Review Article
2025, 15(4): 76-91
DOI: 10.22038/EBCJ.2025.89133.3163

Received: 05/07/2025
Accept & ePublished: 09/12/2025

Evidence Based Care Journal
http://ebcj.mums.ac.ir
Online ISSN: 2008-370X

Strategies for Reducing Nosocomial Infection in Iranian Hospitals: A Scoping Review

Mohammad Abbaszadeh Bazi[1], Monireh Shamsaei[2], Mahdieh Poodineh Moghadam[3], Aliyeh Bazi[4], Parvaneh Isfahani[5*], Marzieh Arefi[6], Sogand Zainali[7]

Abstract

Background: Hospital-acquired infections (HAIs)—also known as nosocomial infections—represent a significant global public health concern, especially in developing countries such as Iran.

Aim: This review was conducted with aim to identify and synthesize effective strategies for reducing nosocomial infections in Iranian hospitals.

Method: In accordance with the Joanna Briggs Institute (JBI) Manual and PRISMA-ScR guidelines, a comprehensive literature search was performed in PubMed, Web of Science, Scopus, SID, Magiran, and Google Scholar up to January 31, 2025. Studies conducted among healthcare professionals in Iranian hospitals that evaluated infection prevention and control interventions were included. After screening and eligibility assessment, 41 studies were analyzed.

Results: The included studies, conducted across multiple provinces in Iran, identified strategies grouped into six domains: governance and leadership, financing, human resources, infrastructure, medical products and equipment, and information systems and service delivery. Key interventions comprised continuous training of healthcare staff, strict adherence to hand hygiene protocols, regular infection control audits, improvement of hospital environments, rational antibiotic stewardship, and development of national infection control guidelines. Additional strategies involved strengthening infection control committees, promoting interdisciplinary collaboration, enhancing workforce competency, and raising public awareness about infection prevention.

Implications for Practice: A comprehensive, multi-faceted, and evidence-based approach is essential to effectively reduce HAIs in Iranian hospitals. Sustained education, leadership engagement, robust monitoring systems, and adherence to national and international standards are critical. Policymakers should integrate these strategies into national health policies to improve overall healthcare quality.

Keywords: Hospital-Acquired Infection, Infection Control, Iran, Nosocomial Infection, Prevention Strategy, Scoping Review

1. Assistant Professor, Department of Public Health, School of Public Health, Zabol University of Medical Sciences, Zabol, Iran
2. Assistant Professor, Department of Health Services Management, School of Public Health, Zabol University of Medical Sciences, Zabol, Iran
3. Assistant Professor, Department of Medical Surgical Nursing, School of Nursing and Midwifery, Zabol University of Medical Sciences Zabol, Iran
4. Assistant Professor, Department of Clinical Pharmacy, School of Pharmacy, Zabol University of Medical Sciences, Zabol, Iran
5. Associate Professor, Department of Health Services Management, School of Public Health, Zabol University of Medical Sciences, Zabol, Iran
6. Lecturer, Department of Health Services Management, School of Public Health, Zabol University of Medical Sciences, Zabol, Iran
7. BSc in Health Management, Department of Health Services Management, School of Public Health, Zabol University of Medical Sciences, Zabol, Iran

* Corresponding Author Email: p.isfehani@gmail.com

Introduction

Hospitals are complex sociotechnical systems that deliver diagnostic, therapeutic, and rehabilitative care through the coordinated use of specialized healthcare professionals, biomedical technologies, and physical infrastructure. Their central mission is to improve population health outcomes by providing cost-effective, evidence-based services (1). However, increasing expectations for high-quality and safe patient care, along with technological advancements, a rise in invasive procedures, and expanded use of immunosuppressive therapies, have collectively led to an **i**ncrease in the incidence of nosocomial infections (2). Healthcare-associated infections (HAIs) remain a major global public health concern, and despite extensive international efforts, sustained control has yet to be achieved (3).

Hospital-acquired infections, or nosocomial infections, are defined as infections that develop during hospitalization or healthcare delivery and are neither present nor incubating at the time of admission. Generally, an infection is considered hospital-acquired if it appears 48 hours or more after admission or within 72 hours of discharge, provided that it was not evident or latent upon entry (4). These infections can occur while the patient is still hospitalized or after discharge (5). Epidemiological evidence suggests that approximately 7% of patients in developed countries and 10% in developing countries acquire HAI during their hospital stay (6). Multiple factors contribute to the development of HAIs**.** Major risk factors include advanced age (particularly patients over 65 years or infants under one year), malnutrition, emergency admissions to intensive care units, and prolonged hospital stays (especially longer than seven days). The use of invasive medical devices—such as urinary catheters, intravenous and arterial lines, suction systems, and endotracheal tubes—significantly increases infection risk by bypassing natural body defenses (7, 8). Surgical procedures, particularly recent or repeated operations, also elevate infection susceptibility. Patients receiving immunosuppressive therapy or in a comatose state face additional vulnerability due to impaired immune function. Other contributing factors include chronic underlying diseases (e.g., cardiovascular disorders), prior antibiotic exposure, and poor nutritional status (9). Among the affected organ systems, the urinary tract is most commonly involved, followed by the respiratory and circulatory systems, often in association with medical devices or invasive procedures (9).

According to the European Centre for Disease Prevention and Control (ECDC), the prevalence of HAIs across 947 hospitals in 30 European countries was approximately 5.7% in 2012 (10). In contrast, developing countries report substantially higher rates, with systematic reviews estimating an average prevalence of 15.5% (11). In Iran, reported prevalence rates vary considerably, ranging from 0.32% to 9.4%, depending on study design, hospital characteristics, and surveillance methodology (12). HAIs represent a critical challenge to patient care, as they are associated with extended hospitalization, delayed recovery, increased complications, and diminished quality of life (13). These infections contribute to higher morbidity and mortality rates, and affected patients incur significantly greater healthcare costs compared with uninfected individuals (14). Furthermore, HAIs undermine hospital efficiency and impose substantial economic burdens on healthcare institutions and insurance systems (15). Globally, HAIs are recognized as one of the most common adverse events in clinical care, affecting millions of patients each year (16). For example, the ECDC estimates that HAIs lead to millions of additional hospital days, tens of thousands of preventable deaths, and billions of euros in direct healthcare expenditures annually (17, 18).

In Iran, numerous studies have explored strategies to prevent and control HAIs (19-22). However, most of these investigations are limited in scope and fragmented, preventing a comprehensive understanding of the most effective interventions. To enable evidence-based policymaking and informed managerial decisions, it is essential to synthesize and integrate the available research evidence. Therefore, the present scoping review aims to identify effective strategies for reducing hospital-acquired infections in Iranian hospitals.

Methods

The approach adopted in this scoping review was guided by the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis (23) and followed the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) as a reporting framework (24). The PRISMA 2020 flow diagram was also used to depict the process of study selection (25). Comprehensive searches were conducted in PubMed, Web of Science, Scopus, Scientific Information

Database (SID), Magiran, and Google Scholar.

The search strategy was developed iteratively, beginning with an initial limited search to identify and analyze relevant keywords and index terms from retrieved studies. The search string was first constructed in MEDLINE (via PubMed) and subsequently refined with input from an experienced medical information specialist. The finalized search syntax was translated and adapted for use across other databases using the Systematic Review Accelerator Polyglot Search Translator tool (26), and further reviewed and modified as required. Relevant subject headings (e.g., MeSH and Emtree terms) were manually incorporated to optimize retrieval accuracy. Common keywords included nosocomial infection, hospital infection, healthcare-associated infection, hospital-acquired infection, strategy, solution, Iran, and hospital (Table 1). The final search was conducted on 31 January 2025.

Table 1: The search strategy and number of studies obtained from databases and search engines

Databases	Search Strategy	Initial Search
Pub Med	(("nosocomial infection"[All Fields] OR "healthcare associated infections"[All Fields] OR "hospital acquired infection"[All Fields]) AND ("strategies"[All Fields] OR "strategies"[All Fields] OR "strategy"[All Fields] OR "strategy s"[All Fields] OR ("pharmaceutical solutions"[Pharmacological Action] OR "solutions"[MeSH Terms] OR "solutions"[All Fields] OR "solution"[All Fields] OR "pharmaceutical solutions"[MeSH Terms] OR ("pharmaceutical"[All Fields] AND "solutions"[All Fields]) OR "pharmaceutical solutions"[All Fields] OR "solutal"[All Fields] OR "solute"[All Fields] OR "solute s"[All Fields] OR "soluted"[All Fields] OR "solutes"[All Fields] OR "solution s"[All Fields])) AND ("Iran"[MeSH Terms] OR "iran"[All Fields])) AND ((1000/1/1:2025/1/31[pdat]) AND (english[Filter] OR persian[Filter]))	69
Scopus	ALL ("nosocomial infection" OR "healthcare associated infections" OR "hospital acquired infection") AND ALL (strategy OR solution) AND ALL (Iran) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Persian")) AND (LIMIT-TO (AFFILCOUNTRY , "Iran")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (OA , "all"))	626
Web of Science	((ALL= ("nosocomial infection" OR "healthcare associated infections" OR "hospital acquired infection")) AND ALL= (strategy OR solution)) AND ALL=(Iran) and All Open Access (Open Access) and IRAN (Countries/Regions) and Open Access	35
Magiran	"nosocomial infection" AND strategies	15
SID	"nosocomial infection" AND strategies	54
Google Scholar	("nosocomial infection" OR "healthcare associated infections" OR "hospital acquired infection") AND (strategy OR solution) AND Iran	11100 (10 pages reviewed)
Final		11899

The study selection process was conducted in three sequential stages. In the first stage, the titles and abstracts of all retrieved records were independently screened to identify potentially relevant studies. In the second stage, the full texts of the selected articles were assessed for eligibility based on the predefined inclusion and exclusion criteria. In the final stage, a manual search of the reference lists of all included studies was performed to identify any additional eligible publications. The inclusion and exclusion criteria were jointly developed and refined by both reviewers. All screening stages were conducted independently by three reviewers, and any disagreements were resolved by discussion or, when necessary, through consultation with a fourth independent reviewer. Additionally, the corresponding authors of potentially eligible conference abstracts were contacted for clarification when no full-text publication was available.

This review included studies involving professional healthcare providers working in hospital settings. These professionals encompassed individuals across various training and responsibility levels, such as nurses, physicians, hospital administrators, and infection prevention and control personnel. Eligible studies were those that evaluated or assessed infection prevention and control (IPC) strategies, programs, or interventions implemented within hospital environments. The review was limited to the hospital context, encompassing both medical and specialized nursing care delivered to inpatients. All types of primary research designs (including cross-sectional studies, case series, and case studies) were eligible for inclusion. Editorials, commentaries, narrative reviews, guidance documents, and studies lacking sufficient methodological detail relevant to the research question were excluded.

Articles were excluded if they were published in languages other than English or Persian, published

after January 31, 2025, books or book chapters, or if full-text access was unavailable. A data extraction form was designed to collect information from the studies, which included sections for the first author's last name, publication year, location of the study, type of hospital, and strategies (Table 2). This study employed the six-stage thematic analysis method developed by Braun and Clarke to analyze qualitative data. The stages include familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (27). For data analysis, version 10 of the MAXQDA software was utilized.

Table 2. Characteristics of studies included in this scoping review

Author/ (reference)	Year	Place	Type of study	Strategies
Ghiasvandian (42)	2002	Tehran	Review	Nurses education; Enhancing the patient's defensive capabilities through medical procedures and the use of equipment; Improving the patient's nutritional status; and proper care of the patient's skin and wound
Ghotbi (43)	2001	Tehran	Cross-Sectional	An increase in bed space from 1.5M² to 2.5 M², using disposable endotracheal tubes, elbow operated water taps, and strict hand washing
Bikmoradi (44)	2013	Hamedan	Quasi-experimental	Hand washing; Education
Khan (45)	2015	Ardebil	Reviewing	Developing a hospital infection control program; Modeled after successful hospital;
Hadipour (46)	2018	Tehran	Interventional	Hand washing
Khosravi (47)	2010	Tehran	Review	Infection Control Committee; Planning and policy-making regarding decontamination and sterilization of equipment and tools in hospital; Using the sterilization method; "The limitation of broad-spectrum antibiotic use, development of treatment protocols for the use of antibiotics, training of staff, and emphasis on hand washing
Ghashghaee (48)	2000	Tehran	Review	Education
Golfiroozi (49)	2023	Gorgan	Cross-Sectional	Monitoring by the infection control committee; Standardizing disinfecting process; Education
Esfandiari (50)	2017	Tehran	Qualitative	Placing prevention and control of HAIs as a national health agenda; Structural reforms; Giving authority to infection control committees; Increasing financial and material resources; Information and reporting system strengthening; Rewards and punishments; Training/education of health care personnel; Appointing a unique steward; Improving Interdisciplinary cooperation; Influence on health care professionals behavior; Developing National guidelines and standards to control of HAI; Increasing the number of skilled nurse staffing; Increasing infectious disease physician as consultants; Increase the number of microbiologist for laboratory diagnostic services; Adequate trained housekeeping staff; Education (of various forms; face to face provision of educational pamphlets and posters on infection control); Active engagement with the media; Suggested a “Hand Hygiene Day” to raise public awareness; Giving incentive to adhere to standards; Being punished for failure to act in accordance with principles; Establishing an Antibiotics Stewardship Program; Developing evidence-based guidelines for prescription of antibiotic; Determining antibiotics using patterns; Consultation with infectious diseases specialist in hospital; Not allowing to prescribe all the antibiotics by all the physicians; Water quality; Proper ventilation for specialized care; Appropriate use of disinfectants, waste management; Hand Hygiene; Compliance of standards precautions
Mohammadnejad (51)	2013	Tehran	Qualitative	Appropriate training management; Effectiveness of educators; Written program for Infection control training; Utilizing the abilities of the trainees; Providing efficient human resources; Providing the desired physical conditions; Cooperation of the relevant units in the hospitals; Competence in organizing the staff; Provide the sufficient motivation to work; Update the knowledge, attitude and skills of the staff; Participation of all health team members in the process of infection control; Setting the goals of infection control in coordination with the infection control team

Author/ (reference)	Year	Place	Type of study	Strategies
Nasiri (52)	2021	Kerman	Mixed-method	development of hospital information systems, increasing the knowledge of infection control nurses
Mamishi(53)	2014	Tehran	Review	production of evidence-based guidelines
Hoseini(54)	2012	Tabriz	Cross-Sectional	1- Observation of hand hygiene principles, using aseptic techniques in invasive procedures, improving physical space, and observation of standard precautions. 2- Usage of human milk and initiation of oral feedings. 3- Reduction of laboratory testing that causes skin damage. 4- Development of a method to differentiate between contaminations and true-positive cultures. 5- Reduction of intubation days and usage of central lines. 6- Encouragement of teamwork to appreciate those responsible for outcomes
Khodadadi (55)	2022	Mashhad	Cross-Sectional	Education; Hand washing; respiratory physiotherapy for patients on ventilators; use of chlorhexidine mouthwash for ventilated patients; the use of the smallest possible catheter size; familiarizing hospital staff with conventional infection control practices in accordance with global standards; developing incentive programs based on the performance of treatment personnel; effective supervision; establishing and upgrading infection control units in emergency centers; improving working conditions;
Azimi(56)	2011	Tehran	Cross-Sectional	Hand hygiene; Isolation of these patients, health policy such as control of staff and nurses, sterilization of bed sheets, dressing and other equipment related to these patients, and preparation of optimum care conditions of burn patients can be helpful to treat of them.
Rahimi (57)	2021	Tehran	Cross-Sectional	Discharging patients as soon as possible
Yaghubi (58)	2019	Guilan	Cross-Sectional	The proper use of antibiotics to reduce drug resistance
Alijani Ranani (59)	2018	Ahvaz	Cross-Sectional	Controlled contact by Patients
Mosadeghrad (60)	2021	Tehran	Review	Education; Establishing infection committee; Establishing quality management; Proper implementation of the accreditation program
Ghasemi (61)	2020	Kermanshah	Review	Disinfection of tools and equipment; Education; Wearing gloves and masks; changing infusion sets; implementing precautionary measures; ensuring proper isolation; preventing accidental contact between hands and needle tips; avoiding exposure to contaminated respiratory secretions; ensuring strict adherence to prescribed medication instructions, particularly for antibiotics
Jahed (62)	2025	Tehran	Review	Compliance of standards precautions
Saberi (63)	2012	Sari	Cross-Sectional	Education
Mohammadi (64)	2019	Kermanshah	Review	Monitoring
Ajami (65)	2016	Isfahan	Review	Wireless sensor networks (WSNs) composed of several nodes and gates are favorable standard technologies to control patients with nosocomial infection.
Askarian (66)	1999	Shiraz	Case-control	Appropriate surveillance system;
Ataee (67)	2017	Tehran	Review	Washing hands before and after contact with patients and after toilet
Basiri (68)	2012	Hamedan	Cross-Sectional	Use of mechanical ventilation and reduction of invasive procedures
Darvishi (69)	2020	Tehran	Review	Preventing inappropriate use of antibiotics
Emami (70)	2016	Shiraz	Cross-Sectional	1) design an action plan to tackle antibiotic resistance; 2) improve surveillance of antibiotic-resistant infections; 3) strengthen policies, programs and implementation of infection prevention and control measures; 4) regulate and promote the appropriate use and disposal of quality medicines; and 5) make information available on the impact of antibiotic resistance for clinicians who prescribe antibiotics
Esfandiari (71)	2017	Tehran	Qualitative	good governance and effective managerial support; Adherence to guidelines; improved nurse-to-patient ratio; availability of material resources (such as hand-rub dispensers);
Farhoudi (72)	2016	Shiraz	Quasi-Experimental	Promotion of hand hygiene

Author/ (reference)	Year	Place	Type of study	Strategies
Hormozi (73)	2015	Tehran	Cross-Sectional	Developing infection control and prevention strategies based on continuous training of healthcare center staff
Izadi (74)	2021	Tehran	Cross-Sectional	Creating a benchmark system to better control infection rates
Karkhane (75)	2012	Tehran	Cross-sectional	Reducing length of stay; Reducing antibiotic use
Kasiri (76)	2011	Torbat Heydariyeh	Cross-sectional	Education
Khammarnia (77)	2021	Iran	Review	Efforts to improve the quality of nursing care, applied staff training, continuous monitoring HAIs, provision of facilities, implementation of infection control programs, prioritization of hospital wards for more stringent health measures, emphasis on preventive cares such as hand washing and appropriate training through mass media
Khoshdel (78)	2015	Shahrekord	Cross-sectional	Doctors caution in prescribing antibiotics to children
Lotfinejad (79)	2020	Mashhad	Review	Developing emojis related to hand hygiene
Mahdizadeh (80)	2021	Mashhad	Cross-sectional	Education
Nouri (81)	2018	Hamadan	Cross-sectional	To increase the effectiveness of antibiotics and prevent multidrug resistance, establish a strict antibiotic dosing schedule and periodically assess resistance patterns.
Rostami (82)	2023	Isfahan	Cross-sectional	Designing a hospital infection registration system in the ICU

Ethical Consideration

Ethical approval was not required, as it exclusively utilized data available in the public domain.

Results

A total of 11,899 records were initially identified. After removing duplicates and records without accessible full texts, 8,985 studies remained for title and abstract screening that 8,477 records were excluded due to not meeting the inclusion criteria, leaving 508 articles related to the topic. Then, 469 studies were excluded because they were not relevant. Additional two studies were identified through reference list screening. Ultimately, 41 studies included in the final synthesis (Figure 1).

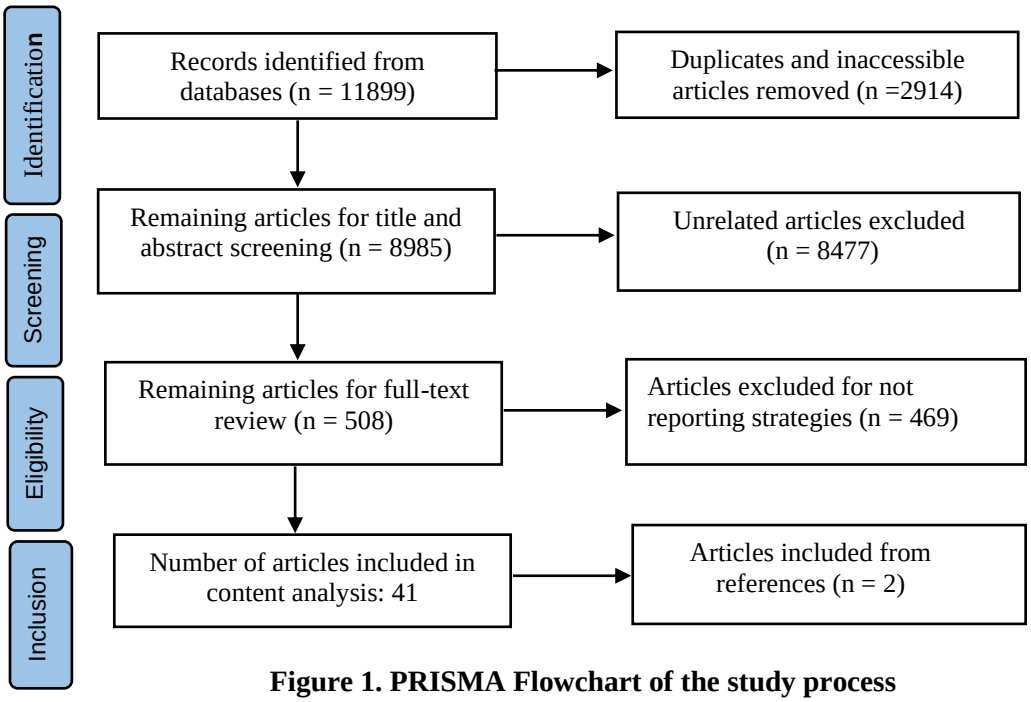

Figure 1. PRISMA Flowchart of the study process

The studies published between 1999 and 2025 (Table 2) consisted of quantitative research designs (n = 23), followed by review articles (n = 14), qualitative studies (n = 3), and one mixed-method study (n = 1). The year 2021 accounted for the highest number of publications (n = 6) (Figure 2). Geographically, the studies conducted across 15 Iranian provinces, Tehran Province representing the highest concentration of research (n = 18) (Figure 3). The strategies for reducing hospital-acquired infections classified into six overarching domains: governance and leadership, financing, human resources, infrastructure, medical products and equipment, information systems, and service delivery (Table 3). A total of 76 distinct strategies were identified, the largest subset (n = 22) pertaining to governance and leadership (Figure 4).

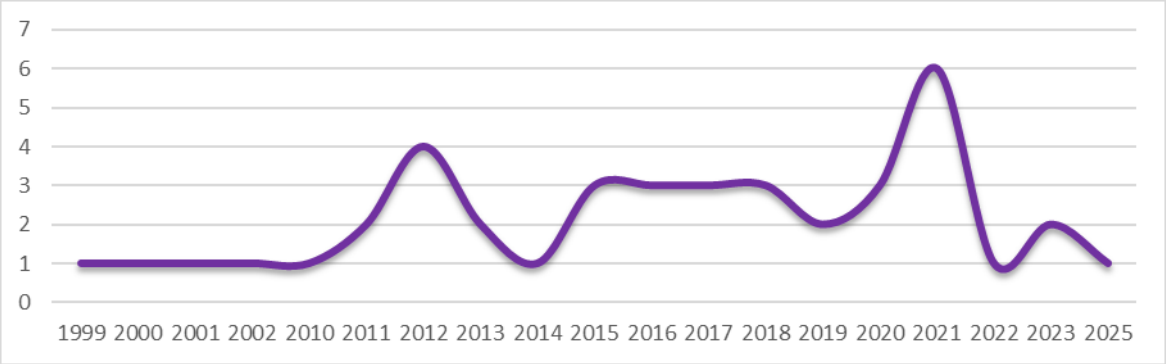

Figure 2. Frequency distribution of articles on strategies for reducing Nosocomial infection by done year

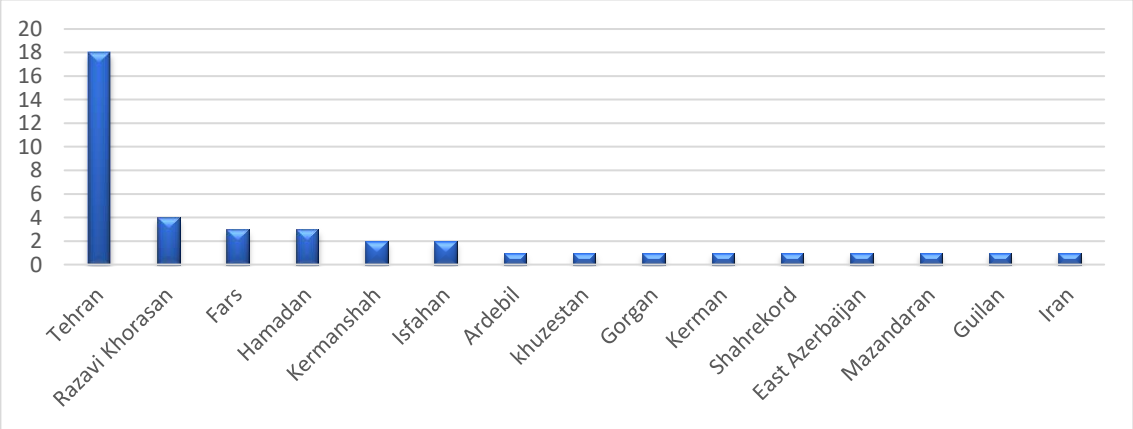

Figure 3. Frequency distribution of articles on strategies for reducing Nosocomial infection by Province

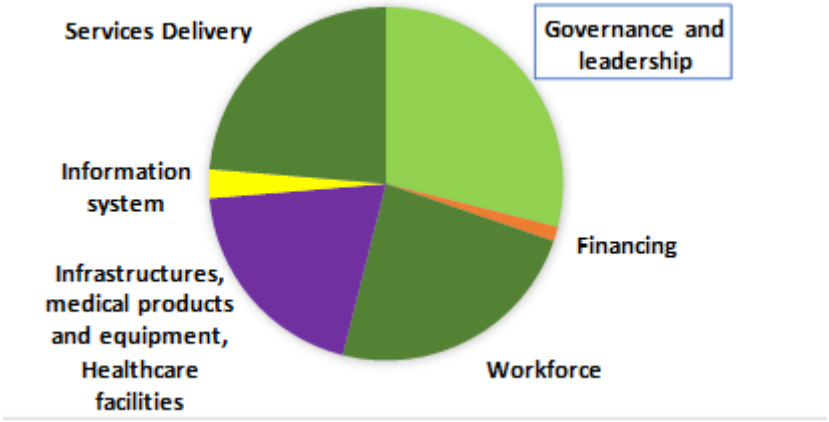

Figure 4. Frequency distribution of hospital-acquired infections in Iranian hospitals by related domains

Table 3: Strategies to Reduce Hospital-Acquired Infections in Iranian Hospitals

	Strategies
Governance and leadership	Establishing a comprehensive infection prevention and control program (45); Benchmarking from successful hospitals (45, 83); Monitoring the infection control program regularly (49, 55, 64, 66, 71); Establishing an Infection Control Committee (47, 60); Developing policies for decontamination and sterilization of equipment and tools (47, 56); Limiting the use of broad-spectrum antibiotic (47, 81, 84); Developing treatment protocols for antibiotic use (47, 50); Standardizing disinfecting process (49); Making prevention and control of hospital-acquired infections a national health priority (50); Implementing structural reforms to support infection control (50); Ensuring good governance and effective managerial support for infection prevention (71) Giving authority to the Infection Control Committee to enforce policies (50); Developing National guidelines and standards to control of HAI (50, 53, 71); Organizing public awareness campaigns, such as a "Hand Hygiene Day (50); Engaging actively with the media to promote infection prevention (50); Improving interdisciplinary cooperation among healthcare workers (50); Establishing and upgrading infection control units in emergency centers (55); Developing incentive programs based on the performance of treatment personnel (55); Proper implementation of the accreditation program (60); Designing action plans to address antibiotic resistance (70); Prioritization of hospital wards for more stringent health measures (77); Designing a hospital infection registration system in the ICU (82);
Financing	Increasing financial resources(50);
Workforce	Training/Education of health care personnel (42, 44, 47-50, 52, 55, 60, 61, 63, 73, 76, 77, 80, 85); Promotion of hand hygiene among healthcare personnel (43, 44, 46, 47, 50, 54-56, 72, 77, 86); Increasing the number of skilled nursing staff (50); Promoting positive behavioral change among healthcare professionals (50); Implementing reward and disciplinary systems to encourage adherence to infection control standards (50); Increasing the number of infectious disease physicians as consultants (50); Increasing the number of microbiologists for laboratory diagnostic services (50); Effective management of infection control training program (51); Ensuring the effectiveness of infection control educator (51); Developing a written program for infection control training (51); Utilizing the skills and abilities of trained personnel in infection control activities (51); Ensuring the availability of efficient and adequately trained human resources (51); Promoting cooperation among relevant hospital units for infection control (51); Ensuring competent organization and coordination of hospital staff (51); Providing sufficient motivation for staff to adhere to infection control practices (51); Encouraging all health team members in infection control processes (51, 54) Setting infection control goals in coordination with the infection control team (51); Improving the nurse-to-patient ratio (71);
Infrastructures, medical products and equipment, Healthcare facilities	Increasing in bed space (43); Using of disposable endotracheal tubes (43); Installation of elbow-operated water taps (43); Provision of proper ventilation systems in specialized care unit (50, 68); Appropriate use of disinfectants, waste management (50); Providing the desired physical condition (51, 54-56); Reduction of intubation days and usage of central lines (54); Strict adherence to aseptic techniques during invasive procedures (54); Use of respiratory physiotherapy for consistency (55); Use of chlorhexidine mouthwash for ventilated patients (55); Use of the smallest possible catheter size (55); Sterilization of bed sheets, dressing and other equipment (56, 61); Implementation of wireless sensor networks (87); Regulation and promotion of appropriate use and disposal of quality medicines (70); Availability of material resources such as hand-rub dispensers (71);
Information system	Strengthening the information and reporting system for hospital infection control (50, 52); Providing clinicians with information on the impact of antibiotic resistance (70)
Services Delivery	Enhancement of patients' immune defenses through medical procedures and appropriate use of equipment (42);

	Use of gloves and masks by healthcare personnel (61); Consultation with infectious disease specialists for complicated cases (50); Improvement of patients' nutritional status to support immune function (42); Appropriate care of patients' skin and wound management (42); Application of effective sterilization methods for instruments and equipment (49); Provision of education through multiple formats such as face-to-face training and dissemination of pamphlets and posters on infection control (50); Implementation of patient isolation when necessary to prevent infection spread (56); Timely discharge of patients to reduce hospital stay duration (57); Rational and appropriate use of antibiotics to prevent resistance and infection (58); Regulation of patient contact to minimize infection transmission (59); Scheduled replacement of infusion sets to reduce infection risk (61); Adherence to standard precautionary measures in clinical practice (61); Avoidance of accidental contact between hands and needle tips to prevent contamination (61); Prevention of exposure to contaminated respiratory secretions (61); Strict compliance with prescribed medication regimens, especially antibiotics (61) Reduction of hospital stay duration to minimize infection risk (75) Strict compliance with prescribed medication regimens, especially antibiotics (77)

Training of health care personnel, promotion of hand hygiene among healthcare personnel, regular monitoring of the infection control program, providing the desired physical environment, limiting the use of broad-spectrum antibiotics, and developing national guidelines and standards for the control of hospital-acquired infections (HAIs) were the most common strategies for reducing the incidence of hospital infections in Iranian hospitals (Figure 5).

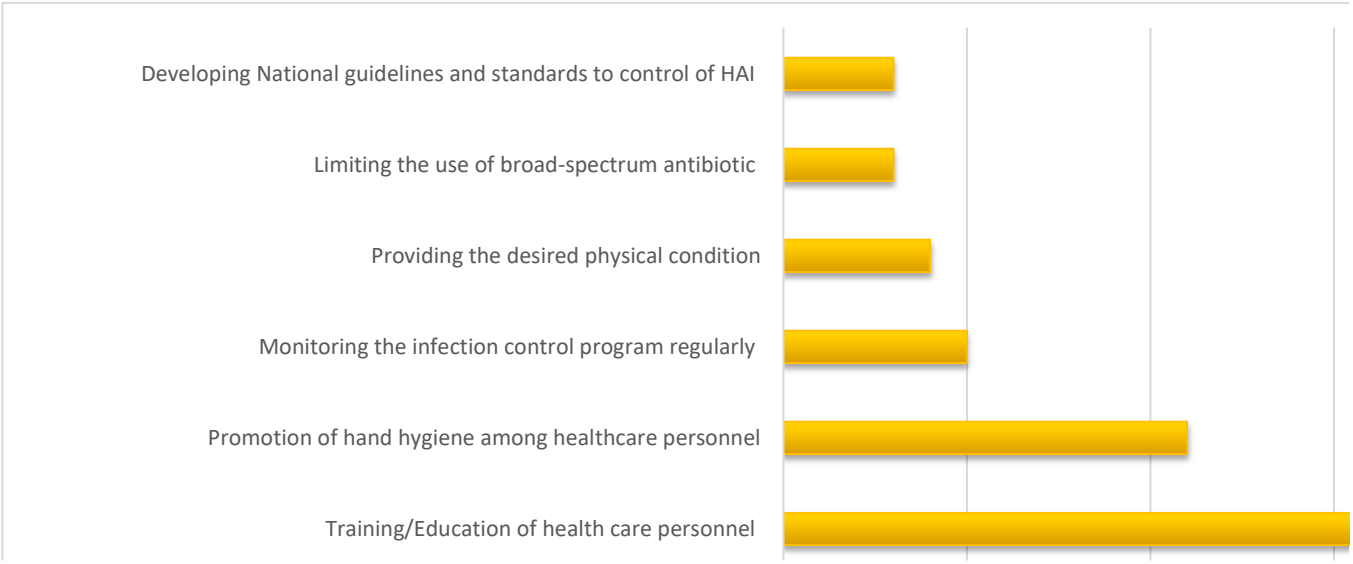

Figure 5. Frequency distribution of the most common strategies for reducing hospital-acquired infections in Iranian hospitals

Discussion

This study aimed to identify effective strategies for reducing the incidence of hospital-acquired infections (HAIs) among hospitalized patients across healthcare facilities in Iran. A total of 76 distinct strategies were identified across the included studies, all targeting the reduction and prevention of HAIs in Iranian hospitals. These strategies were classified into six main domains: governance and leadership, financing, human resources, infrastructure, medical products and equipment, information systems, and service delivery. Among these, healthcare personnel training emerged as one of the most critical and consistently emphasized interventions. Continuous, competency-based education has been shown to enhance healthcare workers' proficiency in essential infection prevention and control (IPC) practices, including hand hygiene, appropriate use of personal protective equipment (PPE),

environmental disinfection, and isolation of infectious patients. Improved staff competency subsequently leads to better patient outcomes and a safer clinical environment by disrupting the chain of infection transmission. The COVID-19 pandemic further highlighted persistent gaps in IPC knowledge and practice among healthcare professionals, emphasizing the urgency of ongoing professional education to strengthen preparedness for emerging and re-emerging infectious threats (28). Clinical trials and observational studies have consistently demonstrated that structured, competency-based training programs significantly enhance healthcare workers' knowledge and adherence to infection prevention and control (IPC) protocols. For instance, periodic in-service education, particularly when delivered through face-to-face modular sessions, has been shown to markedly improve knowledge retention and compliance with IPC practices among healthcare personnel. However, these improvements tend to decline over time in the absence of refresher courses, highlighting the need for regular reinforcement—ideally every six months—to maintain sustainable behavioral compliance and effective infection control (29, 30). This continuous education approach is crucial for sustaining behavioral changes and adherence to IPC protocols.

Training methods that utilize active learning strategies, multimedia-enhanced instruction, and hands-on practical demonstrations have been shown to be more effective than conventional lecture-based formats, as they enhance participant engagement, knowledge acquisition, and long-term skill retention. Evidence further indicates that nurses often receive more IPC training than physicians, despite the critical role of physicians in infection prevention. This disparity underscores the importance of designing training programs that inclusively target all healthcare professionals, ensuring optimal hospital-wide infection control (29). Moreover, patient- and family-centered education on infection prevention and control (IPC) measures has been shown to reduce hospital-acquired infections (HAIs). Evidence indicates that educating patients and their caregivers on hand hygiene and adherence to IPC protocols contributes to reduced surgical site infections and enhanced compliance with hospital infection control guidelines, ultimately supporting a safer healthcare environment (30, 31).

Hand hygiene among healthcare personnel is a cornerstone in reducing hospital-acquired infections (HAIs). Improved hand hygiene compliance is consistently associated with substantial reductions in HAIs, particularly bloodstream and respiratory infections. Proper hand hygiene practices can prevent up to 50% of avoidable healthcare-associated infections, representing a simple, effective, and cost-efficient preventive strategy (32). However, compliance remains suboptimal worldwide, especially in low-income countries where lack of basic water and hand hygiene facilities at the point of care leads to compliance rates as low as 9% (32, 33). This contributes to healthcare-associated infection (HAI) rates that are two to three times higher than in developed countries. In contrast, high-income countries typically achieve compliance rates up to 70%, resulting in lower infection burdens. The transmission of pathogens via contaminated healthcare workers' hands is a primary route for HAIs, including resistant organisms such as MRSA, and improving hand hygiene compliance has been linked to reductions in these infections (34). While hand hygiene alone cannot eliminate all risk factors for HAIs, it remains a cornerstone of infection prevention strategies supported by education, monitoring, and organizational commitment.

Regular monitoring of infection control programs is essential for reducing hospital-acquired infections (HAIs). Evidence consistently demonstrates that electronic hand hygiene monitoring systems enhance healthcare worker compliance by providing real-time, objective feedback, mitigating the bias inherent in direct observation. For instance, an interventional study reported that the implementation of an electronic monitoring system, combined with individual and group feedback, resulted in a marked improvement in hand hygiene compliance and a significant reduction in hospital-acquired bloodstream infections (35). This contrasts with traditional direct observation methods, which may overestimate hand hygiene adherence due to the Hawthorne effect, a phenomenon in which healthcare workers temporarily alter their behavior when aware of being observed, thereby producing less reliable compliance data (36). Furthermore, educational interventions integrated with monitoring have proven effective in sustaining improvements. A study in a respiratory disease hospital showed that hand hygiene training raised compliance rates from 66% to 88.3% and significantly improved healthcare workers' knowledge and attitudes toward infection control practices (37). These findings align with the evidence that combining training with continuous monitoring, especially electronic systems, enhances both adherence and infection prevention outcomes. Regular, technology-assisted

monitoring of infection control programs has been shown to be more effective than traditional observation methods alone. It provides accurate compliance data, reduces observer bias, and, when combined with targeted education and feedback, facilitates sustained improvements in hand hygiene practices and a reduction in hospital-acquired infections (HAIs). Such integrated monitoring strategies should be considered a core component of effective infection prevention programs in healthcare settings. Ensuring a safe and hygienic physical environment is equally essential for preventing HAIs. The design and maintenance of hospital infrastructure—including layout, airflow, ventilation, and antimicrobial materials—play a critical role in controlling infection transmission. Proper ventilation and air conditioning systems help limit airborne pathogens, while thoughtful spatial arrangements minimize cross-contamination by segregating infectious patients and managing the flow of staff, equipment, and waste.

Effective cleaning and disinfection of environmental surfaces is vital, given that pathogens such as MRSA and Clostridium difficile can survive on surfaces for prolonged periods. Ensuring accessible hand hygiene stations and robust hand hygiene infrastructure further supports infection control efforts. Multidisciplinary teams, including infection prevention specialists, facility managers, and healthcare personnel, should collaborate to develop and implement policies and procedures that maintain environmental hygiene and patient safety. By integrating evidence-based design principles with rigorous cleaning protocols, healthcare facilities can create a healing environment that substantially reduces the risk of HAIs (38). Limiting the use of broad-spectrum antibiotics is critical for reducing hospital-acquired infections (HAIs), as overuse contributes to the emergence and dissemination of multidrug-resistant (MDR) pathogens, complicating treatment and increasing morbidity and mortality among hospitalized patients. While broad-spectrum agents may be necessary for initial empiric therapy, especially in critically ill patients or those at high risk for MDR infections, their use should be judicious and guided by pathogen identification and susceptibility patterns. Antimicrobial stewardship programs advocate for the selection of narrow-spectrum agents whenever feasible and the de-escalation of therapy once culture results are available, thereby minimizing unnecessary antibiotic exposure. This strategy reduces selection pressure, prevents difficult-to-treat infections, and ultimately decreases the burden of HAIs in healthcare settings.

Integrating effective infection prevention and control measures with prudent antibiotic use is essential to managing HAIs and preserving the efficacy of antimicrobial agents (39, 40). Developing national guidelines and standards for the control of hospital-acquired infections is critical for reducing their incidence and mitigating their impact. These infections, which typically occur., pose a significant threat to patient safety by increasing morbidity, mortality, prolonging hospitalization, and elevating healthcare costs. National guidelines provide a structured framework for surveillance, prevention, and control measures tailored to healthcare settings, ensuring consistent, evidence-based practices across hospitals. They generally include standardized protocols for key infection control measures, such as hand hygiene, appropriate use of personal protective equipment (PPE), sterilization procedures, and management of invasive devices, which are essential for preventing pathogen transmission. Furthermore, national programs support hospitals by setting objectives aligned with healthcare priorities, promoting staff education, and establishing monitoring systems to evaluate the effectiveness of interventions. Effective implementation of these guidelines reduces the spread of multidrug-resistant organisms and contributes to antimicrobial resistance containment. By fostering collaboration among healthcare workers, hospital management, and public health authorities, national standards create safer healthcare environments, ultimately protecting patients, staff, and the broader community from HAIs (39, 41).

Despite the valuable insights provided by this scoping review, several limitations should be acknowledged. First, the study only included articles published in Persian and English, potentially overlooking relevant research published in other languages and thereby introducing language bias. Second, the review was limited to studies accessible in full text, which may have excluded pertinent data from conference abstracts or unpublished studies, leading to publication bias. Third, the heterogeneity in study designs, settings, and reporting standards among the included articles posed challenges in synthesizing findings and may have affected the comparability of results. Fourth, the reliance on published literature means that the review may not capture recent or ongoing interventions that have not yet been documented in academic sources. Fifth, most of the studies were conducted in certain provinces, such as Tehran, which could limit the generalizability of the findings to other

regions with different healthcare infrastructures or resource levels.

Implications for practice

This scoping review systematically synthesized evidence on strategies to prevent and reduce hospital-acquired infections in Iranian hospitals. Analysis of 41 studies indicated that effective infection control necessitates a multifaceted approach, encompassing six key domains: governance and leadership, financing, human resources, infrastructure, medical products and equipment, information systems, and service delivery. Among the 76 identified strategies, the most frequently emphasized and impactful measures included continuous healthcare personnel training, promotion of hand hygiene, regular monitoring and evaluation of infection control programs, enhancement of hospital infrastructure, rational antibiotic use, and the development of national infection prevention guidelines and standards. Governance and leadership interventions, such as establishing infection control committees and ensuring strong managerial support, were the most commonly reported. The findings underscore that ongoing education and practical training—particularly via interactive, modular approaches—are critical to maintaining healthcare workers' knowledge and adherence to IPC protocols. Furthermore, regular refresher courses and systematic monitoring are essential to sustain high standards of infection control. Reducing HAIs in Iranian hospitals requires an integrated strategy that combines strong leadership, adequate resources, continuous staff training, and evidence-based clinical practices. Policymakers and hospital administrators are urged to implement these multifaceted interventions to enhance patient safety, reduce infection rates, and improve overall healthcare quality across the country.

Acknowledgments

The authors would like to extend their most sincere gratitude and appreciation to the esteemed reviewers of the article.

Conflicts of interest

The authors declare that they have no competing interests.

Funding

None.

Authors' Contributions

MP and PI participated in the design of the study. PI, MA, MS, SZ and AB undertook the literature review process. All authors drafted the manuscript. All authors read and approved the final manuscript. Finally, all authors read and approved the final version for publication.

References

1. Mosadeghrad AM, Isfahani P. Unnecessary hospital admissions in Iran: a systematic review and meta-analysis. Tehran University Medical Journal. 2019;77(6):392-400.
2. Ducel G. Prevention of Hospital Acquired Infections: A Practical Guide. World Health Organization. 2002;64.
3. Haque M, Sartelli M, McKimm J, Bakar MA. Health care-associated infections–an overview. Infection and drug resistance. 2018:2321-33.
4. Greninger AL, Zerr DM. NGSocomial infections: High-resolution views of hospital-acquired infections through genomic epidemiology. Journal of the Pediatric Infectious Diseases Society. 2021;10(Supplement_4):S88-95.
5. Plowman R. The socioeconomic burden of hospital acquired infection. Euro surveillance: bulletin europeen sur les maladies transmissibles= European communicable disease bulletin. 2000;5(4):49-50.
6. Danasekaran R, Mani G, Annadurai K. Prevention of healthcare-associated infections: protecting patients, saving lives. International Journal of Community Medicine Public Health. 2014;1(1):67-8.
7. Rodriguez-Acelas AL, de Abreu Almeida M, Engelman B, Canon-Montanez W. Risk factors for health care–associated infection in hospitalized adults: Systematic review and meta-analysis. American journal of infection control. 2017;45(12): e149-56.
8. Tapia-Rombo CA, Ugarte-Torres RG, Alvarez-Vázquez E, Salazar-Acuña AH. Risk factors for

intrahospital infection in newborns. Archives of medical research. 2001;32(4):304-11.
9. Lewis KL, Thompson JM. Health care professionals' perceptions and knowledge of infection control practices in a community hospital. The health Care manager. 2009;28(3):230-8.
10. Suetens LC, Hopkins S, Kolman J, Hogberg L. European Centre for Disease Prevention and Control. Point prevalence survey of healthcareassociated infections and antimicrobial use in European acute care hospitals. Stockholm: European Centre for Disease Prevention and Control. 2013.
11. WHO. Report on the burden of endemic health care-associated infection worldwide. 2011.
12. Mosadeghrad AM, Afshari M, Isfahani P. Prevalence of Nosocomial Infection in Iranian Hospitals: A Systematic Review and Meta- Analysis. Iranian Journal of Epidemiology. 2021;16(4):352-62.
13. Gandasasmita N, Li J, Loane DJ, Semple BD. Experimental models of hospital-acquired infections after traumatic brain injury: Challenges and opportunities. Journal of Neurotrauma. 2024;41(7-8):752-70.
14. Hutton G, Chase C, Kennedy-Walker RJ. Costs of Health Care Associated Infections from Inadequate Water and Sanitation in Health Care Facilities in Eastern and Southern Africa. Policy Research Working Paper. 2024;10708.
15. Zhang M, Wu S, Ibrahim MI, Noor SS, Mohammad WM. Significance of ongoing training and professional development in optimizing healthcare-associated infection prevention and control. Journal of Medical Signals & Sensors. 2024;14(5):13. DOI: 10.4103/jmss.jmss_37_23
16. Alrebish SA, Yusufoglu HS, Alotibi RF, Abdulkhalik NS, Ahmed NJ, Khan AH. Epidemiology of Healthcare-Associated Infections and Adherence to the HAI Prevention Strategies. Healthcare (Basel). 2022 Dec 26;11(1):63. doi: 10.3390/healthcare11010063.
17. Prevention ECfD. Annual Epidemiological Report on Communicable Diseases in Europe 2008: Report on the State of Communicable Diseases in the EU and EEA/EFTA Countries: European Centre for Disease Prevention and Control; 2008.
18. Tacconelli E, Smith G, Hieke K, Lafuma A, Bastide P. Epidemiology, medical outcomes and costs of catheter-related bloodstream infections in intensive care units of four European countries: literature-and registry-based estimates. Journal of Hospital Infection. 2009;72(2):97-103.
19. Shojaei S, Rahimi T, Amini M, Shams S. Survey of nosocomial infections in patients admitted to Nekoei Hospital of Qom city in 2012, Iran. Qom University of Medical Sciences Journal. 2015; 9: 64-73.
20. Farzanpoor F, Rabiee MH, Fattahi M. The study of the prevalence of nosocomial infections in Vasei Hospital of Sabzevar during 2009-2013. Journal of Sabzevar University of Medical Sciences. 2018;25(2):251-8.
21. Karamolahi S, Kaviar VH, Haddadi MH, Hashemian M, Feizi J, Sadeghifard N, et al. Molecular characterization of Staphylococcus aureus isolated from hospital-acquired infections in Ilam, Iran. Molecular biology reports. 2024;51(1):686. doi: 10.1007/s11033-024-09580-9.
22. Rezapour B, Sharafkhani N. Explaining the Performance of Nurses in Order to Prevent Nosocomial Infections in Urmia City Hospitals: Application of the Health Belief Model. The Open Public Health Journal. 2024;17(1): e18749445256801.
23. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil, H. Scoping Reviews (2020). Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI Manual for Evidence Synthesis. JBI; 2024. Available from: https://synthesismanual.jbi.global. https://doi.org/10.46658/JBIMES-24-09.
24. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Annals of internal medicine. 2018;169(7):467-73.
25. Qual BO. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only. 2021.
26. Accelerator SR. 2025 [Available from: https://sr-accelerator.com/#/polyglot.
27. Arksey H, O'malley L. Scoping studies: towards a methodological framework. International journal of social research methodology. 2005;8(1):19-32.
28. Zhang M, Wu S, Ibrahim MI, Noor SSM, Mohammad W. Significance of Ongoing Training and Professional Development in Optimizing Healthcare-associated Infection Prevention and Control. Journal of medical signals and sensors. 2024;14:13. doi: 10.4103/jmss.jmss_37_23. eCollection 2024.

29.Seifi A, Mohammadnejad E, Miladi R. How Effective Are In-Hospital Training Workshops on Infection Control for Physicians? First Report in Iran. Journal of Kermanshah University of Medical Sciences. 2024;28(2): e148562.
30.Singh S, Kaur K, Saini RS, Singh S, Aggarwal HK, Chandra H. Impact of structured training program about Hospital Infection Control practices on Knowledge and Perception of nursing students at public and private nursing teaching institute of Northern India- An interventional study. Journal of education and health promotion. 2023;12(1):168. doi: 10.4103/jehp.jehp_1471_22. eCollection 2023.
31.Erdek FO, Gozutok CK, Merih YD, Aliogluları A. The effects of training inpatients and their relatives about infection control measures and subsequent rate of infection. Northern Clincs of Istanbul. 2017;4(1):29-35.
32.Organization WH. State of the world's hand hygiene: a global call to action to make hand hygiene a priority in policy and practice: World Health Organization; 2021.
33.Sharma S. Hand Hygiene and Hospital-Acquired Infections. Medical Journal of Dr DY Patil Vidyapeeth. 2018;11(3):201-2.
34.Organization WH. WHO research agenda for hand hygiene in health care 2023–2030: summary. 2023.
35.Knudsen AR, Kolle S, Hansen MB, Møller JK. Effectiveness of an electronic hand hygiene monitoring system in increasing compliance and reducing healthcare-associated infections. The Journal of hospital infection. 2021;115:71-4.
36.Jeanes A, Coen PG, Gould DJ, Drey NS. Validity of hand hygiene compliance measurement by observation: a systematic review. American journal of infection control. 2019;47(3):313-22.
37.Chakma SK, Hossen S, Rakib TM, Hoque S, Islam R, Biswas T, et al. Effectiveness of a hand hygiene training intervention in improving knowledge and compliance rate among healthcare workers in a respiratory disease hospital. Heliyon. 2024;10(5):e27286.
38.Nadi ZB, Raisali F, Jafari N, Bayramzadeh S. The influence of physical environment on health care-associated infections: A literature review. Am J Infect Control. 2024;52(2):229-42.
39.AF M, V M, H R. Hospital-Acquired Infections. [Updated 2023 Feb 12]. In: StatPearls [Internet] Treasure Island (FL): StatPearls Publishing. 2024.
40.Palaiopanos K, Krystallaki D, Mellou K, Kotoulas P, Kavakioti C-A, Vorre S, et al. Healthcare-associated infections and antimicrobial use in acute care hospitals in Greece, 2022; results of the third point prevalence survey. Antimicrobial Resistance & Infection Control. 2024;13(1):11. https://doi.org/10.1186/s13756-024-01367-8
41.Mouajou V, Adams K, DeLisle G, Quach C. Hand hygiene compliance in the prevention of hospital-acquired infections: a systematic review. Journal of Hospital Infection. 2022 Jan 1;119:33-48.
42.Ghiasvandian S. Nosocomial infection in the intensive care unit. Hayat. 2002;8(1):27-34.
43.Ghotbi F, Raghibmotlagh M, Valaie N. Nosocomial sepsis in NICU department in Taleghani hospital, 2001-2002. Research in Medicine. 2005;29(4):313-7.
44.Bikmoradi A, Mardani D, Soltanian A, Khatiban M. The impact of educational evidence-based hand washing program on knowledge, attitude, and adherence of intensive care unit nurses. Scientific Journal of Hamadan Nursing & Midwifery Faculty. 2013;21(3):5-13.
45.Khan HA, Ahmad A, Mehboob R. Nosocomial infections and their control strategies. Asian pacific journal of tropical biomedicine. 2015;5(7):509-14.
46.Hadipour M, Feizabad E, Riahi M, Allameh SF, Ganjalikhan A, Seyfi A, et al. Investigating the Causes of Non-Observance of Hand Hygiene in the Intensive Care Unit and Effective Strategies to Reduce it in Hospitals Affiliated with Tehran University of Medical Sciences, 2018-2020. Journal of Jiroft University of Medical Sciences. 2024;10(4):1385-92.
47.Khosravi B, Razavi A. Nosocomial infection. EBNESINA. 2010;13(1):43-51.
48.Ghashghaee A, Behzadifar M, Azari S, Farhadi Z, Luigi Bragazzi N, Behzadifar M, et al. Prevalence of nosocomial infections in Iran: A systematic review and meta-analysis. Medical journal of the Islamic Republic of Iran. 2018;32:48. doi: 10.14196/mjiri.32.48
49.Golfiroozi S, Fashayi F, Rajabi A, Shahryar A. Disinfectants efficacy in reducing pathogens related to health-care infection associated in universities hospitals of Gorgan, North of Iran. BMC Infectious Diseases. 2024;24(1):1113. doi: 10.1186/s12879-024-09985-8.
50.Esfandiari A, Salari H, Rashidian A, Masoumi Asl H, Rahimi Foroushani A, Akbari Sari A.

Eliminating Healthcare-Associated Infections in Iran: A Qualitative Study to Explore Stakeholders' Views. International journal of health policy and management. 2018;7(1):27-34.
51.Mohammadnejad E, Abbaszadeh A, Soori H, Afhami S. Prevention and control of nosocomial infections proceeding in intensive care units: A content analysis study. Acta Medica Mediterranea. 2016;32:1295-301.
52.Nasiri N, Sharifi A, Ghasemzadeh I, Khalili M, Karamoozian A, Khalooei A, et al. Incidence, accuracy, and barriers of diagnosing healthcare-associated infections: a case study in southeast Iran. BMC Infectious Diseases. 2023;23(1):171. https://doi.org/10.1186/s12879-023-08122-1
53.Mamishi S, Pourakbari B, Teymuri M, Babamahmoodi A, Mahmoudi S. Management of hospital infection control in Iran: a need for implementation of multidisciplinary approach. Osong public health and research perspectives. 2014;5(4):179-86.
54.Hosseini MB, Abdinia B, Ahangarzadeh Rezaee M, Abdoli Oskouie S. The Study of nosocomial infections in neonatal intensive care unit, a prospective study in Northwest Iran. International Journal of Pediatrics. 2014;2(3.2):25-33.
55.Khodadadi B, Sharafi M, Modarres Moghaddam M, Fazli B. Assessment of staff knowledge and practices for nosocomial infection control and prevention. Health Education and Health Promotion. 2024;12(1):159-64.
56.Azimi L, Motevallian A, Ebrahimzadeh Namvar A, Asghari B, Lari AR. Nosocomial infections in burned patients in Motahari Hospital, Tehran, Iran. Dermatology research and practice. 2011;2011(1):436952. https://doi.org/10.1155/2011/436952
57.Rahimi A, Namazi Shabestari A, Sadeh M, Bidaki R, Jamalimoghadamsiahkali S, Vahabi Z. Frequency of Healthcare-Associated Infections in the Elderly Patient Hospitalized. ssu-ehj. 2021;7(1):26-31.
58.Pourkazemi A, Farashbandi H, Balu H. Epidemiological study of nosocomial infections and antibiotic resistance patterns in Guilan. Yafteh. 2019;21(1): 52-62.
59.Ranani HA, Tour M, Nikfar R, Latifi SM, Zadeh FM. The effect of controlled contact on nosocomial infection in neonatal intensive care units. JNE; 2018; 7(1): 23-8.
60.Mosadeghrad A, Afshari M, Isfahani P. Prevalence of nosocomial infection in iranian hospitals: A systematic review and meta-analysis. Iranian Epidemiological Association. 2021; 16 (4): 352-62.
61.Ghasemi S, Nosrati S, Fakhry M, Khadang M. Investigating the Rate of Nosocomial Infections and Providing Solutions to Prevent and Control it. Paramedical Sciences and Military Health. 2021;15(4):64-71.
62.Jahed Y, Nabi Foodani M, Mehr Sorosh S, Abbasi Dolat Abadi Z. Challenges of infection control in prehospital emergency: A descriptive review. Iranian Journal of Nursing Research. 2025;19(6):1-14.
63.Saberi M, Khazaie Nezhad S. Comparison of nurses and nursing students' knowledge and practice about prevention and control of nosocomial infection. Journal of research development in nursing and midwifery. 2012;9(1):76-83.
64.Mohammadi M, Vaisi Raiegan A, Jalali R, Ghobadi A, Salari N, Barati H. The prevalence of nosocomial infections in Iranian hospitals. Journal of Babol University of Medical Sciences. 2019;21(1):39-45.
65.Ajami S, Zerganipor F. Nosocomial infection control by wireless sensor network in Intensive Care Unit. Journal of Research in Medical Sciences. 2016;21(1):35. DOI: 10.4103/1735-1995.184001
66.Askarian M, Gooran NR. National nosocomial infection surveillance system-based study in Iran: additional hospital stay attributable to nosocomial infections. Am J Infect Control. 2003;31(8):465-8.
67.Ataee RA, Ataee MH, Tavana AM, Salesi M. Bacteriological aspects of hand washing: a key for health promotion and infections control. International journal of preventive medicine. 2017;8(1):16. doi: 10.4103/2008-7802.201923. eCollection 2017.
68.Basiri B, Sabzehei MK, Shokouhi M, Moradi A. Evaluating the incidence and risk factors of nosocomial infection in neonates hospitalized in the neonatal intensive care unit of fatemieh hospital in Hamadan, Iran, 2012 – 2013. Archives of Pediatric Infectious Diseases. 2015;3(2): e23327.
69.Darvishi M, Forootan M, Nazer MR, Karimi E, Noori M. Nosocomial Infections, Challenges and Threats: A Review Article. Iran-J-Med-Microbiol. 2020;14(2):162-81.
70.Emami A, Pirbonyeh N, Keshavarzi A, Javanmardi F, Moradi Ghermezi S, Ghadimi T. Three year study of infection profile and antimicrobial resistance pattern from burn patients in southwest Iran.

Infection and drug resistance. 2020:1499-506.
71. Esfandiari A, Salari H, Rashidian A, Asl HM, Foroushani AR, Sari AA. Eliminating healthcare-associated infections in Iran: a qualitative study to explore stakeholders' views. International journal of health policy and management. 2017;7(1):27-34.
72. Farhoudi F, Sanaei Dashti A, Hoshangi Davani M, Ghalebi N, Sajadi G, Taghizadeh R. Impact of WHO hand hygiene improvement program implementation: A quasi-experimental trial. BioMed research international. 2016;2016(1):7026169. doi: 10.1155/2016/7026169.
73. Hormozi SF, Saeedi AA, Aminianfar M, Alishah MS, Darvishi M. Studying the frequency of nosocomial infection and its relative factors in the intensive care unit of hospitals based upon NNI system. Eurasia Journal of Analytical Chemistry. 2018;13(3): em16.
74. Izadi N, Etemad K, Mehrabi Y, Eshrati B, Nazari SS. The Standardization of Hospital-Acquired Infection Rates Using Prediction Models in Iran: Observational Study of National Nosocomial Infection Registry Data. JMIR Public Health and Surveillance. 2021;7(12): e33296.
75. Karkhane M, Pourhosiengholi MA, Torkabad MR, Kimiia Z, Mortazavi SM, Aghdam SK, et al. Annual antibiotic related economic burden of healthcare associated infections; a cross-sectional population-based study. Iranian journal of pharmaceutical research: IJPR. 2016;15(2):605-10.
76. Kasiri N, Barzanoni S, Syedhasani SN, Bakhtiari-Dovvombaygi H, Sarboozi-hoseinabadi T, Yaghoobi H, et al. Prevalence and risk factors of nosocomial infections in different wards and seasons in two hospitals in northeastern Iran. Journal of Public Health and Development. 2022;20(1): 163-74.
77. Khammarnia M, Ansari-Moghaddam A, Barfar E, Ansari H, Abolpour A, Setoodehzadeh F, et al. Systematic review and meta-analysis of hospital acquired infections rate in a middle east country (1995-2020). Medical journal of the Islamic Republic of Iran. 2021;35(1): 102. doi: 10.47176/mjiri.35.102.
78. Khoshdel A, Habibian R, Parvin N, Doosti A, Famouri F, Eshraghi A, et al. Molecular characterization of nosocomial Clostridium difficile infection in pediatric ward in Iran. SpringerPlus. 2015;4: 627. https://doi.org/10.1186/s40064-015-1268-0
79. Lotfinejad N, Assadi R, Aelami MH, Pittet D. Emojis in public health and how they might be used for hand hygiene and infection prevention and control. Antimicrobial Resistance and Infection Control. 2020;9: 27. https://doi.org/10.1186/s13756-020-0692-2
80. Mahdizadeh SM, Sany SBT, Sarpooshi DR, Jafari A, Mahdizadeh M. Predictors of preventive behavior of nosocomial infections in nursing staff: a structural equation model based on the social cognitive theory. BMC Health Services Research. 2021;21(1): 1187. https://doi.org/10.1186/s12913-021-07205-6
81. Nouri F, Karami P, Zarei O, Kosari F, Alikhani MY, Zandkarimi E, et al. Prevalence of common nosocomial infections and evaluation of antibiotic resistance patterns in patients with secondary infections in Hamadan, Iran. Infection and drug resistance. 2020:2365-74.
82. Rostami S, Sindarreh S, Sigari AA, Bani MS, Taheri B, Abbasi S. Feasibility Study and Design of the ICU Infection Registry System for Patients Admitted to the Alzahra University Hospital in Isfahan: A Methodology Study. Advanced Biomedical Research. 2023;12:218. DOI: 10.4103/abr.abr_267_22
83. Izadi N, Eshrati B, Etemad K, Mehrabi Y, Hashemi-Nazari SS. Rate of the incidence of hospital-acquired infections in Iran based on the data of the national nosocomial infections surveillance. New Microbes and New Infections. 2020;38:100768. https://doi.org/10.1016/j.nmni.2020.100768
84. Darvishi M, Forootan M, Nazer MR, Karimi E, Noori M. Nosocomial Infections, Challenges and Threats: A Review Article. Iranian Journal of Medical Microbiology. 2020;14(2):162-81.
85. Saffari M, Sanaeinasab H, Masoumbeigi H, Pakpour AH, O'Garo KN, Koenig HG. An education-based text messaging program to improve nurses' knowledge, attitude, and practice related to nosocomial infections in intensive care settings. The Journal of Continuing Education in Nursing. 2019;50(5):211-7.
86. Ataee RA, Ataee MH, Mehrabi Tavana A, Salesi M. Bacteriological aspects of hand washing: A key for health promotion and infections control. International Journal of Preventive Medicine. 2017;8: 16. doi: 10.4103/2008-7802.201923. eCollection 2017.
87. Ajami S, Zerganipor F. Nosocomial infection control by wireless sensor network in intensive care unit. Journal of Research in Medical Sciences. 2016;21(1): 35. DOI: 10.4103/1735-1995.184001