
Compliance and barriers of infection prevention and control strategies among healthcare workers in Erbil public hospitals

Received: 25/06/2025

Accepted: 29/07/2025

Linda Muhsin¹Samir Mahmood Othman¹

ABSTRACT

Background and objective: Infection prevention and control (IPC) is essential for protecting patient and healthcare worker safety. IPC adherence within a resource-constrained environment, such as Erbil, Iraq, continues to be suboptimal due to multifactorial barriers. The objective of this study was to determine adherence to IPC among healthcare workers (HCWs) and the associated barriers in public hospitals in Erbil.

Methods: A descriptive cross-sectional study was conducted among healthcare workers between October 2024 and end of May 2025, in five public hospitals in Erbil city. A total of 415 HCWs were surveyed via proportionally allocated convenience sampling, using a validated, pilot-tested questionnaire adapted from a WHO tool. SPSS version 26 was used for data entry and analysis. A p-value ≤ 0.05 was considered statistically significant.

Results: Of the total study sample, 14.2% were in full compliance with IPC practices. Nurses carried the greatest burden of human and environmental barriers, including inadequate training, inadequate support from staff, and inadequate equipment availability. Occupation and qualification showed statistically significant associations with compliance ($p=0.003$ and $p=0.013$, respectively), with nurses — including infection control nurses — and Master's degree holders showing higher compliance. Lack of manpower, role conflict, lack of experience, lack of IPC training, lack of IPC staff contact, equipment shortage, quality of materials and equipment, and non-compliance of healthcare workers with IPC protocol were significantly reported as barriers.

Conclusion: IPC practice among HCWs in Erbil is low, especially among disproportionately exposed nurses. There is an urgent need for routine training, institutional support, better infrastructure, and objective monitoring to strengthen IPC compliance and enhance patient safety.

Keywords: Infection prevention and control, Compliance, Barriers, Health workers, Erbil, Iraq

¹ Department of Community Medicine, College of Medicine, Hawler Medical University, Erbil, Kurdistan Region, Iraq.

Correspondence: Linda Muhsin, arinamammed25@gmail.com.

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INTRODUCTION

At every step of healthcare delivery, infection prevention and control (IPC) practices are central to ensuring patient safety and quality of care. Healthcare-associated infections (HAIs) are among the most common and preventable side effects of hospital admission, and IPC practices are intended to prevent and reduce the risk of such infections (1). HAIs lead to increased morbidity and mortality among susceptible populations — such as the elderly, immunocompromised, or critically ill — increased length of hospital stay, and greater healthcare costs (2).

The last few decades have been challenging for Iraq's healthcare system, particularly in the Kurdistan Region. Some of these challenges are war effects, poor infrastructure, financial problems, and a lack of medical staff (3). Severe patient loads, government fiscal limitations, and fragmented supply chains for key IPC materials are severely affecting hospitals in Erbil, the capital and main center for public healthcare services for the area (4).

These barriers hinder healthcare workers' (HCWs') ability to effectively apply IPC protocols, especially in emergencies or crowded settings. There is also evidence of a gap between IPC knowledge and practice. Even when HCWs are informed about IPC guidelines, several obstacles — including availability of personal protective equipment (PPE), time, inadequate training, and institutional implementation — affect their actual use, a pattern also seen among healthcare providers in Erbil more broadly, where facilitators and barriers to professional practice change have been shown to shape day-to-day performance (5, 6). Psychological mechanisms such as moral burnout, exhaustion, and infection anxiety further add to the complexity of compliance, particularly in highly stressful

environments such as intensive care units or emergency rooms (7).

IPC rose in priority even further during the COVID-19 pandemic. While the pandemic increased awareness and temporarily enhanced HCW adherence, it also exposed structural weaknesses in IPC programs, particularly in resource-poor environments (8). Although IPC activities in Erbil received increased attention during the pandemic, momentum has been hard to maintain since, due to the absence of efficient monitoring mechanisms, unstable communication from leadership, and the absence of long-term strategic planning (9).

A negative IPC culture is also the result of sociocultural beliefs, poor senior-staff role modelling, and poor patient education in most public hospitals across Erbil (10).

Previous studies show that healthcare personnel typically perceive IPC guidelines as voluntary rather than compulsory, which undermines compliance and encourages risky behaviors (11). Such behavior often reflects system weaknesses — such as a lack of feedback loops, leadership complacency, and scarce resources — rather than negligence (12).

IPC practice in public hospitals remains inconsistent and poorly suited to the environment, even though there has been some improvement at national and regional levels through training workshops, guidelines, and cross-border collaboration (13).

The purpose of this research is to assess compliance with IPC practices among healthcare workers in public hospitals in Erbil. Alongside this, the study also aims to investigate the association between sociodemographic variables and IPC compliance and to determine the most significant implementation challenges.

METHODS

Study Design

A descriptive cross-sectional study design was used.

Study Setting and Duration

The study was conducted across five major public hospitals in Erbil (Rizgary Teaching Hospital, Hawler Teaching Hospital, Maternity Teaching Hospital, Raparin Teaching Hospital, and Rozhawa Emergency Hospital), from October 2024 to end of May 2025.

Participants

Physicians, registered nurses, midwives, and infection control staff who had been working for at least six months.

Inclusion and Exclusion Criteria

Inclusion criteria: participants who cared for patients directly, had been employed for at least 6 months, and were willing to participate. Exclusion criteria: non-clinical staff, temporarily employed health workers, and those unwilling to participate.

Sample Size and Sampling Method

Using Epi Info version 7, the sample size was calculated based on 3,690 healthcare workers across the chosen hospitals, using a 50% predicted compliance frequency, a 5% margin of error, and a 95% confidence level; the estimated sample size was 384. To improve data reliability and account for potential non-response, a larger sample of 415 was used.

A convenience sampling method was used to select HCWs who were available and willing to participate. To ensure equitable representation, participants were chosen from each hospital using proportionate sampling, based on the total number of healthcare workers employed there, balancing accurate representation with accessibility.

Procedure for Data Collection

A questionnaire modified from the WHO IPC evaluation tool and other globally recognized instruments was used to gather data on HCWs' adherence to IPC practices and to identify obstacles. The questionnaire comprised three sections.

Section A: Socio-demographic characteristics. Seven questions collecting demographic and professional background information such as age, gender, and profession.

Section B: IPC compliance. Fourteen questions assessing adherence to IPC practices, using a Likert scale from 'Never' (1) to 'Always' (5), along with binary response options (1 for Yes, 0 for No). Each participant's total score was calculated and the median score determined; scores below the median were classified as noncompliant, and those above as compliant.

Section C: IPC barriers. Fourteen questions examining the difficulties healthcare professionals encounter in following IPC guidelines, including human, environmental, and individual factors.

Validity and Reliability

The questionnaire was validated by a panel of experts in community medicine. Most experts agreed with the study's components, and the limited comments and recommendations received were all incorporated; the final draft was confirmed as appropriate for the study.

Ethical Approval

The study received ethical approval from the Hawler Medical University/College of Medicine ethics committee (meeting code: 1, paper code: 7, dated 22/9/2024). Informed consent was obtained from each participant, and confidentiality was ensured by not recording participant names on the questionnaire. Strict ethical guidelines were

adhered to throughout the study to ensure participant safety and data integrity.

Data Analysis

Descriptive statistics were used to calculate frequencies and percentages. The chi-square test was used to assess associations between categorical variables. A p-value ≤ 0.05 was considered statistically significant. SPSS version 26 was used to enter, code, and analyze the data.

RESULTS

Of the total 415 participants, 76.7% were aged 30–49 years and only 11.1% were aged 50 and

above; more than half were female, and about two-thirds (67.7%) were nurses. Regarding years of experience, most (43.6%) had 11–20 years of experience, and only 4.3% had 31–40 years. Most participants worked in ward and operation units (33.0% and 16.4%, respectively), as shown in Table 1.

Regarding compliance with IPC guidelines, this study found that only about 14.2% of participants achieved full compliance, as shown in Figure 1.

Table 1. Sociodemographic characteristics of the participants

Variable	Category	n	%
Age (years)	<30	51	12.2
	30-39	187	45.1
	40-49	131	31.6
	50 and more	46	11.1
Gender	Female	239	57.6
	Male	176	42.4
Occupation	Physician/Surgeon	126	30.4
	Nurse	281	67.7
	Infection control staff	8	1.9
Experience	<5 years	48	11.6
	5-10 years	91	21.9
	11-20 years	181	43.6
	21-30 years	77	18.6
	31-40 years	18	4.3

Variable	Category	n	%
Qualification	PhD/board (physicians)	53	12.8
	MSc	11	2.7
	Diploma (institute)	161	38.8
	College graduate nurse	47	11.3
	Bachelor	143	34.5
Workplace	IPC department	10	2.4
	Ward unit	137	33.0
	Operation unit	68	16.4
	Endoscope unit	3	0.7
	ICU unit	46	11.1
	RCU unit	22	5.3
	Consultation	54	13.0
	Emergency	54	13.0
	Others	21	5.1

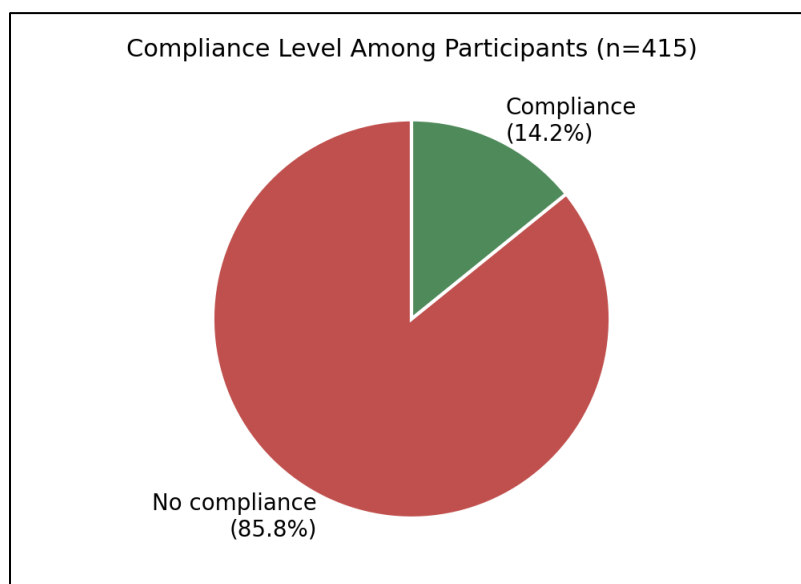


Figure 1. Compliance level among participants

Statistically significant differences in compliance were observed by occupation, with infection control personnel and nurses showing the highest rates (100% and 57.3%, respectively; $p=0.003$).

Educational qualification was also significantly linked to compliance ($p=0.013$), with Master's degree holders showing the highest compliance rate (90.9%), as shown in Table 2.

Table 2. Association between demographic characteristics and level of compliance

Variable	Category	No compliance	Compliance	Total	p
Occupation	Physician/surgeon	69 (54.8)	57 (45.2)	126	0.003
	Nurse	120 (42.7)	161 (57.3)	281	
	IPC staff	0 (0.0)	8 (100.0)	8	
Gender	Female	112 (46.9)	127 (53.1)	239	0.529
	Male	77 (43.8)	99 (56.3)	176	
Age	<30	23 (45.1)	28 (54.9)	51	0.278
	30-39	97 (51.9)	90 (48.1)	187	
	40-49	47 (35.9)	84 (64.1)	131	
	≥50	22 (47.8)	24 (52.2)	46	
Qualification	PhD/board	32 (60.4)	21 (39.6)	53	0.013
	Master's	1 (9.1)	10 (90.9)	11	
	Diploma	74 (46.0)	87 (54.0)	161	
	College/high school	24 (51.1)	23 (48.9)	47	
	Bachelor	58 (40.6)	85 (59.4)	143	
Experience	<5y	20 (41.7)	28 (58.3)	48	0.209
	5-10y	50 (54.9)	41 (45.1)	91	
	11-20y	79 (43.6)	102 (56.4)	181	
	21-30y	30 (39.0)	47 (61.0)	77	
	31-40y	10 (55.6)	8 (44.4)	18	

Note: the demographic breakdown rows in this table (by occupation, gender, age, qualification, experience) use the Section B median-split compliance measure described in Methods, which by construction splits the sample close to 50/50 within each subgroup. This is a different, relative measure from the 14.2% "full compliance" figure reported in the Abstract and Figure 1 (based on complete adherence to all items), so the two are not directly comparable and should not be summed against one another. We recommend the manuscript state explicitly, wherever each figure is used, which of the two compliance measures is being reported.

Regarding human-factor barriers to applying infection prevention measures, this study found that nurses reported the greatest burden, including lack of manpower (64.8%, $p=0.01$), role conflict (66.5%, $p=0.001$), lack of experience with IPC guidelines (63.5%, $p=0.01$), insufficient training (64.6%, $p=0.011$), and lack of IPC staff contact

(65.2%, $p=0.005$). Regarding environmental factors, nurses again reported the most barriers, such as equipment shortage (64.8%, $p=0.047$) and quality of materials and equipment (70.4%, $p=0.006$). Individual factors and complexity were also significantly reported by nurses ($p=0.008$ and $p<0.001$, respectively), as shown in Table 3.

Table 3. Association between barriers and occupation

Barrier	Physician	Nurse	IPC staff	p*
Lack of time	93 (32.4)	212 (67.7)	8 (2.6)	0.249
Lack of manpower	66 (31.4)	136 (64.8)	8 (3.8)	0.01
Role conflict	47 (28.7)	109 (66.5)	8 (4.9)	0.001
Lack of experience/awareness	50 (32.1)	99 (63.5)	7 (4.5)	0.01
Insufficient training	67 (31.6)	137 (64.6)	8 (3.8)	0.011
Lack of IPC staff contact	57 (40.5)	122 (65.2)	8 (4.3)	0.005
Unavailability of PPE	57 (31.8)	118 (65.9)	4 (2.2)	0.764
Heavy workload	84 (32.1)	171 (65.3)	7 (2.7)	0.181
Lack of management support	65 (31.6)	138 (67.0)	3 (1.5)	0.686
Equipment shortages	87 (32.2)	175 (64.8)	8 (3.0)	0.047
Quality of materials/equipment	65 (26.3)	174 (70.4)	8 (3.2)	0.006
Overcrowding	102 (31.3)	217 (66.6)	7 (2.1)	0.575
Lack of cleaning staff	70 (29.7)	160 (67.8)	6 (2.5)	0.633
Non-compliance with IPC protocol	38 (30.6)	84 (67.7)	2 (1.6)	<0.001

**Fisher's exact test. Table condensed for layout; full individual-factor and complexity sub-items are available from the authors on request.*

DISCUSSION

IPC is a cornerstone of patient and healthcare worker safety worldwide, and plays an important role in preventing HAIs that lead to significant morbidity, mortality, and high costs (14). The present research, conducted in several public hospitals in Erbil, offers a comprehensive analysis of the obstacles to IPC among HCWs. These results align with the growing body of evidence suggesting that IPC remains under-utilized despite being widely promoted as the standard of care, with adherence influenced by various individual, organizational, and system-level factors.

This cross-sectional survey represents a detailed, post-COVID-19, point-in-time snapshot of how IPC guidance is being operationalized across public hospitals in Erbil. Overall compliance was low, with only 14.2% fully compliant and 85.8% non-compliant, indicating that a large proportion of staff remain "at risk" of transmitting HAIs. This finding is, unfortunately, below the approximately 40–50% global average reported by the WHO (15, 16), and even lower than the 25–35% reported by large observational studies in Bangladesh (17) and a systematic review (18). Taken together, the data suggest that Erbil's IPC performance sits at the low end of an already concerning global spectrum.

Compliance is de-emphasized where there is a lack of reward, credit, or accountability for IPC practice, particularly in busy clinical settings. This is supported by Gould et al. and Chakma et al., who found that compliance improved considerably where hand hygiene performance was linked to regular monitoring and positive feedback mechanisms (19, 20).

Nurses, who represent two-thirds of the Erbil sample, carried a disproportionate share of human (role conflict, lack of training) and environmental (equipment shortage) barriers, both statistically

significant. Similar trade-specific pressure points have been reported in studies from Jordan (21), Saudi Arabia (22), and Uganda (23).

Lack of PPE and essential equipment were the primary system-level barriers among our respondents. Parallel qualitative work globally, and a pilot study, both cite PPE shortage as the most common barrier to guideline implementation overall (24, 25).

While our study did not directly assess knowledge, the high prevalence of "lack of IPC experience/awareness" is consistent with the literature, which has shown that mere exposure to didactic training does not necessarily improve performance, particularly without feedback and role modelling (15, 26). This gap between intended and actual action is precisely what Ajzen's Theory of Planned Behavior predicts (27), where perceived behavioral control (e.g., time, supplies) is low; educational interventions should therefore be accompanied by practical enablers and leadership commitment.

Higher educational level and older age among health workers were significantly associated with higher compliance, in line with other studies (28, 29). Senior practitioners may benefit from more experiential shortcuts and greater self-efficacy, or may feel more empowered to advocate for supplies. Notably, infection-control staff — though few in number — achieved 100% compliance, suggesting that pockets of excellence may already exist in Erbil hospitals and could be recognized and used as change agents at the facility level.

Human-related challenges such as burnout, time pressure, and unclear role definitions have emerged as barriers to IPC in low- and middle-income countries, including in Southeast Asia (18). Environmental barriers, including issues with functional hand hygiene stations and PPE

availability, have also been described previously in Saudi Arabia¹⁵ and in rural Liberian hospitals, where they were associated with heavy declines in hand hygiene compliance (30).

Several immediate policy and practice measures are needed to strengthen infection prevention and control. Hospital leaders must first establish a culture in which IPC is regarded as a fundamental, non-negotiable discipline, including regular performance observation, public reporting of performance measures, and formal acknowledgement of good performers. There is also a need for focused, hands-on training for nurses, who are both the least prepared and the most vulnerable group; IPC training has been shown to increase compliance by more than 30% in a controlled trial. Third, hospitals should guarantee a steady supply of PPE and disinfection products through dedicated budgeting and centralized procurement. Fourth, increasing staffing ratios, particularly for nurses, may relieve the workload pressures that compromise IPC adherence. Finally, low-cost behavioral nudges — such as well-positioned hand sanitizers, visual prompts, and just-in-time reminders — can substantially increase compliance and are practical even in low-resource settings.

The main strengths of this study include a large and diverse sample drawn from multiple public hospitals, and its exploration of individual, environmental, and organizational barriers together. There are also limitations. As a cross-sectional, self-report-based study, it is subject to recall and social desirability bias. Convenience sampling may also have underrepresented staff working night shifts or in distant satellite hospital units.

CONCLUSION

This research further confirms that IPC adherence in Erbil's public hospitals is suboptimal, due to remediable structural and behavioral obstacles. Building institutional leadership, strengthening training, improving equipment provision, and empowering healthcare workers — especially nurses — to practice safely must be important next steps. Without serious attention, avoidable healthcare-associated infections will continue to place the safety of patients and practitioners in the region at ongoing risk.

COMPETING INTEREST

The authors declare that they have no competing interests.

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