KAP Study Assessing Infection Prevention Among Healthcare Professionals in the Western Region, Saudi Arabia

Dalia Gaber[1], Hanaa Bali[1], Eman Aljohani[1], Mansour Al-Johani[1], Safaa Mashhadis[1], Eman Hamed[2]

[1]Clinical Pharmacy Program, College of Health Sciences and Nursing, Al-Rayan National College, Madina, Saudi Arabia

[2]Clinical Pharmacy department, college of pharmacy, King Abdul-Azizi University, Jeddah, Saudi Arabia

Corresponding author: Dalia Gaber

Al-Rayan National College, Clinical Pharmacy Program

College of Health Sciences and Nursing

Madina, Saudi Arabia,42541

Phone number: +966-1-48215555

Email: da.gaber@amc.edu.sa

Submitted on 08/25/2025

Accepted on 11/06/2025

DOI: https://doi.org/10.47456/hb.v6i4.49851

ABSTRACT

Healthcare-associated infections (HAIs) remain a significant global health concern, contributing to increased morbidity, prolonged hospital stays, and rising healthcare costs. Adherence to infection prevention and control (IPC) practices by healthcare workers (HCWs) is critical to reducing these risks. To evaluate the knowledge, attitudes, and practices (KAP) of HCWs in the Western Region of Saudi Arabia regarding IPC. A cross-sectional survey was conducted among 780 HCWs, including physicians, nurses, pharmacists, and allied health staff from multiple hospital departments. Data were collected using a structured questionnaire assessing demographics, knowledge, attitudes, and practices toward IPC. Descriptive statistics and logistic regression analysis were performed to identify predictors of compliance. Most participants demonstrated good knowledge of hand hygiene (92%) and WHO IPC guidelines (88%), though gaps persisted in knowledge of sterilization protocols (68%). Attitudes were generally positive, with 88% identifying IPC as highly important and 84% emphasizing the role of leadership support. However, practices were inconsistent: 80% reported updating practices according to new IPC guidelines, only 56% conducted regular IPC assessments, and just 20% consistently reported non-compliance. Logistic regression analysis showed that availability of PPE (OR = 3.6), prior IPC training (OR = 2.0), confidence in applying IPC measures (OR = 2.5), and longer work experience (OR = 2.8) were significant predictors of adherence. HCWs in Western Saudi Arabia demonstrate strong knowledge and positive attitudes toward IPC but suboptimal compliance in practice. Continuous training, supportive leadership, and systematic institutional audits are essential to strengthen adherence and reduce the burden of HAIs.

Keywords: infection prevention and control-IPC; healthcare-associated infections-HAIs; knowledge, attitudes, practices-KAP; healthcare workers; Saudi Arabia.

INTRODUCTION

Healthcare-associated infections (HAIs) remain a major public health challenge worldwide, despite the continuous advancements in healthcare systems and medical technologies **(**AL-QAHTANI, 2023; ALSHAGRAWI & ALHODAITHY, 2024**).** These infections contribute substantially to patient morbidity, mortality, and healthcare costs, prolonging hospital stays and straining already burdened health systems. According to the World Health Organization (WHO), HAIs affect between 5.7% and 19.1% of hospitalized patients globally, with higher prevalence in low- and middle-income countries compared to high-income settings. Even in developed countries, such as the United States and European nations, prevalence rates of 3–7% remain a persistent concern. In the Middle East, including Saudi Arabia, evidence suggests that HAIs continue to pose a substantial burden on both healthcare facilities and the wider community (WHO, 2023**;** TARTARI et al., 2024)

The impact of HAIs extends beyond individual patient outcomes. They place significant economic pressure on hospitals due to increased treatment costs, extended hospitalization, and reduced workforce productivity (GAREEBALLAH et al., 2022; ALSHAGRAWI & ALHODAITHY, 2024; ALTHIYABI et al., 2024; TARTARI et al., 2024)**.** Furthermore, the rise of antimicrobial resistance (AMR) compounds the problem, as infections become more difficult to treat. Global estimates suggest that by 2050, AMR could result in 10 million deaths annually and cost the global economy up to USD 100 trillion. Preventing HAIs through robust infection prevention and control (IPC) practices is, therefore, a critical strategy for reducing the impact of both HAIs and AMR **(**ALHUMAID et al., 2021**).**

Healthcare workers (HCWs) play a central role in implementing IPC measures. Simple practices such as proper hand hygiene, correct and consistent use of personal protective equipment (PPE), sterilization of equipment, safe injection practices, and effective environmental cleaning have been shown to significantly reduce infection transmission (ALSHAMMARI et al., 2019; AL-QAHTANI, 2023)**.** However, compliance with these practices is often inconsistent and influenced by factors such as knowledge, workload, access to PPE, organizational support, and workplace culture. For example, studies have revealed that even when HCWs recognize the importance of hand hygiene, actual adherence rates remain suboptimal, especially during peak workloads or emergencies **(**ALSABAANI et al., 2022; IYER et al, 2023; ALSULAMI et al., 2025**)**.

In Saudi Arabia, several studies have investigated HCWs' knowledge and practices regarding infection control, but findings are variable. Some studies report good levels of awareness, while others highlight critical gaps, particularly in hand hygiene compliance, reporting of incidents, and participation in routine audits. For instance, Al-Qahtani (2023) reported strong awareness but inconsistent hand hygiene adherence among nurses in Najran **(**AL-QAHTANI, 2023**).** Similarly, GAREEBALLAH et al. (2022) found that radiographers in Saudi Arabia showed adequate theoretical knowledge but limited practical compliance with IPC protocols **(**GAREEBALLAH et al., 2022**).** These inconsistencies highlight the importance of identifying contextual barriers to compliance, which may include inadequate training, insufficient PPE, or limited institutional leadership support.

Assessing the knowledge, attitudes, and practices (KAP) of HCWs provides a structured way to understand the current state of IPC adherence and identify areas for targeted improvement. Knowledge reflects awareness of IPC guidelines, attitudes reflect motivation and perceived importance, and practices reflect actual compliance with recommended measures **(**ALQURASHI et al., 2023**).** Together, these dimensions form the foundation for designing interventions that can effectively strengthen IPC at both the individual and institutional levels **(**ABALKHAIL et al., 2021**).**

The Western Region of Saudi Arabia presents a unique context for IPC research, as it includes a wide range of healthcare facilities—both public and private—that serve large, diverse populations, including residents and seasonal visitors for religious pilgrimages. The high patient turnover and workload in these facilities create challenges for consistent IPC compliance, making this region an important setting for evaluating current practices **(**ABALKHAIL et al., 2022**).**

Therefore, the present study was conducted to evaluate the knowledge, attitudes, and practices of HCWs regarding IPC in the Western Region of Saudi Arabia. By identifying both strengths and gaps, this study aims to provide evidence that can guide policymakers, hospital administrators, and public health authorities in strengthening IPC policies, enhancing training, and improving healthcare worker compliance, ultimately reducing the burden of HAIs in the Kingdom **(**ABALKHAIL et al., 2022**).**

METHODS

The study was conducted following the Declaration of Helsinki and approved by the Ethics Committee of the Faculty of Medicine, Al-Qassim University (Approval number, EMED 2536, February 19th, 2024).

Study Design and Setting

This study employed a descriptive cross-sectional survey design. Data were collected from healthcare workers employed in hospitals and clinics across the Western Region of Saudi Arabia in 2025. The region encompasses both public and private healthcare facilities, serving a diverse patient population (AL-TAWFIQ et al., 2013).

Study Population and Sample Size

The study included 780 HCWs, comprising physicians, nurses, pharmacists, and allied health professionals. Participants were recruited from a variety of departments, including emergency, internal medicine, surgery, and critical care. The sample size was determined using a standard formula for cross-sectional studies, with a 95% confidence interval and a 5% margin of error. An additional margin was added to account for potential non-response (TIMILSHINA; ANSARI; DAYAL, 2011; AL-TAWFIQ et al., 2013; ALSAREII, 2021).

Sampling Method

A multistage random sampling technique was used. First, healthcare facilities were randomly selected from different cities in the Western Region. Within each facility, departments were identified, and HCWs were randomly chosen to participate. This approach ensured proportional representation across professional categories and healthcare settings (ALSAREII, 2021).

Data Collection Tool

Data were collected using a structured, pre-tested questionnaire. The instrument consisted of four sections:

Demographics and professional background (age, gender, years of experience, qualification, department, prior IPC training, PPE availability); Knowledge (questions on hand hygiene, sterilization, isolation precautions, aseptic technique, and WHO guidelines); Attitudes (perceptions of IPC importance, confidence in implementation, leadership support, and

satisfaction with institutional protocols); Practices (use of PPE, hand hygiene compliance, training participation, reporting non-compliance, participation in audits, and updating IPC knowledge).

The questionnaire was adapted from validated IPC KAP surveys and reviewed by infection control specialists for content validity. A pilot test was conducted with 20 HCWs outside the study population to ensure clarity. Minor modifications were made before full distribution (TIMILSHINA; ANSARI; DAYAL, 2011; ALJOHANI et al., 2021).

Data Collection Procedure

Trained research assistants distributed the questionnaires in person and electronically, depending on facility preference. Participation was voluntary, and anonymity was maintained. Written informed consent was obtained from all participants prior to data collection.

Statistical Analysis

Data were entered into EpiData version 3.0 with double entry for validation, then analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize demographic and KAP variables. Associations between independent variables (e.g., demographic and professional characteristics) and IPC practices were examined using univariate and multivariate logistic regression. Variables with $p < 0.10$ in univariate analysis were included in the multivariate model.

Odds ratios (OR) with 95% confidence intervals (CI) were reported. Statistical significance was set at $p < 0.05$ (TENNA et al., 2013).

Ethical Considerations

Ethical approval was obtained from the Medical Research Ethics Committee of the King Abdul-Aziz University, Saudi Arabia. All participants provided informed consent, and confidentiality of responses was strictly maintained.

RESULTS

Socio-Demographic Characteristics

A total of 780 HCWs participated in this study. The mean age was 36.2 years (range 20–60), with females representing 64% of respondents. The majority were in the 30–40 age group (44%). Participants included general practitioners (16%), specialists (16%), pharmacists (36%), and nurses/allied health professionals (32%). Most respondents worked in emergency departments (60%), while 20% worked in inpatient wards and 20% in other units. PPE was reported as available to 84% of participants (Table 1).

Table 1. Demographic and Professional Characteristics of Participants (n = 780).

Variable	Categories	Frequency (N)	Percentage (%)
Gender	Male	281	36.0
	Female	499	64.0
Age Group	20–30	281	36.0
	30–40	343	44.0
	40–50	125	16.0
	50–60	31	4.0
Professional Qualification	General Practitioner	125	16.0
	Specialist	125	16.0
	Pharmacist	281	36.0
	Nurses & Allied Health	249	31.9
Working Department	Outpatient	0	0.0
	Ward	156	20.0
	Laboratory	0	0.0
	Emergency	468	60.0
	Others	156	20.0
PPE Availability	Present	655	84.0
	Absent	125	16.0

Knowledge of IPC

Knowledge was high overall (Table 2). Most participants were familiar with standard precautions (92%) and WHO IPC guidelines (88%). Knowledge of recommended hand hygiene practices and isolation protocols was reported by 80% of respondents. However, only 68% correctly identified sterilization protocols, representing a notable gap in specific technical knowledge.

Table 2. Infection Prevention Knowledge (n = 780).

Question	Yes (N)	No (N)	Other/Unknown (N)	Yes (%)	No (%)
Received IP training?	624	156	0	80.0	20.0
Familiar with standard precautions?	718	62	0	92.1	7.9
Know recommended hand hygiene practices?	624	156	0	80.0	20.0
Know sterilization protocols?	530	250	0	68.0	32.1
Familiar with isolation precautions?	624	156	0	80.0	20.0
Familiar with aseptic technique?	624	156	0	80.0	20.0
Familiar with WHO IP guidelines?	686	94	0	88.0	12.1

Attitudes Toward IPC

Attitudes were strongly positive (Table 3). Nearly 9 in 10 participants (88%) considered IPC very important in healthcare settings, and 84% emphasized leadership support as crucial for compliance. Confidence levels were high, with 60% reporting being "very confident" in implementing IPC measures, while 36% felt "somewhat confident."

Table 3. Attitudes Toward Infection Prevention (n = 780).

Question	Response Category	Frequency (N)	Percentage (%)
Importance of IP in healthcare settings	Very Important	686	88.0
	Somewhat Important	94	12.1
	Not Important	0	0.0
Confidence in implementing IP measures	Very Confident	468	60.0
	Somewhat Confident	281	36.0
	Not Confident	31	4.0
Perception of organizational prioritization	Yes	499	64.0
	No	281	36.0
Satisfaction with current IP protocols	Very Satisfied	343	44.0
	Satisfied	250	32.1
	Neutral	94	12.1
	Dissatisfied	62	7.9
	Very Dissatisfied	31	4.0
Importance of leadership support	Very Important	655	84.0
	Somewhat Important	125	16.0
	Not Important	0	0.0

Practices of IPC

Despite good knowledge and positive attitudes, practices were inconsistent (Table 4). While 80% reported modifying their practice according to updated IPC guidelines and 72% performed risk assessments before procedures, only 56% conducted regular IPC practice

assessments. Incident reporting was particularly low, with just 20% consistently reporting non-compliance. Participation in audits was limited, with 28% always involved and 32% sometimes involved. Regular review and updating of IPC knowledge was reported by less than half (32% always, 40% sometimes).

Table 4. Practices Regarding Infection Prevention (n = 780).

Question	Always (N)	Sometimes (N)	Rarely (N)	Never (N)	Always (%)	Sometimes (%)	Rarely (%)	Never (%)
Use PPE when required	468	187	94	31	60.0	24.0	12.1	4.0
Participate in IP training in the past year	562	0	0	218	72.1	0.0	0.0	28.0
Conduct regular IP practice assessments	437	0	0	343	56.0	0.0	0.0	44.0
Report incidents of non-compliance	156	218	250	156	20.0	28.0	32.1	20.0
Modify practice based on new IP guidelines	624	0	0	156	80.0	0.0	0.0	20.0
Participate in IP audits or evaluations	218	250	218	94	28.0	32.1	28.0	12.1
Perform risk assessment before procedures	562	0	0	218	72.1	0.0	0.0	28.0
Review and update knowledge on IP protocols	250	312	187	31	32.1	40.0	24.0	4.0

Logistic Regression Analysis

Multivariate logistic regression (Table 5) identified key predictors of adherence to IPC practices. Availability of PPE (OR = 3.6, p = 0.001), participation in IPC training (OR = 2.0, p = 0.015), confidence in implementing IPC measures (OR = 2.5, p = 0.008), and >5 years of work experience (OR = 2.8, p = 0.005) were significantly associated with better compliance. Department type (emergency vs. others) showed a weaker but suggestive association (OR = 1.6, p = 0.10).

Table 5. Variables and Odds Ratios from Multivariate Logistic Regression (Outcome: PPE Use).

Variable	p	OR	95% CI Lower	95% CI Upper
Availability of sufficient PPE	0.001	3.600	1.800	7.200
Participation in infection prevention training	0.015	2.000	1.150	3.480
Familiarity with standard infection precautions	0.020	1.900	1.100	3.270
Confidence in implementing IP measures	0.008	2.500	1.280	4.900
Work experience > 5 years	0.005	2.800	1.350	5.790
Department: Emergency	0.100	1.600	0.890	2.880

DISCUSSION

This study assessed the knowledge, attitudes, and practices (KAP) of 780 healthcare workers (HCWs) in the Western Region of Saudi Arabia regarding infection prevention and control (IPC). The results demonstrate that while HCWs generally have strong knowledge and positive attitudes toward IPC, actual compliance with recommended practices remains inconsistent. This gap between knowledge and practice highlights the complexity of behavior change in healthcare settings and the need for continuous, multifaceted interventions (SAHILEDENGLE et al., 2018). The demographic distribution of participants (Figure 1) shows that most HCWs were female, in the 30–40 age group, and predominantly pharmacists and nurses working in emergency departments.

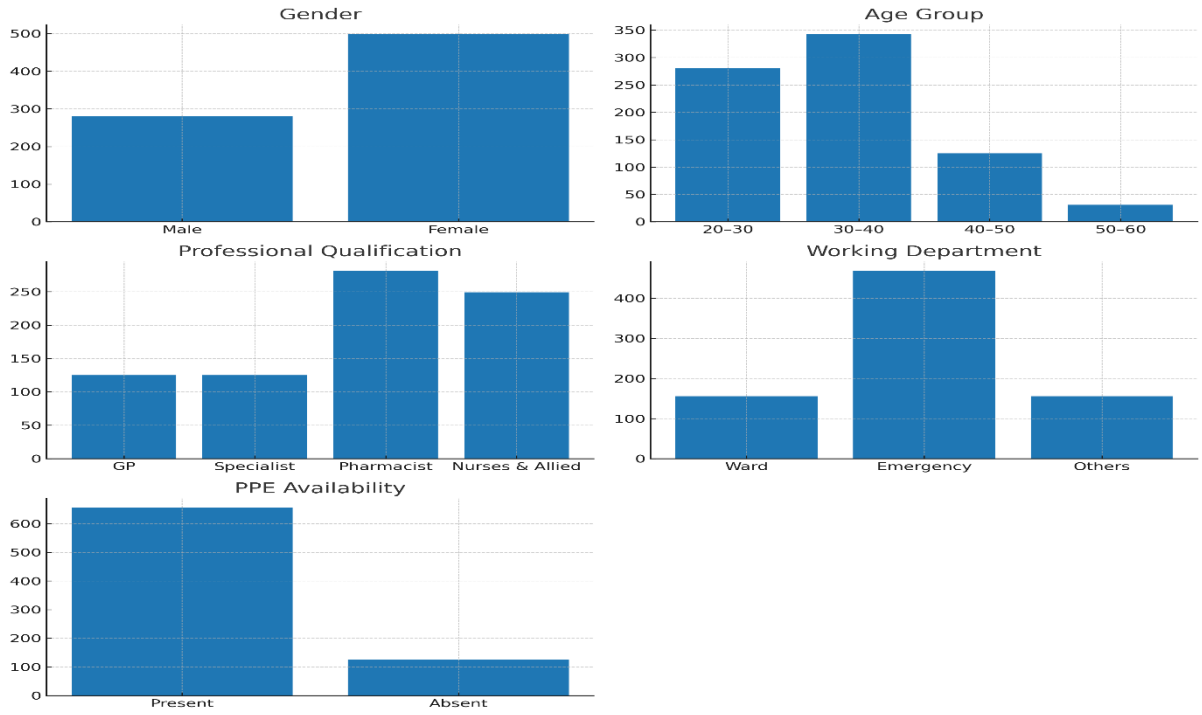

Figure 1. Demographic and professional Characteristics of Health care Professionals of HCWs (n=780).

This distribution reflects the real workforce pattern in Saudi Arabia, where younger staff and emergency units often have the highest patient contact, thereby reinforcing the importance of infection prevention in these high-risk settings

Our findings align with existing literature from Saudi Arabia and other countries. For example, Al-Qahtani (2023) reported that nurses in Najran demonstrated strong awareness of hand hygiene principles but failed to consistently follow correct techniques in practice (AL-QAHTANI, 2023). Similarly, Gareeballah et al. (2022) observed that radiographers had good theoretical knowledge of infection control but lacked adherence to sterilization and equipment handling protocols (GAREEBALLAH et al., 2022). These parallels suggest that knowledge alone does not guarantee behavioral change, emphasizing the need for supportive environments and strong institutional leadership.

Attitudes toward IPC in this study were highly positive, with the majority of participants recognizing its importance and expressing confidence in their ability to implement IPC measures. This is encouraging, as positive attitudes are often considered a precursor to behavioral compliance (DESTA et al., 2018). However, the observed gaps in practice, particularly in incident reporting, participation in audits, and regular review of IPC guidelines—

indicate that motivational factors must be supported by structural and organizational measures. Studies in Saudi Arabia and the wider region have highlighted that underreporting of non-compliance is a widespread issue, often linked to fear of punitive responses or lack of feedback mechanisms. Creating a culture of safety where HCWs feel empowered to report without fear of blame is therefore critical (MOHAN et al., 2021).

As demonstrated in Figure 2, PPE availability was the strongest predictor of compliance, followed by work experience, confidence in implementing IPC measures, and prior training.

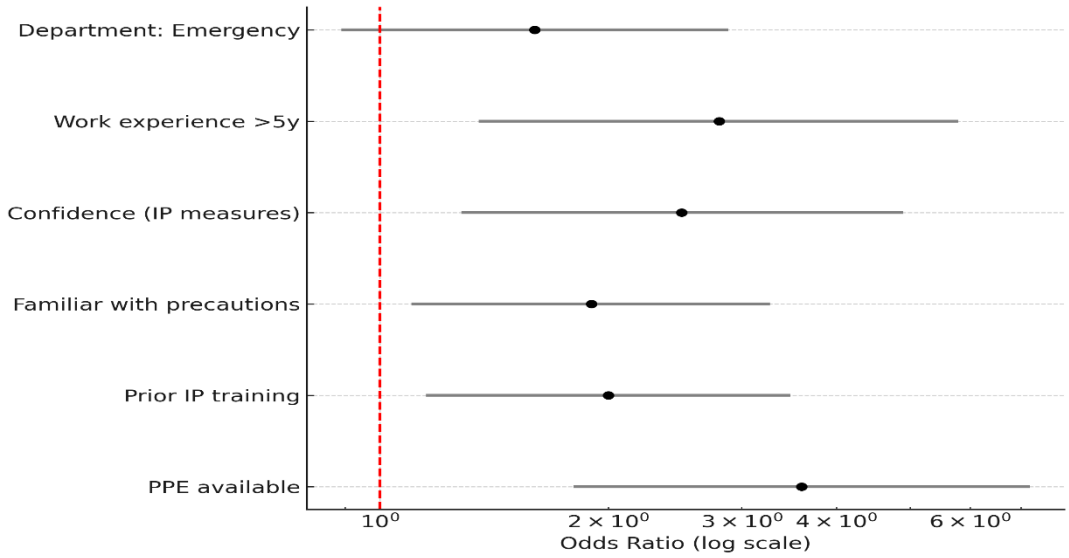

Figure 2. Factors Associated with Implementation of Infection Prevention Measures.

These findings visually emphasize that structural support (such as adequate PPE supply) is equally critical as individual factors like training and confidence. The weaker association for emergency department staff suggests that despite high exposure risk, systemic pressures such as workload may limit adherence.

Logistic regression analysis in this study identified several predictors of compliance, including availability of PPE, prior IPC training, confidence in implementing measures, and longer work experience. These findings reinforce global evidence that adequate resources, structured training, and professional maturity significantly enhance compliance (LABEAU et al., 2007; LABEAU et al., 2008; RABAAN et al., 2017). PPE availability is particularly crucial, as shortages have been repeatedly identified as barriers to IPC during outbreaks, including the COVID-19 pandemic. Similarly, regular training has been shown to sustain HCWs' skills and

reinforce the importance of consistent IPC practices, reducing complacency over time (KHOBRANI et al., 2023).

The role of leadership emerged strongly in this study, with most participants emphasizing its importance. Leadership support is a well-documented facilitator of IPC adherence. Hospitals with visible, engaged, and supportive management tend to have higher compliance rates because HCWs perceive IPC as an institutional priority rather than an individual burden. Leadership also plays a key role in ensuring the availability of PPE, scheduling regular training, and conducting routine audits (AL-DOSSARY et al., 2020; DERESSA et al., 2021; MUTSONZIWA & MUNEMO, 2024).

Despite the positive findings, several areas require urgent attention. First, the low rates of routine IPC audits and underreporting of non-compliance highlight weak monitoring systems. Without accountability and structured evaluation, even well-trained HCWs may fall into inconsistent practices (CASAS et al., 2022). Second, the moderate knowledge gaps in sterilization protocols indicate that specialized training is needed for particular departments, such as surgery, emergency, and radiology. Third, the inconsistent updating of IPC knowledge reflects a need for institutionalized continuing education programs rather than reliance on one-time training sessions (PITTET et al., 2000).

This study has important implications for healthcare policy and practice in Saudi Arabia. Strengthening IPC requires a comprehensive approach: ensuring consistent PPE supply, integrating IPC into continuing professional education, conducting regular audits, and building a culture of accountability supported by non-punitive reporting systems. Moreover, leadership must actively champion IPC, embedding it into hospital policies, daily routines, and performance evaluations (LOVEDAY et al., 2014).

Limitations of the study include its reliance on self-reported data, which may be influenced by social desirability bias. Additionally, the cross-sectional design limits the ability to establish causality. However, the large and diverse sample of 780 HCWs enhances the generalizability of the findings to healthcare facilities in the Western Region.

CONCLUSION

This study demonstrates that HCWs in Western Saudi Arabia possess strong knowledge and positive attitudes toward IPC but continue to show inconsistent compliance in practice.

Addressing this gap requires not only ongoing training and resource provision but also systemic changes that strengthen leadership support, institutional monitoring, and workplace culture. By investing in these strategies, Saudi Arabia can advance its national health goals, reduce HAIs, and contribute to the global fight against antimicrobial resistance.

REFERENCES

1. ABALKHAIL A, AL IMAM MH, ELMOSAAD YM, JABER MF, HOSIS KA, ALHUMAYDHI FA, ALSLAMAH T, ALAMER A, MAHMUD I. Knowledge, attitude, and practice of standard infection control precautions among healthcare workers in a university hospital in Qassim, Saudi Arabia: a cross-sectional survey. *Int J Environ Res Public Health* 18(22): 11831, 2021.
2. AL-DOSSARY R, ALAMRI M, ALBAQAWI H, AL HOSIS KHALED, ALJELDAH M, ALJOHAN M, ALJOHANI K, ALMADANI N, ALRASHEADI B, FALATAH R, ALMAZAN J. Awareness, attitudes, prevention, and perceptions about the COVID-19 outbreak among Nurses in Saudi Arabia. *Int J Environ Res Public Health* 17(21): 8269, 2020.
3. ALHUMAID S, AL MUTAIR A, AL ALAWI Z, ALSULIMAN M, AHMED GY, RABAAN AA, AL-TAWFIQ JA, AL-OMARI A. Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: a systematic review. *Antimicrob Resist Infect Control* 10(1): 86, 2021. doi: 10.1186/s13756-021-00957-0.
4. ALJOHANI A, KARUPPIAH K, AL MUTAIRI A, AL MUTAIR A. Narrative review of infection control knowledge and attitude among healthcare workers. *J Epidemiol Glob Health* 11(1): 20-25, 2021.
5. AL-QAHTANI AM. Clean hands, safe care: how knowledge, attitude, and practice impact hand hygiene among nurses in Najran, Saudi Arabia. *Front Public Health* 11: 1158678, 2023. doi:10.3389/fpubh.2023.1158678.
6. ALSABAANI A, ALQAHTANI NSS, ALQAHTANI SSS, AL-LUGBI JHJ, ASIRI MAS, SALEM SEE, ALASMARI AA, MAHMOOD SE, ALALYANI M. Incidence, knowledge, attitude and practice toward needle stick injury among health care workers in Abha City, Saudi Arabia. *Front Pub Health* 10, 2022. doi: 10.3389/fpubh.2022.771190.
7. ALSAREII SA. Surgical site infections at a Saudi hospital: the need for a national

surveillance program. *Int Surg* 105: 265-270, 2021.

8. ALSHAGRAWI S, ALHODAITHY N. Determinants of hand hygiene compliance among healthcare workers in intensive care units: a qualitative study. *BMC Pub Health* 24(1): 2333, 2024. doi:10.1186/s12889-024-19461-2.
9. ALSHAGRAWI S, ALHODAITHY N. Predictors of hand hygiene attitudes among healthcare workers of the intensive care unit in Saudi Arabia. *Sci Rep* 14(1): 19857, 2024. doi:10.1038/s41598-024-68494-5.
10. ALSHAMMARI TM, YUSUFF KB, AZIZ MM, SUBAIE GM. Healthcare professionals' knowledge, attitude and acceptance of influenza vaccination in Saudi Arabia: a multicenter cross-sectional study. *BMC Health Serv* 19(1): 229, 2019. doi: 10.1186/s12913-019-4054-9.
11. ALSULAMI A, SACGACA L, PANGKET P, PASAY-AN E, AL AMOUDI FA, ALRESHIDI MS, ALRASHEDI N, MOSTOLES R JR, BUTA J, AREOLA B JR, DOMINGUEZ AJ, GONZALES A. Exploring the relationship between knowledge, attitudes, self-efficacy, and infection control practices among Saudi Arabian nurses: A multi-center study. *Healthcare (Basel)*13(3): 238, 2025. doi: 10.3390/healthcare13030238.
12. AL-TAWFIQ JA, ABED MS, AL-YAMI N, BIRRER RB. Promoting and sustaining a hospital-wide, multifaceted hand hygiene program resulted in significant reduction in healthcare-associated infections. *Am J Infect Control* 41(6): 482-486, 2013.
13. ALTHIYABI FS, KHUDED FM, ALZAIDI FM, ALSWAT ASG, ALOTAIBI FSB, ALOTAIBI WSB, ALOTAIBI KIA, ALSHEHRI FAH, ALMUTAIRI AMA, ALNATHLI JAA. Assessment of nursing knowledge and practice toward prevention of acquired infections in the emergency department of King Faisal Medical Complex in Taif. *SAGE Open Med* 12:20503121231222341, 2024. doi: 10.1177/20503121231222341.
14. CASAS I, CASTELLÀ L, GIMENEZ M, PULIDO A, SOPENA N, CIÉRCOLES A, MENA G, REINA D, LÓPEZ R, GARCIA-QUESADA MJ. Impact of a multimodal intervention on compliance with hand hygiene among health care workers of a tertiary hospital. *Med Clin (Barc)*159(9): 426-431, 2022.
15. DERESSA W, WORKU A, ABEBE W, GIZAW M, AMOGNE W. Risk perceptions and preventive practices of COVID-19 among healthcare professionals in public hospitals in Addis Ababa, Ethiopia. *PLoS One* 16(6) :e0242471, 2025. doi: 10.1371/journal.pone.0242471.

16. DESTA M, AYENEW T, SITOTAW N, TEGEGNE N, DIRES M, GETIE M. Knowledge, practice and associated factors of infection prevention among healthcare workers in Debre Markos Referral Hospital, Northwest Ethiopia. *BMC Health Serv Res* 18(1): 465, 2018.
17. GAREEBALLAH A, AL-SEHLI SM, AL-MUTAIRI RT, GAMERADDIN M, ALSHARIF W, ELZAKI M, ALSHOABI SA, ALSULTAN KD, ALZAIN AF, OMER AM, HAMD ZY. Assessment of the knowledge and practice of infection control among radiographers in Saudi Arabia: A cross-sectional survey study. *Healthcare (Basel).* 11(21): 2817, 2023. doi: 10.3390/healthcare11212817.
18. IYER K, ALKHALIFAH K, ALSHAHRANI BN, IBRAHIM ALGHAMDI SS, ALBISHI S, A ALSHERAIHI AA, AL SUDAIRY N. Assessment of knowledge, attitude, and practice (KAP) among nurses on oral care for intensive care unit patients in Riyadh, Saudi Arabia: A cross-sectional study. *Cureus* 15(12): e50682, 2023. doi: 10.7759/cureus.50682.
19. KHOBRANI M, VASUDEVAN R, KANDASAMY G, GRAMISH JA, PRABAHAR K, PAULSAMY P. Evaluation of health care professionals' knowledge, attitudes, and practice to prevent the pandemic spread of COVID-19: A Questionnaire-Based cross-sectional study from Abha, Saudi Arabia. *Healthcare (Basel)* 11(4): 509, 2023.
20. LABEAU S, VANDIJCK DM, CLAES B, VAN AKEN P, BLOT SI. Critical care nurses' knowledge of evidence-based guidelines for preventing ventilator-associated pneumonia: an evaluation questionnaire. *Am J Crit Care* 16(4): 371-377, 2007.
21. LABEAU S, VEREECKE A, VANDIJCK DM, CLAES B, BLOT SI. Critical care nurses' knowledge of evidence-based guidelines for preventing infections associated with central venous catheters: an evaluation questionnaire. *Am J Crit Care* 17(1) :65-71, 2008.
22. LOVEDAY HP, WILSON JA, PRATT RJ, GOLSORKHI M, TINGLE A, BAK A, BROWNE J, PRIETO J, WILCOX M. Epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect* 86(Suppl 1): S1-70, 2014. doi:10.1016/S0195-6701(13)60012-2.
23. MOHAN CRV, KIRAN LV, ANUSHA DVB, SHRIDEVI K, SREE OS. Knowledge, attitude and practice on infection prevention and control measures among intensive care unit staff during coronavirus disease pandemic in a tertiary care hospital. *Int J Contemp Med Res* 8(11): 2454-7379, 2021.
24. MUTSONZIWA GA, MOJAB M, KATUWAL M, GLEW P. Influences of healthcare workers' behaviours towards infection prevention and control practices in the clinical

setting: a systematic review. *Nurs Open* 11(3): e2132. doi:10.1002/nop2.2132

25. PITTET D, HUGONNET S, HARBARTH S, MOUROUGA P, SAUVAN V, TOUVENEAU S, PERNEG TV. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection control programme. *Lancet* 356(9238): 1307-1312, 2000.
26. RABAAN AA, ALHANI HM, BAZZI AM, AL-AHMED SH. Questionnaire-based analysis of infection prevention and control in healthcare facilities in Saudi Arabia in regards to Middle East Respiratory Syndrome. *J Infect Public Health* 10(5): 548-63, 2017.
27. SAHILEDENGLE B, GEBRESILASSIE A, GETAHUN T, HIKO D. Infection prevention practices and associated factors among healthcare workers in governmental healthcare facilities in Addis Ababa. *Ethiop J Health Sci* 28(2): 177-186, 2018.
28. TARTARI E, BELLISSIMO-RODRIGUES F, PIRES D, FANKHAUSER C, LOTFINEJAD N, SAITO H, SUCHOMEL M, KRAMER A, ALLEGRANZI B, BOYCE J, SAX H, STEWARDSON AJ, PITTET D; Updates and future directions regarding hand hygiene in the healthcare setting: insights from the 3rd ICPIC alcohol-based handrub (ABHR) task force. *Antimicrob Resist Infect Control* 13(1): 26, 2024. doi: 10.1186/s13756-024-01374-9.
29. TENNA A, STENEHJEM EA, MARGOLES L, KACHA E, BLUMBERG HM, KEMPKER RR. Infection control knowledge, attitudes, and practices among healthcare workers in Addis Ababa, Ethiopia. *Infect Control Hosp Epidemiol* 34(12): 1289-1296, 2013.
30. TIMILSHINA N, ANSARI MA, DAYAL V. Risk of infection among primary health workers in the Western development region, Nepal: knowledge and compliance. *J Infect Dev Ctries* 5(1): 18-22, 2011.
31. World Health Organization. WHO. First-ever WHO research agenda on hand hygiene in health care to improve quality and safety of care [Internet]. Geneva, 2023. Available from: https://www.who.int/news/item/12-05-2023-first-ever-who-research-agenda-on-hand-hygiene-in-health-care-to-improve-quality-and-safety-of-care. Accessed on August 15, 2025.