, immunosuppression and device use among important risk factors for HAIs.

Antimicrobial Resistance in Healthcare-Associated Infections

Antimicrobial resistance (AMR) is a major challenge in the management of healthcare-associated infections (HAIs). It occurs when microorganisms develop the ability to survive or grow despite exposure to antimicrobial medicines that would normally inhibit or kill them. Healthcare facilities can facilitate the emergence and transmission of resistant organisms because of frequent antimicrobial exposure, high numbers of vulnerable patients, invasive procedures, and close contact between patients, healthcare workers, equipment and the environment. The WHO identifies HAIs as an important driver of AMR and emphasizes infection prevention and control (IPC) as a key strategy for limiting its spread.

Common antimicrobial-resistant organisms associated with healthcare settings include methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus faecium* (VRE), extended-spectrum β -lactamase (ESBL)-producing *Enterobacterales*, carbapenem-resistant *Enterobacterales* (CRE), carbapenem-resistant *Acinetobacter baumannii*, and carbapenem-resistant *Pseudomonas aeruginosa*. The WHO 2024 Bacterial Priority Pathogens List places carbapenem-resistant *A. baumannii* and carbapenem- and third-generation-cephalosporin-resistant *Enterobacterales* in the critical-priority category, while MRSA, vancomycin-resistant *E. faecium*, and carbapenem-resistant *P. aeruginosa* are classified as high-priority pathogens.

Several factors contribute to AMR in healthcare settings. Inappropriate antimicrobial prescribing, unnecessary or prolonged antibiotic therapy, inadequate infection-control practices, poor hand hygiene, insufficient environmental cleaning, and inappropriate use of invasive devices can increase selection and transmission of resistant organisms. Horizontal transmission may occur through contaminated hands, medical equipment, surfaces or direct contact between individuals.

AMR also increases the complexity and cost of HAI management. Resistant infections may require alternative or reserve antimicrobials, prolonged hospitalization and additional laboratory testing. In severe infections, limited therapeutic options can contribute to poorer clinical outcomes. Therefore, prevention of infection is particularly important because preventing an infection also reduces the need for antimicrobial treatment. WHO describes strong IPC, including hand hygiene and healthcare-environment hygiene, as a fundamental approach to limiting AMR transmission.



Antimicrobial stewardship (AMS) complements IPC by promoting appropriate antimicrobial selection, dose, route and duration according to clinical and microbiological evidence. Microbiology laboratories have an important role in stewardship through accurate organism identification and antimicrobial susceptibility testing (AST), which can support targeted rather than unnecessary broad-spectrum therapy. Regular monitoring of antimicrobial resistance patterns can also help healthcare facilities develop appropriate empirical treatment guidelines.

Thus, controlling AMR-associated HAIs requires an integrated approach involving infection prevention, microbiological surveillance, antimicrobial stewardship, environmental hygiene, healthcare-worker education and appropriate antimicrobial prescribing. Combining these measures can reduce transmission of resistant organisms while preserving the effectiveness of available antimicrobial agents.

Diagnosis and Surveillance

Early diagnosis and systematic surveillance are essential for identifying healthcare-associated infections (HAIs), guiding appropriate treatment, detecting outbreaks, and evaluating infection-prevention measures. HAI surveillance should use standardized case definitions and consistent methods so that infection trends can be reliably measured and compared between healthcare facilities. The WHO 2024 practical handbook provides simplified and validated HAI case definitions and guidance for surveillance at national and healthcare-facility levels.

Laboratory Diagnosis

Diagnosis begins with clinical assessment and appropriate specimen collection according to the suspected site of infection. Depending on the infection, specimens may include urine, blood, respiratory samples, wound/pus specimens, cerebrospinal fluid, or other relevant clinical material. Proper collection, labelling, transport and processing are important to minimize contamination and ensure reliable results.

Microscopic examination, culture and identification remain important approaches for bacterial and fungal infections. Culture allows isolation of the causative organism, followed by identification using conventional biochemical tests or automated systems. Molecular methods such as polymerase chain reaction (PCR) and other nucleic-acid amplification techniques may provide more rapid detection of specific pathogens or resistance determinants when available. CDC laboratory resources include testing approaches for important HAI pathogens and antimicrobial-resistance detection.

Antimicrobial susceptibility testing (AST) is particularly important in HAIs because resistant organisms are common in healthcare settings. AST helps determine the susceptibility of an isolate to antimicrobial agents and supports targeted therapy. Standardized laboratory methods and interpretation criteria should be followed to ensure reliable results.

HAI Surveillance

HAI surveillance involves systematic collection, analysis and interpretation of infection-related data. Important information may include the number and type of infections, patient characteristics, device exposure, microbiological findings, antimicrobial susceptibility patterns and infection rates.

Surveillance can be prospective or retrospective and may focus on specific infections such as CAUTI, CLABSI, SSI or VAP. Device-associated infection rates can be related to device-days, while surgical-site surveillance can be linked to procedures performed. Regular analysis allows infection-control teams to identify unusual increases, recognize possible outbreaks and assess the effectiveness of interventions.

Role of Microbiology and Infection-Control Teams

The microbiology laboratory and infection-control team should work together to identify important pathogens and resistance patterns and communicate significant findings promptly. Surveillance data can guide infection-



control interventions, antimicrobial stewardship and hospital policies. WHO emphasizes that HAI surveillance is a core component of effective infection prevention and control programmes.

Prevention and Infection Control

Effective infection prevention and control (IPC) is the primary approach for reducing healthcare-associated infections (HAIs). WHO considers IPC a fundamental component of safe, high-quality healthcare and recommends structured IPC programmes at both national and healthcare-facility levels. A combination of standard precautions, transmission-based precautions, surveillance, staff training and adequate infrastructure is required for sustained infection prevention.

Hand Hygiene

Hand hygiene is one of the simplest and most important measures for preventing transmission of microorganisms in healthcare settings. Healthcare workers should perform hand hygiene at appropriate moments during patient care, using an alcohol-based hand rub when appropriate or soap and water when hands are visibly soiled. Improving hand-hygiene compliance can reduce transmission of healthcare-associated pathogens and multidrug-resistant organisms.

Standard and Transmission-Based Precautions

Standard precautions should be applied to all patients, regardless of their suspected or confirmed infection status. They include hand hygiene, appropriate use of personal protective equipment (PPE), respiratory hygiene, safe injection practices, appropriate patient placement, and safe handling of contaminated equipment and materials. Transmission-based precautions, including contact, droplet and airborne precautions, are added when specific infections or colonization require additional measures.

Sterilization and Disinfection

Reusable medical instruments must be appropriately cleaned and reprocessed before reuse. Sterilization is required for critical items that enter sterile tissues or the vascular system, whereas appropriate levels of disinfection are used for items according to their intended contact with patients. Proper cleaning before disinfection or sterilization is essential because organic material can interfere with the effectiveness of the process.

Environmental Cleaning and Waste Management

Contaminated surfaces and equipment can contribute to transmission of healthcare-associated microorganisms. Regular cleaning and appropriate disinfection of frequently touched surfaces, patient-care areas and medical equipment are therefore important. Proper segregation, handling and disposal of healthcare waste and safe management of linen also reduce opportunities for transmission. WHO emphasizes that environmental cleaning is an important component of HAI and AMR prevention, particularly in resource-limited settings.

Prevention of Device-Associated Infections

Invasive devices such as urinary catheters, central venous catheters and mechanical ventilators increase infection risk. Their use should therefore be based on clinical need, with appropriate insertion and maintenance practices. Unnecessary devices should be removed as soon as they are no longer required. Specific prevention strategies should be incorporated into care bundles for CAUTI, CLABSI and VAP.

Safe Injection and Surgical Practices

Safe injection practices prevent transmission of blood-borne pathogens and include use of sterile equipment and appropriate medication-handling procedures. Surgical-site infections can be reduced through appropriate surgical hand preparation, aseptic technique, skin preparation, environmental control and evidence-based



perioperative practices. WHO identifies injection safety and surgical-site infection prevention as important components of comprehensive IPC programmes.

Healthcare-Worker Education and Institutional Support

Successful IPC requires continuous education and training of healthcare workers, adequate supplies, monitoring of compliance and strong institutional leadership. WHO recommends multimodal strategies, combining education, monitoring and feedback, communication, availability of necessary resources and institutional safety culture rather than relying on a single intervention.

Overall, effective HAI prevention depends on the consistent implementation of hand hygiene, standard precautions, appropriate device management, sterilization and disinfection, environmental cleaning, surveillance, staff education and antimicrobial stewardship. These measures should be integrated into routine healthcare practice and regularly evaluated for effectiveness.

Challenges in India and Future Perspectives

India has made progress in strengthening infection prevention and control (IPC) and healthcare-associated infection (HAI) surveillance; however, important implementation challenges remain. These include variation in healthcare infrastructure, shortage of trained IPC personnel, limited laboratory capacity, inadequate surveillance systems, inconsistent availability of supplies, and differences in infection-control practices between healthcare facilities. WHO identifies gaps in HAI surveillance expertise, human resources, information systems, microbiology capacity, WASH infrastructure and isolation facilities as important barriers in resource-constrained settings.

Challenges in the Indian Healthcare System

A major challenge is the limited availability of standardized and continuous HAI surveillance data across healthcare facilities. Indian studies have highlighted difficulties related to human resources, funding, digitalization, laboratory practices and consistent reporting. A 2024 evaluation of an Indian HAI bloodstream-infection surveillance network involving 39 hospitals across 22 states found that standardized surveillance was feasible, but sustainability required improved staffing, digital systems, microbiological practices, feedback mechanisms and financial support.

Another challenge is the increasing burden of antimicrobial resistance (AMR). HAIs can facilitate the selection and transmission of resistant microorganisms, while inappropriate antimicrobial use can further promote resistance. Consequently, IPC, microbiological surveillance and antimicrobial stewardship need to be implemented together rather than as separate activities.

Future Perspectives

Future HAI prevention in India should focus on strengthening standardized national surveillance, microbiology laboratories, digital reporting systems and trained IPC teams. Regular monitoring and feedback can help hospitals identify gaps and measure improvements.

Greater use of rapid diagnostic methods, molecular testing and genomic surveillance may improve the detection and characterization of resistant pathogens. Digital health technologies can also facilitate real-time collection and analysis of HAI and antimicrobial-resistance data.

Future programmes should further integrate IPC with antimicrobial stewardship, WASH improvement, occupational safety, environmental cleaning and patient-safety initiatives. WHO emphasizes sustained investment, multimodal IPC strategies and stronger surveillance as important priorities for reducing HAIs and AMR.

For India, strengthening collaboration among hospitals, microbiology laboratories, public-health institutions



and national surveillance programmes can improve the quality and usefulness of HAI data. The National Centre for Disease Control (NCDC) currently supports national AMR surveillance and related infection-prevention activities, providing an important framework for continued development of surveillance and stewardship capacity.

Overall, the future approach should move from reactive infection management toward proactive prevention, supported by reliable surveillance, rapid diagnosis, evidence-based IPC practices, antimicrobial stewardship and continuous healthcare-worker training.

CONCLUSION

Healthcare-associated infections (HAIs) remain a significant challenge to patient safety, healthcare quality and antimicrobial-resistance (AMR) control. They are associated with increased morbidity, mortality, prolonged hospitalization and additional healthcare costs. However, a substantial proportion of HAIs can be prevented through effective infection prevention and control (IPC) practices and adequate water, sanitation and hygiene (WASH) services.

Prevention requires a multidimensional approach involving hand hygiene, appropriate use of personal protective equipment, environmental cleaning, sterilization and disinfection, safe management of invasive devices, appropriate antimicrobial use, laboratory support and continuous surveillance. Standardized surveillance is particularly important for identifying infection trends, detecting outbreaks and evaluating the effectiveness of preventive interventions. WHO's 2024 surveillance handbook emphasizes facility- and national-level HAI surveillance as a core component of IPC programmes.

In India, strengthening standardized HAI surveillance, microbiological capacity and IPC infrastructure remains important. Evidence from the Indian HAI surveillance network demonstrates the feasibility of coordinated surveillance across hospitals and provides a foundation for improving infection-prevention strategies.

Overall, sustained institutional commitment, trained healthcare personnel, reliable microbiological and surveillance systems, antimicrobial stewardship, and adequate IPC and WASH infrastructure are essential for reducing the burden of HAIs. Integrating these measures into routine healthcare practice can improve patient safety while also helping to limit the emergence and transmission of antimicrobial-resistant microorganisms.

Table 1. Common healthcare-associated infections and key prevention priorities

Infection type	Commonly associated organisms	Key prevention priorities
Catheter-associated urinary tract infection (CAUTI)	<i>E. coli</i> , <i>Klebsiella</i> spp., <i>Pseudomonas aeruginosa</i> , <i>Enterococcus</i> spp.	Avoid unnecessary catheterization; aseptic insertion; closed drainage; prompt removal.
Central-line-associated bloodstream infection (CLABSI)	<i>S. aureus</i> , coagulase-negative staphylococci, <i>Enterococcus</i> spp., <i>Enterobacterales</i> , <i>Candida</i> spp.	Hand hygiene; aseptic insertion; skin antisepsis; line-site care; prompt removal.
Surgical-site infection (SSI)	<i>S. aureus</i> and other skin or enteric organisms, depending on procedure	Surgical asepsis; appropriate skin preparation; indicated prophylaxis; wound care.
Hospital-/ventilator-associated pneumonia (HAP/VAP)	<i>P. aeruginosa</i> , <i>Acinetobacter baumannii</i> , <i>Enterobacterales</i> , <i>S. aureus</i>	Hand hygiene; respiratory equipment care; oral care; appropriate positioning; reduce ventilation duration where possible.

REFERENCES

1. World Health Organization. Global report on infection prevention and control 2024. Geneva: World Health Organization; 2024. ISBN: 978-92-4-010398-6
2. World Health Organization. Surveillance of health care-associated infections at national and facility levels: practical handbook. Geneva: World Health Organization; 2024. ISBN: 978-92-4-010145-6.
3. Swaminathan S, Prasad J, Dhariwal AC, Guleria R, Misra MC, Malhotra R, et al. Strengthening infection prevention and control and systematic surveillance of healthcare associated infections in India. *BMJ*. 2017;358:j3768. doi:10.1136/bmj.j3768.
4. Mathur P, Malpiedi P, Walia K, Srikantiah P, Gupta S, Lohiya A, et al. Health-care-associated bloodstream and urinary tract infections in a network of hospitals in India: a multicentre, hospital-based, prospective surveillance study. *Lancet Glob Health*. 2022;10(9):e1317-e1325. doi:10.1016/S2214-109X(22)00274-1.
5. Tartari E, Tomczyk S, Twyman A, Rehse APC, Gomaa M, Talaat M, et al. Evaluating national infection prevention and control minimum requirements: evidence from global cross-sectional surveys, 2017-22. *Lancet Glob Health*. 2024;12(10):e1620-e1628. doi:10.1016/S2214-109X(24)00277-8.
6. World Health Organization. Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Geneva: World Health Organization; 2016.
7. World Health Organization. WHO bacterial priority pathogens list, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. Geneva: World Health Organization; 2024.
8. World Health Organization. Global action plan and monitoring framework on infection prevention and control, 2024-2030. Geneva: World Health Organization; 2024.
9. World Health Organization. The case for investment and action in infection prevention and control. Geneva: World Health Organization; 2025.
10. World Health Organization. Global report on infection prevention and control 2024: executive summary. Geneva: World Health Organization; 2024.
11. Centers for Disease Control and Prevention. Standard precautions for all patient care. Atlanta: CDC; 2024.
12. Centers for Disease Control and Prevention. Disinfection and sterilization guideline: methods of sterilization and disinfection. Atlanta: CDC; 2023.
13. World Health Organization. Hand hygiene in health care: WHO guidelines on hand hygiene in health care. Geneva: World Health Organization; 2009.
14. World Health Organization. Environmental cleaning and infection prevention and control in health care facilities. Geneva: World Health Organization; 2023.
15. World Health Organization. Infection prevention and control: global progress report and related resources. Geneva: World Health Organization; 2024.

DECLARATIONS

1. **Funding:** No specific funding statement was provided in the source manuscript; please confirm and amend before submission.
2. **Conflict of interest:** The author should confirm whether any competing interests exist.
3. **Ethics approval:** Not applicable to this narrative review, which does not report original human-participant data.
4. **Data availability:** No new datasets were generated or analysed for this review.