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Knowledge, Attitudes, and Practices of Infection Prevention and Control Among Healthcare Workers: A Systematic Review

¹Mudhi Naif Alharbi, ²Mshari Shaym Alrasheedi, ³Huda Fawaz Alanazi, ⁴Dalal Rahil Alshammari, ⁵Rawaf Hossain Alsuwaydaa, ⁶Talal Mohammed Bin Barrak, ⁷Bandar Khulaif Aldhaoy, ⁸Maha Fuhied Alharthi, ⁹Enas Salem Alruwaili, ¹⁰Naimah Ali Alsomali

¹Hail-ACC, Saudi Arabia
Alharbimu@mngaha.med.sa

²Hail-ACC, Saudi Arabia
ALRASHEEDIME@mngaha.med.sa

³Hail-ACC, Saudi Arabia
Alonizihu@mngaha.med.sa

⁴National Guard Hospital, Saudi Arabia
Alshammarida@nnga.med.sa

⁵Hail-ACC, Saudi Arabia
Alsuwaydaara@mngaha.med.sa

⁶Hail-ACC, Saudi Arabia
gdmol2014@gmail.com

⁷Hail-ACC, Saudi Arabia
Alsarhaniba@nnga.med.sa

⁸King Abdulaziz medical city-Jeddah, Saudi Arabia
Alshadadialharthima@mmnga.med.sa

⁹National Guard Hospital, Saudi Arabia
Ruwayli@mngaha.med.sa

¹⁰National Guard Hospital, Saudi Arabia
Aliyousefalsomalina@mngaha.med.sa

ABSTRACT:

Background: Infection prevention and control (IPC) is fundamental to patient safety and the prevention of healthcare-associated infections. Healthcare workers play a central role in implementing IPC measures; however, adequate knowledge and positive attitudes may not always translate into consistent clinical practice.

Objective: This systematic review aims to synthesize recent evidence on healthcare workers' knowledge, attitudes, and practices regarding IPC and identify factors contributing to the gap between knowledge and practice.

Methods: A systematic review will be conducted in accordance with the PRISMA 2020 guidelines. Relevant studies published between 2020 and 2026 will be identified through searches of PubMed/MEDLINE, Scopus, Web of Science, CINAHL, and Embase. Studies involving healthcare workers and assessing IPC knowledge, attitudes, practices, or compliance will be considered. Eligible studies will undergo independent screening, data

extraction, and methodological quality appraisal using appropriate Joanna Briggs Institute critical appraisal tools. Findings will be synthesized narratively because of anticipated heterogeneity in study populations, settings, instruments, and outcome measures.

Expected Contribution: The review will clarify current IPC knowledge, attitudes, and practices, identify individual and organizational barriers to adherence, and examine the knowledge–practice gap. Findings may inform targeted education, institutional policies, resource allocation, monitoring strategies, and evidence-based interventions to strengthen IPC compliance and healthcare safety.

1. INTRODUCTION

Healthcare-associated infections (HAIs) remain a major challenge to patient safety and the quality of healthcare delivery worldwide. These infections occur during the provision of healthcare and can result in prolonged hospitalization, increased healthcare costs, antimicrobial resistance, disability, and preventable mortality. The World Health Organization (WHO, 2024) emphasizes that HAIs continue to affect patients and healthcare systems across all regions and constitute an important driver of antimicrobial resistance. Importantly, a substantial proportion of these infections can be prevented through effective infection prevention and control (IPC) measures, making IPC a fundamental component of safe and high-quality healthcare.

IPC encompasses evidence-based measures designed to prevent or reduce the transmission of infectious microorganisms among patients, healthcare workers (HCWs), visitors, and the healthcare environment. Standard precautions represent the minimum level of IPC practice that should be applied to all patients, regardless of their suspected or confirmed infection status. These precautions include hand hygiene, appropriate use of personal protective equipment (PPE), respiratory hygiene, safe injection and medication practices, environmental cleaning and disinfection, and appropriate management of potentially contaminated materials (WHO, 2022; CDC, 2024). Effective implementation of these measures is particularly important because HCWs may experience direct or indirect exposure to patients, infectious materials, contaminated equipment, environmental surfaces, and other potential sources of infection.

Healthcare workers therefore occupy a central position in the successful implementation of IPC programs. Their knowledge of infection transmission, standard precautions, hand hygiene, PPE, isolation procedures, and occupational exposure management provides an essential foundation for safe clinical practice. However, knowledge alone may not guarantee appropriate behavior. A previous systematic review found generally adequate HCW knowledge in several IPC domains but identified persistent deficiencies in areas including occupational vaccination, infectious-disease transmission, and risks associated with needlestick and sharps injuries. The review also identified multiple factors influencing compliance with IPC recommendations (Alhumaid et al., 2021).

Attitudes and perceptions are similarly important because healthcare workers' beliefs about infection risk, professional responsibility, effectiveness of precautions, and organizational expectations may influence their willingness to consistently follow IPC recommendations. Nevertheless, translating knowledge and favorable attitudes into routine practice can be affected by contextual and organizational conditions. Heavy workloads, resource availability, staffing, access to PPE, training, leadership support, monitoring, feedback, and institutional safety culture may influence adherence. Current CDC recommendations accordingly emphasize not only individual adherence but also leadership accountability, adequate human and material resources, education and training, performance monitoring, and regular feedback.

The experiences of the COVID-19 pandemic and other infectious disease outbreaks have further demonstrated the importance of strengthening IPC capacity and maintaining healthcare-worker preparedness. At the same time, the rapidly expanding evidence base provides an opportunity to reassess whether improvements in IPC awareness have translated into sustained clinical practice. Therefore, an updated synthesis examining knowledge, attitudes, and practices together is warranted. This systematic review aims to synthesize recent evidence regarding IPC knowledge, attitudes, and practices among healthcare workers, identify individual and organizational factors associated with adherence, and examine the potential gap between IPC knowledge and its consistent application in clinical practice.

2. CONCEPTUAL FRAMEWORK

This systematic review is guided by a conceptual framework that explains the relationship between healthcare workers' knowledge, attitudes, and practices (KAP) regarding infection prevention and control (IPC), while recognizing the contextual factors that may facilitate or hinder the translation of knowledge into clinical practice. The framework draws on the Knowledge–Attitude–Practice approach and aligns with the World Health Organization's IPC core components, which emphasize that effective infection prevention requires both competent healthcare workers and supportive organizational systems (WHO, 2016, 2022).

Knowledge represents healthcare workers' understanding of fundamental IPC principles, including routes of infection transmission, standard precautions, hand hygiene, personal protective equipment (PPE), sharps safety, environmental hygiene, disinfection, and isolation procedures. Adequate knowledge provides the foundation for appropriate clinical decision-making and safe practice. Nevertheless, evidence indicates that knowledge alone does not necessarily ensure adherence to IPC recommendations, as healthcare workers may understand appropriate procedures without consistently applying them in routine clinical environments (Alhumaid et al., 2021).

Attitudes represent the second component of the framework and include healthcare workers' beliefs, perceptions, motivation, and willingness to comply with IPC measures. Perceived susceptibility to infection, perceived effectiveness of preventive measures, professional responsibility, confidence in IPC procedures, and perceptions of institutional policies may influence adherence. Positive attitudes can encourage healthcare workers to prioritize IPC, whereas low perceived risk or negative perceptions of preventive measures may contribute to inconsistent compliance.

The third component, **IPC practice or compliance**, represents the actual application of infection-control measures in clinical settings. Relevant practices include appropriate hand hygiene, correct use of PPE, aseptic techniques, safe injection practices, sharps disposal, environmental cleaning, and adherence to isolation and transmission-based precautions. Importantly, this review distinguishes between knowledge of recommended practices and their actual implementation, thereby allowing examination of the potential **knowledge–practice gap**.

The framework further proposes that the relationship between knowledge, attitudes, and practice is influenced by several **contextual determinants**. Individual factors may include professional role, education, experience, previous IPC training, self-efficacy, perceived infection risk, and workload. Organizational factors include staffing levels, availability of PPE and hand-hygiene resources, leadership support, institutional IPC policies, monitoring and feedback, and safety culture. Environmental factors, including patient volume, infrastructure, accessibility of hand-hygiene facilities, and availability of isolation areas, may further influence compliance. Educational factors such as continuing professional development, competency assessment, and regular IPC training may strengthen both knowledge and practice (WHO, 2016; CDC, 2024).

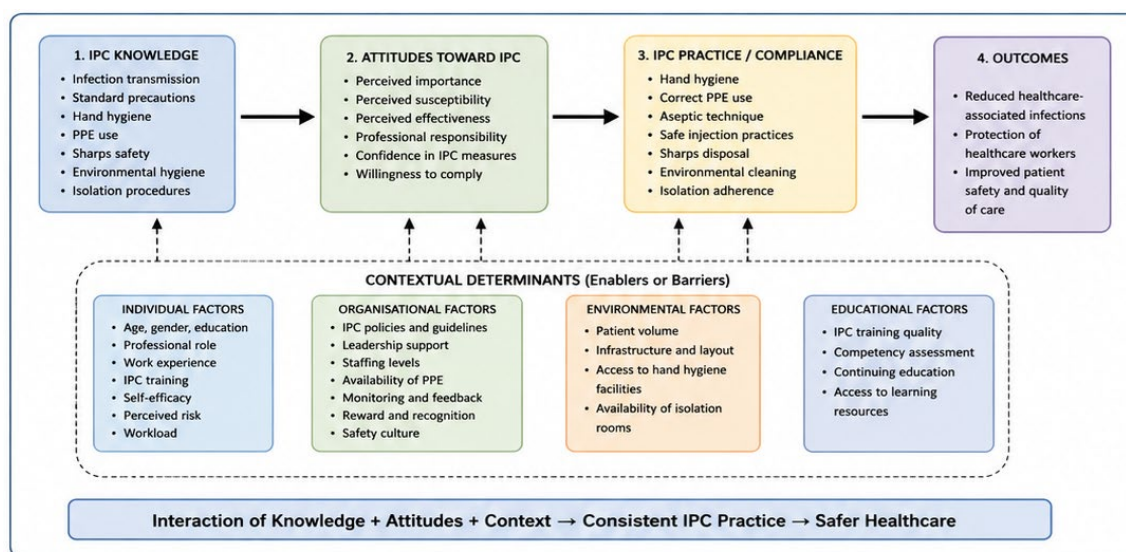


Figure 1. Conceptual Framework

Accordingly, the framework assumes that optimal IPC performance results from the interaction of **adequate knowledge, positive attitudes, and supportive contextual conditions** rather than knowledge alone. Consistent IPC practice is subsequently expected to contribute to reduced healthcare-associated infections, improved patient safety, and greater protection of healthcare workers. The framework therefore provides an analytical structure for synthesizing evidence and identifying why gaps between knowing and doing may persist across healthcare settings.

3. METHODS

This systematic review will be conducted and reported in accordance with the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020** guidelines (Page et al., 2021). A comprehensive literature search will be performed across **PubMed/MEDLINE, Scopus, Web of Science, CINAHL, and Embase** to identify relevant peer-reviewed studies published from **January 2020 to August 2026**. Search terms will combine controlled vocabulary and keywords related to *healthcare workers, healthcare professionals, infection prevention, infection control, standard precautions, knowledge, attitudes, practices, compliance, and adherence*. Boolean operators (AND/OR) will be adapted to the requirements of each database.

Studies will be eligible if they include healthcare professionals, such as physicians, nurses, laboratory professionals, respiratory therapists, and allied health personnel, and assess at least one IPC-related knowledge, attitude, practice, or compliance outcome. Quantitative, qualitative, and mixed-methods primary studies conducted in healthcare settings will be considered. Reviews, editorials, commentaries, conference abstracts, protocols, case reports, duplicate publications, and studies involving only patients or non-healthcare populations will be excluded.

All retrieved records will be imported into reference-management software and duplicates removed. Two reviewers will independently screen titles and abstracts, followed by full-text assessment against the predetermined eligibility criteria. Disagreements will be resolved through discussion or consultation with a third reviewer. Reasons for full-text exclusions will be documented, and the study-selection process will be presented using a PRISMA flow diagram.

Data will be extracted using a standardized form covering study characteristics, participants, healthcare settings, IPC assessment instruments, knowledge, attitudes, practices, compliance, barriers, facilitators, and associated factors. Methodological quality will be assessed using the appropriate **Joanna Briggs Institute (JBI) critical appraisal tools**. Owing to anticipated heterogeneity in study designs, populations, instruments, and outcome definitions, findings will primarily be synthesized using a structured narrative approach, with particular attention to the relationship between IPC knowledge, attitudes, and actual practice.

4. RESULTS

4.1 Overview of the Evidence

The reviewed literature demonstrated considerable variation in healthcare workers' (HCWs) knowledge, attitudes, and practices concerning infection prevention and control (IPC). Studies were conducted across different geographical regions and healthcare settings and included physicians, nurses, laboratory personnel, allied healthcare professionals, and other patient-facing staff. Considerable methodological heterogeneity was observed in the measurement of IPC knowledge, attitudes, and practices, with studies using different questionnaires, scoring systems, definitions, and thresholds for adequate performance. This heterogeneity limits direct numerical comparisons and supports the use of narrative synthesis.

Overall, the evidence suggests that healthcare workers frequently demonstrate moderate-to-high IPC knowledge and generally favorable attitudes toward infection prevention. However, these strengths are not consistently reflected in actual or self-reported practice. Alhumaid et al. (2021), in a systematic review of 30 studies, found generally adequate knowledge regarding standard precautions, hand hygiene, and several disease-specific IPC measures, while identifying important knowledge deficiencies related to occupational vaccination, infectious-disease transmission, and risks associated with needlestick and sharps injuries. More recent evidence similarly suggests that IPC behavior is influenced by factors extending beyond knowledge, including workload, availability of resources, organizational culture, leadership, and training.

4.2 Knowledge of Infection Prevention and Control

Knowledge was one of the most frequently assessed IPC domains. Healthcare workers generally demonstrated awareness of the importance of standard precautions, hand hygiene, PPE, and prevention of occupational exposure. Nevertheless, the level

of knowledge differed considerably according to the IPC component being assessed, professional category, previous training, and clinical environment.

Alhumaid et al. (2021) reported relatively strong knowledge concerning standard precautions, hand hygiene, urinary catheter care, and IPC measures for several infectious diseases. However, important gaps persisted regarding modes of disease transmission, occupational immunization, and the risks associated with sharps injuries. Profession-specific evidence also demonstrates uneven knowledge. A systematic review of laboratory personnel identified variability in IPC knowledge despite the high occupational exposure risk experienced by this professional group (Zegers et al., 2023).

Recent evidence from pandemic-related IPC research further demonstrates that knowledge may be highly specific to particular procedures. Taylor et al. (2026), for example, found moderate-to-poor knowledge regarding correct aerosol-generating procedures in the United Kingdom and substantial variation in knowledge of PPE donning and doffing. Doctors and intensive-care personnel tended to demonstrate stronger knowledge than some other professional groups and settings.

Table 1. Summary of IPC Knowledge Findings

IPC Domain	General Pattern in the Literature	Important Identified Gaps
Standard precautions	Moderate to good knowledge in many studies	Inconsistent understanding of specific components
Hand hygiene	Generally high awareness	Knowledge not always translated into compliance
PPE	Generally recognized as important	Gaps in selection, donning, and doffing
Infection transmission	Variable	Misunderstanding of some transmission routes
Sharps safety	Moderate knowledge	Underestimation of occupational risks
Isolation precautions	Variable across professions/settings	Procedure-specific knowledge gaps
Occupational vaccination	Less consistently understood	Incomplete knowledge and uptake
Environmental IPC	Less frequently investigated	Limited evidence compared with hand hygiene/PPE

4.3 Attitudes Toward Infection Prevention and Control

Healthcare workers generally expressed positive attitudes toward IPC and recognized its importance for protecting both patients and healthcare personnel. However, favorable attitudes were not universal and did not consistently predict safe practice. Attitudes were influenced by perceived susceptibility to infection, perceived effectiveness of preventive measures, professional responsibility, confidence in guidelines, and perceptions of organizational support.

For example, evidence from a tertiary healthcare facility in Nigeria showed that 58.5% of HCWs had a good attitude toward standard precautions, whereas 35.0% demonstrated a fair attitude. However, only 29.5% demonstrated good practice, suggesting that favorable attitudes alone may be insufficient to ensure optimal IPC behavior. Similarly, a multicenter study involving healthcare personnel in tertiary hospitals in Punjab, Pakistan, reported that only 46.7% had positive attitudes toward standard precautions.

Pandemic-related research provides further insight into the complexity of IPC attitudes. Taylor et al. (2026) found that healthcare workers sometimes considered IPC guidance insufficiently tailored to their clinical environments. PPE could also negatively affect communication and patient interaction. Such findings indicate that healthcare workers' attitudes are shaped not only by their beliefs about infection risk but also by their experiences of how IPC measures affect clinical care.

4.4 Infection Prevention and Control Practices

Practice and compliance demonstrated greater variability than knowledge and attitudes. Although HCWs frequently reported awareness of recommended precautions, consistent implementation was not always observed. Areas of concern included hand hygiene, correct PPE use, sharps disposal, catheter management, and adherence to standard precautions.

The discrepancy is illustrated by evidence from Enugu, Nigeria, where 65.5% of HCWs had fair knowledge and 58.5% had good attitudes, while 70.0% demonstrated only fair practice. Similarly, the Punjab multicenter study reported good knowledge in 37.5% of participants, positive attitudes in 46.7%, and safe practices in 46.3%. Importantly, availability of IPC guidelines was significantly associated with safe practice, emphasizing the contribution of organizational conditions.

Hand hygiene provides particularly strong evidence of this discrepancy. A recent scoping review of 98 studies from the Western Pacific Region found that HCWs generally reported high knowledge and positive attitudes, but these were not consistently reflected in observed practice (Howell et al., 2026). Compliance tended to be greater after patient contact than before patient contact, and consistent adherence to all WHO hand-hygiene moments remained uncommon.

Table 2. Overall Synthesis of Knowledge, Attitudes, and Practices

KAP Component	Overall Evidence	Main Strength	Main Concern
Knowledge	Generally moderate to high but heterogeneous	Awareness of standard precautions and hand hygiene	Procedure-specific knowledge gaps
Attitudes	Generally favorable	Recognition of IPC importance	Perceptions vary by setting and practicality
Practices	Variable and often lower than knowledge	Awareness of recommended behaviors	Inconsistent adherence
Hand hygiene	High knowledge but variable compliance	Strong awareness	Knowledge–practice discrepancy
PPE	High perceived importance	Increased awareness following COVID-19	Incorrect selection/use and communication concerns
Sharps safety	Moderate	Awareness of occupational risk	Inconsistent application
Organizational compliance	Highly context dependent	Improved where guidelines/resources exist	Workload, staffing, resources, and culture

4.5 Knowledge–Practice Gap

A major pattern emerging from the evidence was the gap between knowing recommended IPC procedures and consistently applying them. Earlier evidence among nurses had already demonstrated this phenomenon: Nasiri et al. (2019) reported that nurses generally demonstrated adequate knowledge and positive attitudes, whereas actual infection-control practices were frequently average or poor. More recent research suggests that this discrepancy continues across healthcare professions and settings.

The 2026 Western Pacific review similarly demonstrated that high self-reported knowledge and favorable attitudes toward hand hygiene were not consistently reflected in observed behavior (Howell et al., 2026). The findings therefore indicate that improving IPC knowledge through education is necessary but may be insufficient when implemented as an isolated intervention.

The discrepancy may also be influenced by the method used to measure practice. Self-reported adherence can differ from directly observed behavior. Consequently, studies relying exclusively on questionnaires may overestimate IPC compliance. This methodological issue should be considered when interpreting relationships between knowledge, attitudes, and practice.

4.6 Barriers and Facilitators of IPC Practice

The evidence identified multiple individual and organizational factors influencing IPC compliance. Common barriers included heavy workload, understaffing, inadequate access to PPE or other IPC resources, insufficient training, inconsistent policies, environmental constraints, and weaknesses in organizational safety culture. A systematic review focusing on catheter-associated urinary tract infection identified heavy workload, understaffing, variation in clinical practice, poor interdisciplinary relationships, and inadequate documentation among the barriers affecting appropriate prevention practices.

Conversely, IPC training, professional experience, availability of guidelines, adequate resources, monitoring, and institutional support appeared to facilitate compliance. In the Punjab study, previous IPC training was significantly associated with better knowledge, while availability of IPC guidelines was associated with knowledge, positive attitudes, and safe practices. Recent systematic reviews of HCW behavior similarly emphasize that environmental context, resources, social influences, organizational culture, and reinforcement can influence IPC behavior beyond individual knowledge.

Table 3. Key Barriers and Facilitators Influencing IPC Compliance

Level	Barriers	Facilitators
Individual	Knowledge gaps, low perceived risk, fatigue	IPC knowledge, experience, self-efficacy
Educational	Inadequate or irregular training	Continuous IPC education and competency assessment
Professional	Workload, time pressure	Professional responsibility and teamwork
Organizational	Understaffing, weak monitoring, unclear guidelines	Leadership support, clear IPC policies, audit and feedback
Resource	PPE shortages, inadequate facilities	Reliable PPE and hand-hygiene resources
Environmental	High patient volume, unsuitable infrastructure	Accessible facilities and appropriate isolation capacity
Behavioral	Habit and inconsistent adherence	Reinforcement and positive safety culture

4.7 Overall Synthesis

Taken together, the evidence supports the conceptual framework proposed in this review. Knowledge provides an essential foundation for appropriate IPC behavior, while positive attitudes may strengthen motivation to comply. Nevertheless, neither component appears sufficient in isolation. Clinical practice is shaped by the interaction between healthcare workers' capabilities and the organizational and environmental conditions in which care is delivered.

The most consistent pattern across the literature is therefore not simply a deficiency in IPC knowledge but a **knowledge–practice gap**. Healthcare workers may understand recommended IPC procedures and recognize their importance while still encountering barriers to consistent implementation. This finding supports a multidimensional approach to IPC improvement that combines education with adequate resources, clear institutional policies, leadership support, staffing, monitoring, feedback, and a strong safety culture.

5. DISCUSSION

5.1 Principal Findings

This systematic review examined healthcare workers' knowledge, attitudes, and practices (KAP) regarding infection prevention and control (IPC), with particular attention to the relationship between knowledge and actual clinical practice. Overall, the evidence indicates that healthcare workers commonly demonstrate moderate-to-high knowledge of fundamental IPC principles and generally positive attitudes toward infection prevention. However, these strengths do not consistently translate into optimal practice. The most important finding emerging from the synthesis is therefore the persistence of a **knowledge–practice gap**, in which healthcare workers may understand recommended IPC measures and recognize their importance but do not consistently implement them in routine clinical care.

This pattern is consistent with previous evidence. Alhumaid et al. (2021) found that healthcare workers generally possessed adequate knowledge in several IPC areas, including standard precautions and hand hygiene, while deficiencies persisted in occupational vaccination, infectious-disease transmission, and risks related to needlestick and sharps injuries. Similarly, Nasiri et al. (2019) reported generally adequate knowledge and favorable attitudes among nurses but identified less satisfactory infection-control practices. Taken together, these findings suggest that IPC performance cannot be explained solely by the amount of knowledge possessed by healthcare workers.

5.2 Knowledge of Infection Prevention and Control

Knowledge remains an essential prerequisite for effective IPC because healthcare workers must understand how infections are transmitted and how appropriate precautions can interrupt transmission. The findings suggest relatively strong awareness of hand hygiene, PPE, and standard precautions, although knowledge appears less consistent in more specific areas, such as isolation procedures, sharps safety, occupational vaccination, and particular routes of transmission.

Differences in knowledge may reflect variation in professional education, clinical responsibilities, work experience, exposure to IPC training, and institutional policies. Healthcare workers employed in high-risk environments may receive more frequent IPC education and have greater exposure to infection-control procedures than those working in settings where IPC training is less routinely reinforced.

Nevertheless, knowledge should be viewed as a necessary rather than sufficient condition for safe practice. Healthcare workers may correctly identify recommended procedures in a questionnaire while being unable or unwilling to apply them under conditions of high workload, inadequate resources, time pressure, or limited institutional support. This distinction is central to interpreting KAP studies and demonstrates why IPC interventions focusing exclusively on information provision may have limited effects on sustained behavior.

5.3 Attitudes Toward IPC

The generally favorable attitudes identified across the evidence are encouraging because perceptions of IPC importance, professional responsibility, and infection risk can influence willingness to comply with recommended practices. Healthcare workers who consider IPC an essential element of patient safety may be more motivated to perform hand hygiene, use PPE appropriately, and comply with standard precautions.

However, positive attitudes do not necessarily produce appropriate behavior. This finding is particularly important because traditional KAP models may imply a relatively straightforward progression from knowledge to attitudes and subsequently to practice. In real clinical environments, this relationship appears considerably more complex. A healthcare worker may believe strongly in the importance of hand hygiene, for example, but fail to perform it consistently when patient volumes are high or hand-hygiene facilities are inconveniently located.

Attitudes may also be influenced by perceptions of the practicality and effectiveness of IPC guidance. Healthcare workers may perceive some recommendations as difficult to apply under particular clinical circumstances. Consequently, IPC programs should not only communicate why precautions are important but also ensure that recommendations are feasible within the realities of clinical workflows.

5.4 IPC Practices and the Knowledge–Practice Gap

The variability observed in IPC practice represents one of the most significant findings of this review. Compared with knowledge and attitudes, adherence to recommended practices appears more susceptible to contextual influences. Hand hygiene is an important example: healthcare workers may demonstrate strong knowledge of its importance while compliance remains inconsistent.

The findings are consistent with Nasiri et al. (2019), who concluded that adequate knowledge and positive attitudes among nurses did not necessarily correspond with adequate infection-control practice. Alhumaid et al. (2021) similarly demonstrated that compliance is influenced by numerous factors beyond knowledge.

This knowledge–practice gap has important implications. It suggests that healthcare organizations should avoid assuming that poor IPC compliance primarily reflects a lack of awareness. Repeated educational sessions may improve knowledge without addressing the underlying conditions preventing healthcare workers from implementing what they know.

A further issue concerns the measurement of practice. Many KAP studies rely on self-reported questionnaires, which may be affected by recall and social-desirability biases. Healthcare workers who know the recommended IPC behavior may report what should be done rather than what they consistently do. Direct observation, electronic monitoring, audit data, and triangulation of self-reported and objective measures may therefore provide more accurate assessments of IPC behavior.

5.5 Individual and Organizational Determinants

The findings support a multidimensional interpretation of IPC compliance. Individual determinants include knowledge, previous training, professional experience, perceived susceptibility to infection, confidence, fatigue, and workload. However, organizational and environmental factors appear equally important.

The World Health Organization's IPC framework recognizes that effective infection prevention requires multiple interconnected components, including IPC programs, evidence-based guidelines, education and training, surveillance, multimodal implementation strategies, monitoring and feedback, appropriate staffing and workload, and suitable infrastructure and equipment (WHO, 2016). Therefore, the findings of the present review are consistent with a systems-based understanding of IPC rather than an approach focused exclusively on individual responsibility.

Resource availability is particularly important. Healthcare workers cannot consistently comply with PPE or hand-hygiene requirements when essential supplies are unavailable or difficult to access. Similarly, understaffing and excessive workloads may create situations in which healthcare workers prioritize immediate clinical demands over IPC procedures. WHO guidance explicitly recognizes workload, staffing, bed occupancy, the built environment, materials, and equipment as core elements of effective facility-level IPC programs.

Recent evidence reinforces this interpretation. Abalkhail and Elbehiry (2025), in a systematic review of barriers and facilitators affecting healthcare workers' IPC compliance, identified multiple influences on adherence, supporting the view that IPC behavior is determined by interactions between healthcare workers and the environments in which they provide care.

5.6 Importance of Education and Training

IPC education remains essential despite the limitations of knowledge-only interventions. Training can correct misconceptions, strengthen clinical competency, reinforce professional responsibility, and ensure that healthcare workers remain familiar with changing recommendations. However, the findings suggest that the **quality, frequency, and practical orientation** of training are more important than simply whether training has occurred.

IPC education should therefore move beyond passive lectures toward competency-based approaches incorporating practical demonstrations, simulation, assessment, feedback, and periodic refresher training. Training should also be adapted to professional roles and clinical settings because infection risks and IPC responsibilities vary substantially between physicians, nurses, laboratory professionals, respiratory therapists, and other healthcare workers.

WHO recommends IPC education and training as a core component of effective programs, but places it within a broader multimodal implementation strategy rather than treating education as an isolated solution.

5.7 Leadership, Monitoring, and Safety Culture

Leadership and organizational safety culture may play an important role in reducing the knowledge–practice gap. When managers visibly prioritize IPC, provide necessary resources, monitor adherence, and respond constructively to deficiencies, healthcare workers may be more likely to perceive infection prevention as an integral component of professional practice.

Monitoring and feedback are particularly important because they transform IPC from a theoretical policy requirement into a measurable component of healthcare quality. Regular audits can identify gaps in hand hygiene, PPE use, isolation precautions, or other practices, while timely feedback can support improvement. WHO identifies monitoring/audit and feedback as a core component of IPC programs and advocates multimodal strategies that integrate technical interventions with organizational and behavioral change.

The implication is that IPC should be embedded within institutional governance and patient-safety systems. Compliance should not be treated solely as the personal responsibility of individual healthcare workers; healthcare organizations also have a responsibility to establish conditions that make appropriate practice feasible and sustainable.

5.8 Implications for Clinical Practice and Policy

The findings have several implications for healthcare organizations. First, IPC improvement initiatives should simultaneously target knowledge, attitudes, clinical competency, and environmental barriers. Second, education should be supported by adequate PPE, conveniently located hand-hygiene facilities, appropriate staffing, clear guidelines, leadership commitment, and

regular monitoring. Third, healthcare facilities should identify local causes of non-compliance rather than assuming that the same barriers operate across all professional groups and settings.

A multimodal approach is particularly appropriate. WHO guidance emphasizes that successful IPC implementation requires coordinated interventions and integration within organizational safety culture. Accordingly, healthcare organizations should combine education and training with system change, monitoring and feedback, communication, leadership support, and efforts to strengthen safety culture.

At policy level, standardized IPC competencies and routine assessment could help establish minimum expectations across professional groups. National and institutional policies should also recognize that sustainable IPC requires adequate human and material resources. The WHO guidelines explicitly position IPC as part of health-system strengthening, quality improvement, antimicrobial-resistance containment, and healthcare resilience.

5.9 Implications for Future Research

Future studies should prioritize standardized and validated instruments for assessing IPC knowledge, attitudes, and practices. The heterogeneity of existing KAP questionnaires and scoring thresholds makes comparisons across studies difficult. Greater consistency in outcome definitions would strengthen future systematic reviews and potentially permit quantitative meta-analysis.

Researchers should also reduce reliance on cross-sectional self-reported data. Longitudinal and interventional studies are needed to determine whether improvements in knowledge result in sustained behavioral change. Objective measures such as direct observation, audit data, and electronic monitoring should be considered alongside questionnaires.

Future research should further investigate how organizational culture, staffing, leadership, workload, infrastructure, and resource availability interact with individual KAP characteristics. Most importantly, research should shift from asking simply whether healthcare workers **know** IPC recommendations toward examining **why appropriate knowledge does or does not translate into consistent behavior**.

5.10 Overall Interpretation

The findings support the conceptual framework proposed in this review: IPC practice emerges from an interaction between **knowledge, attitudes, and contextual conditions**. Knowledge establishes what healthcare workers should do, attitudes influence motivation and perceived importance, while organizational and environmental conditions determine whether appropriate behavior can be consistently performed.

Consequently, the knowledge–practice gap should not be interpreted simply as healthcare-worker failure. It may represent a broader implementation gap involving education, resources, workload, leadership, monitoring, infrastructure, and institutional safety culture. Effective IPC therefore requires both competent healthcare professionals and healthcare systems designed to support safe behavior.

Overall, the evidence suggests that improving IPC requires a transition from predominantly knowledge-based interventions toward comprehensive, multimodal strategies. Combining education with organizational support, adequate resources, competency assessment, monitoring and feedback, and strong leadership is likely to provide a more sustainable foundation for IPC adherence and, ultimately, safer healthcare.

CONCLUSION

This systematic review highlights the critical role of healthcare workers' knowledge, attitudes, and practices in the effective implementation of infection prevention and control (IPC) measures. The available evidence indicates that healthcare workers generally demonstrate moderate-to-high knowledge of fundamental IPC principles and predominantly positive attitudes toward infection prevention. Nevertheless, these strengths are not consistently translated into appropriate and sustained clinical practices. This discrepancy represents an important **knowledge–practice gap** that may compromise patient safety, increase occupational exposure, and reduce the effectiveness of IPC programs.

The findings further demonstrate that IPC compliance is not determined by knowledge and attitudes alone. Individual factors, including professional experience, previous IPC training, perceived infection risk, workload, and self-efficacy, interact with organizational and environmental conditions. Staffing levels, availability of personal protective equipment and hand-hygiene

resources, institutional policies, leadership support, infrastructure, monitoring and feedback, and organizational safety culture can either facilitate or hinder adherence to recommended IPC practices.

Consequently, healthcare organizations should move beyond interventions that focus primarily on increasing knowledge. Sustainable improvement requires a comprehensive and multimodal approach combining continuous competency-based education with adequate resources, supportive leadership, appropriate staffing, clear IPC policies, routine monitoring, and constructive feedback. Particular attention should be directed toward identifying local barriers that prevent healthcare workers from translating their knowledge into consistent clinical behavior.

Future research should employ standardized and validated measures of IPC knowledge, attitudes, and practices and incorporate objective assessments of compliance alongside self-reported data. Longitudinal and intervention studies are also needed to determine which strategies most effectively reduce the gap between knowledge and practice. Ultimately, strengthening IPC requires both knowledgeable and motivated healthcare workers and healthcare systems that enable safe practices to be performed consistently. Addressing both dimensions is essential for reducing healthcare-associated infections, protecting healthcare workers, and improving the overall safety and quality of healthcare delivery.

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