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INFECTION PREVENTION AND CONTROL COMPLIANCE AMONG HOSPITAL HEALTHCARE WORKERS: DETERMINANTS, INTERVENTIONS, AND PATIENT OUTCOMES, A SYSTEMATIC REVIEW

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Abstract

Background: Infection prevention and control (IPC) depends on consistent healthcare worker (HCW) adherence to core practices. Suboptimal compliance contributes to healthcare-associated infections (HAIs) and avoidable harm. **Methods:** A PRISMA-aligned systematic review was conducted using PubMed Central to identify hospital-based original research evaluating IPC compliance, determinants of compliance, interventions to improve compliance, or patient outcomes. Eligible designs included randomized and nonrandomized interventional studies and observational studies among hospital HCWs. Ten original

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studies were included for Results, and nine additional PMC articles were used to frame the Introduction and Discussion. **Results:** Ten original studies (multi-country; ICUs and general wards) addressed hand hygiene and, or standard precautions. Interventional studies consistently improved hand hygiene compliance, with examples including increases from 50.17% to 71.75% alongside reduced HAI and CAUTI rates in a Saudi university hospital, 30.9% to 69.5% after an ICU educational program in Egypt, and 32.1% to 39.4% after a multimodal program in Tunisia. Determinants of compliance were repeatedly linked to training, resource availability, workload, time pressure, safety climate, and monitoring, feedback. **Conclusion:** IPC compliance among hospital HCWs is modifiable. Multimodal interventions improve compliance and can translate to better patient outcomes when coupled with surveillance and leadership accountability.

Keywords: Infection Prevention And Control; Hand Hygiene; Standard Precautions; Compliance; Adherence; Healthcare Workers; Hospital-Acquired Infection; Multimodal Intervention.

INTRODUCTION

IPC is a cornerstone of patient safety because many HAIs are preventable through reliable implementation of evidence-based practices, particularly hand hygiene and standard precautions (Mathur et al. 2011). Despite decades of guidance, observed compliance often remains inconsistent across departments and professional groups, especially under high workload and resource constraints (Gould et al. 2017).

Hand hygiene is widely regarded as the single most important IPC action to interrupt transmission in routine care and during outbreaks (Mathur et al. 2011). Improvement is rarely achieved through education alone; rather, sustained gains tend to require multicomponent approaches that address behavior, environment, and organizational systems (Gould et al. 2017; Armstrong-Novak et al. 2023). Recent synthesis indicates that audit-and-feedback, reminders, access to hand rub, and leadership engagement are frequently combined in effective programs, although effect sizes vary by setting and baseline performance (Armstrong-Novak et al. 2023).

Beyond clinician-facing interventions, there is growing interest in enabling conditions that make compliance the “easy default,” such as workflow design, staffing adequacy, supply chain reliability, and usability of monitoring systems (Bajunaid et al. 2024). Behavioral determinants also matter: perceptions of risk, social norms, and safety culture can influence adherence even when staff are knowledgeable (Houben et al. 2023; Chen et al. 2021). In addition, patient and family engagement strategies (supporting patient hand hygiene) are being explored as complementary safety layers within multimodal IPC programs (Loveday et al. 2020).

Given the persistent implementation gap, this systematic review synthesizes determinants, interventions, and patient outcome signals related to IPC compliance among hospital HCWs using PMC-available evidence, focusing on original studies for results synthesis and using additional PMC sources to contextualize findings.

Review question: Among hospital HCWs, what determinants are associated with IPC compliance, what interventions improve compliance, and what patient outcomes are reported?

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METHODS

Protocol and reporting standard

This review followed PRISMA principles for transparent reporting (screening, eligibility, and synthesis). A protocol was developed a priori (not registered).

Eligibility criteria

Inclusion: Original quantitative research (randomized, quasi-experimental, before–after, cohort, cross-sectional) available in PMC;

Conducted in hospital settings;

Participants were HCWs (nurses, physicians, allied health, housekeeping, etc.);

Reported at least one of: IPC compliance level, determinants of compliance, intervention effect on compliance, and, or patient outcomes (HAI rates).

Exclusion: non-hospital-only settings, purely laboratory studies, editorials, protocols without results, and studies not reporting compliance or its determinants.

Information sources and search strategy

We searched PubMed Central for English-language articles without restricting geography. Search terms combined IPC concepts and compliance outcomes, for example:

(“hand hygiene” OR “standard precautions” OR “infection prevention and control”) AND (compliance OR adherence) AND (healthcare workers OR HCWs) AND hospital.

Selection process

Titles, abstracts were screened for relevance to hospital HCW IPC compliance. Full texts were then assessed against eligibility criteria. Disagreements were resolved by re-checking eligibility definitions. Ten original studies were included for Results synthesis.

Data extraction

From each included study we extracted: country, setting, design, population, IPC domain (hand hygiene, standard precautions), measurement method (WHO “5 Moments” observation; survey), main determinants, and outcome(s) (compliance change; HAI where reported).

Risk of bias appraisal

Design-appropriate tools were planned: RoB 2 for randomized trials, ROBINS-I for nonrandomized interventions, and a structured checklist approach for cross-sectional studies (items covering sampling, measurement validity, confounding control, and missing data). Overall, nonrandomized pre–post designs were expected to carry higher risk from secular trends and Hawthorne effects (Gould et al. 2017).

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Synthesis approach

Because studies differed in designs, populations, and outcome definitions, we conducted a narrative synthesis structured around: (1) baseline compliance and determinants; (2) intervention components and effect direction; (3) patient outcome signals where available.

RESULTS

Study selection and overview

Ten original studies were included: hand hygiene-focused interventional studies plus observational studies examining standard precautions and determinants in hospital HCWs. Interventions were typically multimodal (training, reminders, workflow support, audit, feedback).

Table 1: Characteristics of included original studies

Study	Setting	Design	IPC domain	Measurement	Main endpoints
Al Kuwaiti et al. 2017	Saudi university hospital	Before–after multicomponent program	Hand hygiene	Compliance monitoring + infection surveillance	HH compliance; HAI, CAUTI rates
Anwar et al. 2019	Egypt, 6 ICUs	Before–after educational intervention	Hand hygiene	WHO direct observation (“5 Moments”)	HH compliance by role, moment
Fredj et al. 2020	Tunisia university hospital	Pre–post multimodal program	Hand hygiene	Observed HH opportunities	Overall HH compliance
Mathai et al. 2011	ICU setting	Multimodal intervention study	Hand hygiene	ICU compliance monitoring	Overall HH compliance change
Bahegwa et al. 2022	Tanzania facilities incl. hospitals	Cross-sectional	Standard precautions	Survey-based practice assessment	Determinants of compliance
Endalew et al. 2022	Ethiopia hospitals	Cross-sectional	Standard precautions	Survey	Compliance + associated factors
Haile et al. 2017	Ethiopia (Gondar Univ. Hospital)	Cross-sectional	Standard precautions	Survey	Compliance + associated factors
Han et al. 2021	Hospital program	Longitudinal interventional	Hand hygiene	Compliance + HAI tracking	HH compliance; HAI signals
Saharman et al. 2019	Hospital program	Multifaceted intervention	Hand hygiene	Compliance monitoring	HH compliance change
Chakma et al. 2024	Hospital setting	Training evaluation	Hand hygiene	Training + compliance assessment	HH knowledge, compliance outcomes

Note: Several included studies were available via PMC and, or indexed with PMCID. Where infection outcomes were explicitly reported, they were extracted as patient outcome signals (Al Kuwaiti et al. 2017).

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Table 2: Determinants, intervention components, and outcomes

Study	Determinants highlighted	Intervention components	Key results
Al Kuwaiti et al. 2017	System-level WHO-recommended strategies	Year-long multicomponent HH intervention	HH compliance increased 50.17% → 71.75%; HAI 3.37 → 2.59; CAUTI 3.73 → 1.75; negative correlation between HH and infection rates
Anwar et al. 2019	Role differences; moment-specific adherence	Educational program in ICUs	Overall HH compliance 30.9% → 69.5%; higher compliance among nurses
Fredj et al. 2020	Department variability; organizational constraints	Training sessions + posters	Overall compliance 32.1% → 39.4%; nurse compliance 34.1% → 45.7%
Mathai et al. 2011	ICU baseline low compliance	Multimodal ICU strategy	Overall HH compliance 25.95% → 57.36% after intervention
Han et al. 2021	Sustainability and monitoring emphasized	Multimodal long-term program	Reported improved compliance with accompanying HAI outcome tracking (directional improvement)
Saharman et al. 2019	Implementation barriers in practice	Multifaceted HH improvement program	Reported HH compliance improvement following program implementation
Chakma et al. 2024	Training, skills emphasis	HH training	Reported improvement in HH-related outcomes after training
Bahegwa et al. 2022	Resource access, training, workload	—	Identified determinants associated with standard precautions compliance
Endalew et al. 2022	Training, availability of supplies, PPE, workplace factors	—	Reported associations between workplace, training factors and standard precautions compliance
Haile et al. 2017	Knowledge, training and enabling resources	—	Reported factors associated with standard precautions compliance among HCWs

Across interventional studies, multimodal or education-plus-system-support approaches improved observed hand hygiene compliance, although magnitude varied by baseline performance, ward type, and implementation intensity (Gould et al. 2017; Armstrong-Novak et al. 2023). Studies that additionally tracked infection outcomes suggested potential downstream benefit when compliance improvements were sustained and paired with surveillance (Al Kuwaiti et al. 2017). Observational studies consistently pointed to a familiar set of determinants: training exposure, access to supplies (including PPE and hand hygiene infrastructure), workload, time pressure, and institutional monitoring and accountability (Haile et al. 2017; Endalew et al. 2022; Bahegwa et al. 2022).

DISCUSSION

This review found that IPC compliance in hospitals is both behavioral and systems-dependent. Interventions that only “tell people what to do” risk limited effect; more reliable gains are seen when programs combine education with reminders, access to supplies at

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the point of care, feedback loops, and leadership support—consistent with prior synthesis (Gould et al. 2017; Armstrong-Novak et al. 2023).

Across included observational studies, compliance clustered around modifiable workplace factors: training opportunities, resource availability, and workload constraints (Haile et al. 2017; Endalew et al. 2022; Bahegwa et al. 2022). These align with broader behavioral evidence suggesting that attitudes and social norms shape adherence even when knowledge is present (Houben et al. 2023; Chen et al. 2021). In practical terms, hospitals should treat compliance as a reliability problem: if supplies are not consistently available, if staffing is thin, or if workflows force shortcuts, nonadherence becomes predictable rather than exceptional.

The interventional evidence in this review supports improvement with structured programs: for example, large increases were observed in some ICU-focused education and monitoring efforts (Anwar et al. 2019), and system-wide multicomponent programs were associated with both compliance gains and reductions in certain infection rates (Al Kuwaiti et al. 2017). These patterns are consistent with the broader evidence base showing multimodal interventions tend to outperform single-component approaches (Gould et al. 2017; Armstrong-Novak et al. 2023).

Technology-enabled monitoring (electronic systems) may strengthen feedback and accountability, but implementation feasibility, staff acceptability, and measurement validity are critical (Bajunaid et al. 2024). If monitoring is perceived as punitive rather than supportive, it may undermine safety climate and provoke workarounds. Complementary approaches—such as engaging patients (Loveday et al. 2020) or adapting interventions to local workflow constraints—may improve acceptability and sustainability.

Only a subset of included studies explicitly reported patient outcome signals (HAI metrics). Where reported, findings suggested that higher compliance can coincide with lower infection rates (Al Kuwaiti et al. 2017). However, attributing infection reductions solely to hand hygiene is challenging because concurrent IPC measures (bundles, device protocols, antimicrobial stewardship) and secular trends can contribute. This is a key reason why systematic reviews often emphasize the need for robust designs and consistent outcome definitions (Gould et al. 2017).

Many IPC intervention studies are before–after designs, which are vulnerable to Hawthorne effects and confounding by time-varying changes (Gould et al. 2017). Observational determinant studies frequently rely on self-report measures, which may overestimate compliance compared with direct observation.

CONCLUSION

Hospital IPC compliance among HCWs is frequently suboptimal but improvable. Evidence from included PMC original studies supports multicomponent strategies (education + reminders + system enablers + audit, feedback) to increase compliance, with some studies reporting concurrent reductions in infection outcomes when surveillance accompanies sustained implementation (Al Kuwaiti et al. 2017; Gould et al. 2017).

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Hospitals seeking durable gains should prioritize: point-of-care resource availability, workflow-compatible training, continuous monitoring with constructive feedback, and leadership accountability.

List of Abbreviations

CAUTI, Catheter-Associated Urinary Tract Infection
CI, Confidence Interval
HAI, Healthcare-Associated Infection
HCW, Healthcare Worker
HH, Hand Hygiene
ICU, Intensive Care Unit
IPC, Infection Prevention and Control
OR, Odds Ratio
PPE, Personal Protective Equipment
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses
WHO, World Health Organization

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