Original Article

Assessment of Knowledge and Practices Regarding Disinfection and Healthcare-Associated Infection Prevention and Control Among Infection Prevention and Control Supervisors in Tehran, Iran

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Abstract

Background: The global emergence of antimicrobial resistance has been accelerated by the inappropriate use of antimicrobials. Hospitals are major reservoirs for the transmission of multidrug-resistant (MDR) pathogens and healthcare-associated infections (HCAIs). This study aimed to evaluate hospital staff knowledge of HCAI prevention and control and disinfection practices in Tehran, Iran.

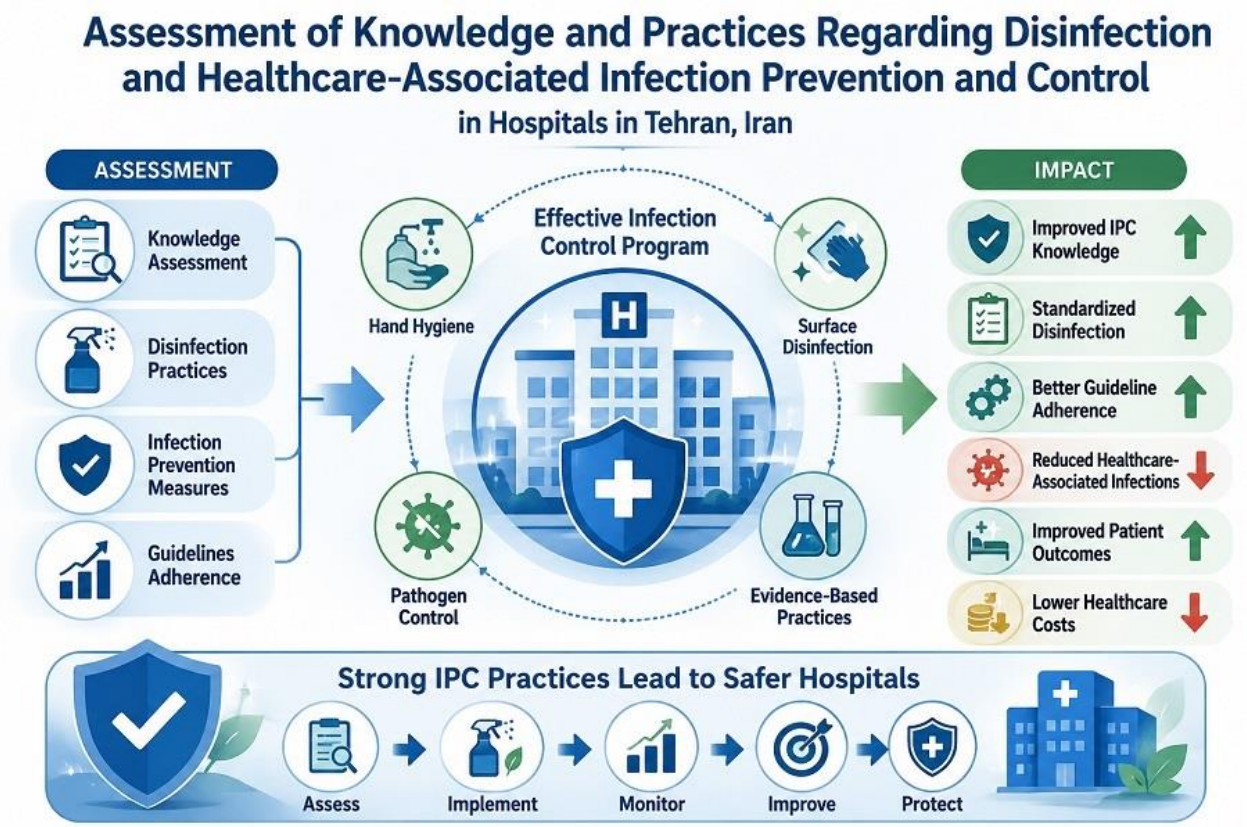
Methods: A cross-sectional descriptive study was conducted in 51 hospitals in Tehran, Iran. Between March and June 2019, data were collected through face-to-face interviews with infection prevention and control (IPC) supervisors using a structured questionnaire assessing disinfection practices and healthcare-associated infection (HCAI) prevention and control.

Results: The study included 51 hospitals in Tehran, with one infection prevention and control (IPC) supervisor from each hospital completing the questionnaire. Regular Infection Control Committee (ICC) meetings and HCAI training programs were reported in most hospitals. Multidrug-resistant (MDR) infections were reported in 72.5% of hospitals, with antibiotic overuse and misuse identified as the leading contributing factor. Overall, respondents rated their hospitals' HCAI prevention and control practices as satisfactory; however, 13% reported being unaware of an HCAI surveillance program. Disinfectant selection was primarily guided by Infection Control Committee (ICC) recommendations, national guidelines, product quality, supplier agreements, and product availability.

Conclusion: Although most hospitals reported established IPC programs, gaps in HCAI surveillance, microbiological monitoring, and disinfectant management remain. Strengthening IPC and antimicrobial stewardship programs may improve infection prevention and patient safety.

Implications for Patient Care: Strengthening infection prevention and control programs, improving HCAI surveillance, expanding routine microbiological monitoring, and optimizing antimicrobial stewardship may reduce healthcare-associated infections, improve patient safety, and support higher-quality healthcare delivery.

Keywords: Disinfection; Sterilization; Nosocomial Infection; Healthcare-associated Infection; Biocides



Graphical Abstract. Disinfection Practices and Infection Prevention in Hospitals of Tehran, Iran. Identifying knowledge and practice gaps among infection prevention and control supervisors enables targeted educational interventions, strengthens adherence to evidence-based infection prevention strategies, and ultimately improves patient safety while reducing healthcare-associated infections.

Introduction

Healthcare-associated infections (HCAIs), also referred to as nosocomial infections, are infections that develop 48 hours or more after hospital admission or within 30 days following the receipt of healthcare services (1–3). These infections range from mild illnesses to severe, life-threatening conditions. The most common categories of HCAIs include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections, and ventilator-associated pneumonia (4–7). Affecting millions of patients worldwide each year, HCAIs remain a major public health challenge, contributing substantially to morbidity, mortality, prolonged hospital stays, and healthcare costs, particularly in low- and middle-income countries (8).

In Iran, a systematic review published in 2018 estimated the overall prevalence of HCAIs at 4.5%. The review also identified Klebsiella pneumoniae as the leading causative pathogen, particularly in urinary tract, respiratory tract, and bloodstream infections (9). More broadly, approximately 80% of HCAIs are caused by a relatively small group of microorganisms, including Escherichia coli, Staphylococcus aureus, vancomycin-resistant enterococci, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Clostridioides difficile (10–13). The widespread use of antimicrobial agents has accelerated the emergence and persistence of

antimicrobial-resistant microorganisms in healthcare environments, making the treatment and control of HCAIs increasingly challenging (14).

Healthcare-associated infections are transmitted through multiple routes, including contaminated environmental surfaces, medical devices, healthcare workers' hands, direct contact, droplet, and airborne transmission (15). Cross-transmission occurs when pathogens are transferred from one patient to another through direct contact or indirectly via contaminated surfaces, medical equipment, or healthcare personnel (16,17). In addition, contaminated air, food, water, and zoonotic sources may contribute to pathogen dissemination in healthcare settings (18). Medical implants and invasive devices, such as catheters and prosthetic heart valves, also provide favorable surfaces for microbial adhesion and biofilm formation, thereby increasing the risk of healthcare-associated infections (19,20).

Because many of these transmission routes are preventable, infection prevention and control (IPC) measures play a pivotal role in reducing the incidence of HCAIs (21,22). International organizations and public health agencies have therefore developed evidence-based standards and recommendations for the sterilization, disinfection, and reprocessing of medical devices (23–25). In addition to device reprocessing, environmental cleaning and surface disinfection have been recognized as essential components of IPC programs, and numerous studies have demonstrated their effectiveness in reducing pathogen transmission within healthcare settings (16).

Disinfection substantially reduces the microbial burden on inanimate surfaces by eliminating most pathogenic microorganisms, although bacterial spores generally remain resistant to conventional disinfection procedures (26). Consequently, comprehensive guidelines have been developed to standardize disinfection practices for healthcare environments and medical equipment. These guidelines emphasize the selection of appropriate disinfectants, adherence to standardized protocols, consideration of antimicrobial resistance, and continuous education and training of healthcare personnel to ensure effective implementation (27).

Given the critical role of environmental disinfection in preventing healthcare-associated infections and the growing challenge posed by antimicrobial-resistant microorganisms, this study aimed to evaluate hospital disinfection practices and assess the knowledge of hospital staff regarding disinfection procedures in hospitals in Tehran, Iran.

Methods

Study design

A cross-sectional descriptive study was conducted to evaluate disinfection practices and healthcare-associated infection (HCAI) control measures in hospitals in Tehran, Iran. The study was conducted in 51 hospitals in Tehran, Iran, including public, private, and teaching hospitals. One infection prevention and control (IPC) supervisor from each participating hospital was recruited as the study respondent. The study protocol was approved by the Ethics Committee of Tehran University of Medical Sciences (Approval No. IR.TUMS.VCR.REC.1398.284). Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, and the confidentiality and anonymity of all participants were ensured throughout the study.

Questionnaire development and validation

Data were collected using a structured questionnaire developed to assess hospital disinfection processes, infection prevention and control (IPC) practices, and HCAI-related knowledge, attitudes, and practices. The questionnaire was developed based on a review of the published literature and national infection prevention and control guidelines. Content

validity was assessed by a panel of 10 experts in infection control and hospital epidemiology. Based on their feedback, necessary modifications were applied to improve clarity, relevance, and comprehensiveness. The final questionnaire included yes/no questions, multiple-choice items, and a limited number of open-ended questions addressing hospital characteristics, IPC infrastructure, disinfection practices, and antimicrobial-related factors. The questionnaire consisted of eight yes/no questions and eleven multiple-choice questions, along with a limited number of open-ended questions for additional comments and suggestions (Table 1).

Data collection

Data were collected through face-to-face interviews with infection prevention and control (IPC) supervisors in participating hospitals. IPC supervisors were selected as key informants due to their direct involvement in infection control policies and implementation. Data collection was conducted from March to June 2019. Prior to participation, the purpose of the study was explained to all respondents, and written or verbal assurance of confidentiality and anonymity was provided. Participation was voluntary, and respondents were informed that they could withdraw at any stage without consequence.

N	Questions	Response Rate (%)
	Yes-No questions	
Q 1	Are the infection control committee meetings held in your hospital regularly?	88
Q 2	Do you have a specific program in your hospital for training sessions?	88
Q 3	Do you know about the nosocomial infection monitoring program in your hospital?	74.5
Q 4	Have you ever treated cases of multidrug-resistant (MDRO) infection in your hospital?	78.5
Q 5	Do you know how to wash your hands in the ten-step handwashing technique?	100
Q 6	Do you consider all patients potentially contagious?	88
Q 7	Do you have a rotation plan for using disinfectants?	
Q 8	Are disinfectants used in conjunction with mops or wipes in your hospital	100
	Multi-choice questions	
Q 9	Do you think your hospital has good HCAIs control management and practice?	86
Q 10	How often do you replace mop heads?	94
Q 11	Do you have a regular plan for preparing microbial culture from different parts of the hospital?	98
Q 12	How often do you wash your white coat or nurse uniform?	100
Q 13	Which is the most important source/reservoir of HCAIs?	82
Q 14	Which of the following is/are closely associated with the emergence of multidrug resistant organisms (MDROs)?	80.4
Q 15	In what areas of your hospital can you find disinfectant?	100
Q 16	What determines your decision to purchase a disinfectant?	100
Q 17	Who approves the disinfectant purchase at the end?	100
Q 18	Which disinfectant and antiseptic do you use in your hospital?	100

Table 1. Structure and domains of the study questionnaire. Summary of questionnaire items and response rates among infection prevention and control (IPC) supervisors.

Variables and measures

The study assessed hospital-level characteristics (type, teaching status, and bed capacity), IPC infrastructure (presence of infection control committees and training programs), surveillance practices, antimicrobial resistance-related factors, hand hygiene practices, environmental cleaning procedures, and disinfectant use and management.

Data analysis

Data were coded, entered into SPSS version 24.0 (IBM Corp., Armonk, NY, USA), and analyzed using descriptive statistics. Descriptive statistics, including frequencies and percentages, were used to summarize responses. No inferential statistical analysis was performed.

Results

Characteristics of participating hospitals

A total of 51 hospitals in Tehran participated in the study. One infection prevention and control (IPC) supervisor from each hospital completed the questionnaire. The characteristics of the participating hospitals are presented in Table 2. Of these hospitals, 68.63% were private and 31.37% were public. Teaching hospitals accounted for 33.33% of the sample. Most hospitals (approximately 69%) had fewer than 200 inpatient beds; however, hospital size varied considerably, ranging from 10 beds in a surgical center to more than 1,000 beds in a large tertiary hospital.

Item		Frequency (n)	Percentage (%)
Type of hospital	Public hospital	16	31.37
	Private hospital	35	68.63
	Total	51	100
Educational status	Educational	17	33.33
	Non-educational	34	66.66
	Total	51	100
Inpatient bed count	≤ 100	20	39.21
	100-200	15	29.41
	200-300	9	17.64
	300-400	1	1.96
	400-500	2	3.92
	≥ 500	4	7.84

Table 2. Characteristics of participating hospitals. Distribution of participating hospitals according to ownership, teaching status, and inpatient bed capacity

HCAI Prevention and Control Policies and Knowledge

Responses regarding HCAI prevention and control policies and knowledge are summarized in Table 3. Most participating hospitals reported holding regular Infection Control Committee (ICC) meetings and implementing formal educational programs on HCAI prevention and control. Consistent with these findings, respondents generally considered their hospitals' HCAI prevention and control practices to be satisfactory. However, a small proportion of IPC supervisors reported being unaware of an established HCAI surveillance program in their hospitals, indicating potential gaps in surveillance awareness and implementation.

HCAI Prevention and Control Programs and Practices

Approximately three-quarters of participating hospitals reported the occurrence and management of multidrug-resistant (MDR) infections. According to respondents, antibiotic overuse or misuse and inadequate antibiotic stewardship practices were the most important contributing factors, accounting for 66% of responses. To monitor and control HCAIs, hospitals also reported their microbiological surveillance practices. Only 2% of hospitals performed routine microbiological cultures on hospital equipment, environmental surfaces, and staff, whereas more than half (52%) conducted such cultures only in response to reported infection outbreaks.

Regarding routine infection prevention and control practices, 66.7% of IPC supervisors considered all patients to be potentially infectious, and respondents identified healthcare personnel and hospitalized patients as the primary sources of HCAI transmission. All participating hospitals reported that healthcare workers were familiar with standard hand hygiene techniques. Hand antiseptic products were generally available at nurses' stations, in corridors, and at patients' bedsides; however, in psychiatric hospitals they were mainly limited to nurses' stations. Approximately 80% of hospitals reported that healthcare workers washed their white coats once or twice per week.

Disinfection Practices

The disinfectants used in participating hospitals are presented in Table 4. Low- and intermediate-level disinfectants were mostly produced by domestic manufacturers, whereas high-level disinfectants were primarily manufactured by international companies. Respondents reported that disinfectant selection was mainly based on national guidelines, product quality, distributor agreements, and product availability. In most hospitals, the final decision regarding disinfectant procurement was made by the Infection Control Committee (ICC). Regarding disinfectant use, 73% of respondents indicated that their hospitals did not have a disinfectant rotation program. Instead, disinfectants were typically replaced only after an infection outbreak or when the current product was no longer available.

Environmental cleaning practices also varied across hospitals. In all hospitals, disinfectants were applied to environmental surfaces using mops or wipes. Regular replacement of mop heads every two weeks was reported by 41.6% of hospitals, whereas approximately half reported replacing mop heads only when they became

worn out. Sodium hypochlorite was commonly used for cleaning mop heads.

Suggestions for Improving HCAI Prevention and Control

Participants most frequently recommended strengthening staff education on HCAI prevention and infection control guidelines, increasing financial support for Infection Control Committee (ICC) activities, enhancing managerial commitment to infection prevention programs, and expanding the workforce dedicated to disinfection, sterilization, and infection control.

Discussion

The findings of the present study indicate that infection prevention and control programs are in place in most participating hospitals in Tehran. Regular Infection Control Committee (ICC) meetings and structured educational programs on healthcare-associated infection (HCAI) prevention were reported by the majority of respondents. Effective infection prevention programs rely on multidisciplinary collaboration, organization-wide information sharing, and strong leadership support to implement evidence-based infection prevention strategies (28). In line with these recommendations, most hospitals in the present study reported active infection control structures and educational activities.

Despite the widespread implementation of these infection prevention activities, the findings suggest that compliance with infection prevention measures remains a challenge. Although most respondents considered their hospitals' infection control practices to be satisfactory, the ongoing occurrence of HCAIs and multidrug-resistant infections indicates that educational interventions alone may not be adequate. Similar findings have been reported in previous studies demonstrating that infection prevention and control behaviors are influenced by multiple behavioral determinants rather than knowledge alone, particularly environmental context and resources, social/professional role and identity, and beliefs about consequences (29). Sukhlecha et al. reported that inadequate sterilization training and poor implementation of infection control procedures may contribute to the transmission of infectious diseases in healthcare settings (30). Likewise, Rajakaruna et al. identified deficiencies in knowledge and compliance as important factors contributing to the spread of healthcare-associated infections (HCAIs) (31). A substantial proportion of hospitals reported the occurrence of multidrug-resistant (MDR) infections. Respondents identified antibiotic overuse, misuse, and inadequate antibiotic stewardship practices as major contributors to antimicrobial resistance. This finding is consistent with previous evidence showing that antimicrobial exposure promotes the selection and persistence of resistant microorganisms within healthcare environments (32). The study also revealed limitations in microbiological surveillance practices. Routine microbiological testing was often underused and inconsistently implemented, which limited the representativeness and quality of surveillance data (33). Limited surveillance may delay the detection of environmental contamination and emerging outbreaks, thereby reducing opportunities for timely infection prevention interventions. Active surveillance may facilitate earlier identification of contamination sources and support timely infection prevention interventions (34).

N	Answers and their frequency percentage (%)					
Yes-No question						
	Yes	No				
Q 1	95.5	4.5				
Q 2	93.3	6.67				
Q 3	87	13				
Q 4	72.5	27.5				
Q 5	100	0				
Q 6	66.6	33.4				
Q 7	27	73				
Q 8	100	0				
	Multi-choice question					
Q 9	Yes	No	Almost			
	86	2.3	11.7			
Q 10	Weekly	After 2 weeks	After 3-4 weeks	When it is torn and unusable		
	2	41.7	6.3	50		
Q 11	regularly	irregular	Only after an outbreak of infection			
	4	44	52			
Q 12	Daily	3 times a week	Twice a week	Weekly	In case of clear contamination	
	4	8	36	44	8	
Q 13	Inpatients	Treatment staff	Cleaners	Visitors	Caregivers or Attendants	All items
	28.8	35.6	5.5	9.6	12.3	8.2
Q 14	Poor patient compliance	Antibiotic cycling practice	Antibiotic abuse or overuse	Poor infection control guidelines	Poor adherence to recommended infection control practices	
	9.4	24.7	41.2	10.6	14.1	
Q 15	Nurse stations	Corridors	Beside the bed of patients	All items		
	4	-	-	96		
Q 16	High Quality	Availability	Good selling conditions of the distributor company	Personnel Satisfaction + Pilot Studies	Central supply warehouse is provider	
	31.2	21.9	29.2	8.3	9.4	
Q 17	Hospital Manager	ICC[a]	Medical equipment officer	Environmental Health Unit	Pharmacy manager + ICC	
	4.1	79.6	6.1	4.1	6.1	
Q 18	The answers are extensively listed in the table 4.					

Table 3. Responses of infection prevention and control (IPC) supervisors. Summary of IPC supervisors' responses regarding HCAI prevention and control policies, surveillance practices, and disinfection procedures.

Trade Name	Active ingredient	Manufacturing Country-company	Frequency Percentage n (%)
Septicidine®	Ethyl alcohol, chlorhexidine	Iran-BSCO	15.8
Deconex®	Quaternary ammonium, Glutaraldehyde, Guanidine, Alcohol	Switzerland-Borer	8.9
Surfosept®	DDAC, Isopropanol	Iran-Rezarad	8.9
Microzed®ultra-hd	Quaternary ammonium, Alcohol	Iran-Sepano	8.4
Septigel®	Ethanol, isopropanol	Iran-BSCO	7.9
Sayasept®	DDAC, PHMB	Iran-BSCO	6.4
Manocid®	Alcohol	Iran- NIPCO	5.4
Aniospray®	Quaternary ammonium, PHMB	France-Anios	4.9
Formalin®	Formaldehyde	Iran-chemical seller	4.9
Cidex®	Glutaraldehyde	USA-Johnson & Johnson	4.5
Dermosept®	BAK, chlorohexidine, Ethanol	Iran- Rrezarad	4
Opidex®	Phthalaldehyde	Iran-Rezarad	4
Septisurface ®	PHMB, DDAC	Iran-BSCO	3.5
Soluside®	Quaternary ammonium	USA-MCC	2
Septiprep® hd	Quaternary ammonium, chlorohexidine, Isopropanol, Ethanol	Iran-BSCO	1.5
Wavicide®	Glutaraldehyde	USA-MCC	1.5
Epimax®	Sodium hypochlorite	Iran-Emadpharma	1
Septoman®	Isopropanol, polyoxyethylene lanolin	Germany-Dr. Schumacher	1
sorfanious®	DDAC, Bis(aminopropyl)laurylamine	France-Anios	1
Aniosyme®	Quaternary ammonium, PHMB, Enzymatic complex	France-Anios	0.5
Behsadex®	Glutaraldehyde	Iran-Behsa	0.5
Descoton ®	Glutaraldehyde	Germany-Dr.Schumacher	0.5
Easyclenz®	Glutaraldehyde, Glyoxale	Iran –kimia fam	0.5
Gigasept ®	Guanidine Phenoxypropanols, BAK.	Germany-Schülke	0.5
Minoten ®	Quaternary ammonium, Alcylamines, Alcohols	India-Alpro	0.5
Percidin®	Hydrogen peroxide, Peracetic acid	Iran-BSCO	0.5
Septiturbo®	DDAC isopropanol	Iran-BSCO	0.5
Sporcidin®	Glutaraldehyde	Iran-BSCO	0.5

Table 4. Types and distribution of disinfectants used in participating hospitals (n = 49). List of disinfectants used in hospitals, including active ingredients and manufacturers. Two hospitals did not provide information regarding disinfectant products. Abbreviations: BAK, benzalkonium chloride; DDAC, didecyldimethylammonium chloride; PHMB, polyhexamethylene biguanide.

Approximately two-thirds of respondents considered all patients to be potentially contagious. In a study conducted among healthcare workers in Saudi Arabia, most respondents (96.2%) correctly recognized that standard precautions should be be applied to all patients regardless of their diagnosis or perceived infection status (35). In addition, healthcare workers are themselves at risk of acquiring healthcare-associated infections through occupational exposure during patient care and routine clinical activities (36).

Consistent with these observations, respondents in the present study identified healthcare workers and hospitalized patients as the major sources of pathogen transmission within hospitals. This finding underscores the importance of strict adherence to standard infection prevention measures by both healthcare personnel and patients to minimize cross-transmission within healthcare settings. Previous studies have demonstrated that adherence to hand hygiene practices is one of the most effective measures for reducing HCAIs and may have a greater impact

on infection prevention than environmental disinfection alone (37). Although all participating hospitals reported familiarity with recommended hand hygiene techniques, inadequate compliance may still contribute to pathogen transmission. Disinfection practices were based on national regulations, institutional policies, and established infection prevention and control guidelines (38). The selection of disinfectants was influenced by product quality, availability, and procurement-related factors. According to established guidelines, disinfectant selection should be based on spectrum of antimicrobial activity, intended use, and effectiveness against common healthcare-associated pathogens (39). Rutala and Weber further emphasized the importance of selecting appropriate disinfectants and recommended one-step disinfectants for routine environmental surface decontamination in healthcare facilities (40). Beyond disinfectant selection, organizational policies governing disinfectant use also deserve attention. An important finding of the present study was the absence of disinfectant rotation programs in most hospitals. Although disinfectants were occasionally changed following outbreaks or product shortages, routine rotation was uncommon. Similar to antimicrobial stewardship strategies, disinfectant rotation has been proposed as a method for reducing selective pressure and limiting the emergence of resistant microorganisms. However, further research is needed to determine its practical benefits in healthcare settings. Environmental cleaning procedures were generally standardized, with disinfectants applied using mops or wipes. Nevertheless, considerable variation was observed in the frequency of mop-head replacement. Since cleaning equipment may become contaminated and contribute to environmental transmission of pathogens, regular replacement and proper maintenance are important components of infection prevention programs. Failure to adequately maintain cleaning equipment may reduce the effectiveness of environmental disinfection and facilitate indirect pathogen transmission. Similar concerns were reported by R.E. Thomas et al. identified substantial gaps in the available evidence regarding the effects of environmental service workers' training and disinfection activities on hospital cleaning effectiveness, emphasizing the need for more detailed evaluations (41). Overall, the findings suggest that infection prevention infrastructure and educational programs are well established in many hospitals in Tehran. However, gaps remain in staff compliance, microbiological surveillance, antimicrobial stewardship, and optimization of environmental disinfection practices. These findings highlight several priority areas for future quality improvement initiatives in infection prevention and control. Addressing these challenges may contribute to reducing healthcare-associated infections and improving patient safety and healthcare quality.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, its cross-sectional design provides a snapshot of current practices and does not allow causal inferences regarding infection prevention and control measures. Second, the data were based on self-reported responses from Infection Prevention and Control (IPC) supervisors, which may have been influenced by recall or social desirability bias. Third, only one IPC supervisor from each hospital completed the questionnaire; therefore, the responses may not fully reflect the practices and perceptions of all healthcare personnel. Finally, because the study was conducted

exclusively in hospitals in Tehran, the findings may not be generalizable to healthcare facilities in other regions of Iran. Future multicenter studies incorporating direct observational assessments and microbiological monitoring are warranted to validate and expand upon these findings.

Conclusion

This study demonstrated that infection prevention and control programs are well established in many hospitals in Tehran, particularly with respect to Infection Control Committee activities, staff education, and adherence to national disinfection guidelines. Nevertheless, important gaps remain in compliance with infection prevention measures, microbiological surveillance, antimicrobial stewardship, and optimization of environmental disinfection practices. Addressing these challenges through strengthened surveillance systems, continuous monitoring of compliance, evidence-based disinfectant management, and sustained institutional support may contribute to reducing healthcare-associated infections, improving patient safety, and enhancing the quality of healthcare delivery.

Implications for Patient Care

The findings of this study have important implications for patient care and healthcare quality improvement. Although most participating hospitals reported the presence of infection control committees, staff training programs, and established disinfection procedures, gaps in compliance with infection prevention measures were identified. These gaps may increase the risk of healthcare-associated infections (HCAIs), which are associated with prolonged hospitalization, increased healthcare costs, and adverse patient outcomes. The high prevalence of multidrug-resistant infections reported among participating hospitals highlights the need for strengthened antimicrobial stewardship programs and enhanced infection prevention strategies. Improved adherence to hand hygiene practices, routine microbiological surveillance, and evidence-based disinfection protocols may help reduce pathogen transmission within healthcare settings.

The findings also suggest that infection control interventions should move beyond knowledge-based training and place greater emphasis on monitoring compliance, providing regular feedback to healthcare personnel, and fostering a culture of patient safety. Strengthening Infection Control Committee activities and ensuring adequate institutional support may improve the implementation of infection prevention policies and enhance patient protection. Furthermore, standardized procedures for disinfectant selection and optimization of environmental cleaning practices may help reduce environmental contamination and lower the risk of HCAIs. Collectively, these measures have the potential to improve patient safety, reduce the burden of HCAIs, and enhance the overall quality of clinical care.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Author Contributions

All authors contributed to the conception and design of the study, literature search, data interpretation, drafting of the manuscript, and critical revision of the article. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Ethics Statement

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Publisher's Note

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