JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Original Article

Closing the implementation gap: applying a behavioral science integration in the current WHO and CDC infection prevention policies

Ahmad Sabbah[1], Fatmah Albalwi[1], Awad Al-Omrani[2], Hanan Albalawi[2]

[1] *University of Tabuk, Applied College, Department of Assistance Medical Sciences, Tabuk, 47512, Saudi Arabia*
[2] *King Khalid Hospital, Training and Education Department, Tabuk, 47915, Saudi Arabia*

Abstract

Introduction: Despite decades of technical guidance, healthcare-associated infections (HAIs) remain a global challenge. Although the current infection prevention and control (IPC) guidelines, produced by the WHO and the CDC, provide robust procedural recommendations, they do not fully address the behavioral determinants of compliance.
Objectives: This study evaluates both the WHO and CDC IPC guidelines for areas in which the Social Cognitive Theory (SCT) constructs are integrated to strengthen behavioral strategies.
Methodology: The study used qualitative content analysis on 17 IPC documents (published during 2010-2023). Using a deductive coding framework based on the SCT, documents were systematically analyzed using NVivo 12. Comparative assessments examined temporal trends and differences between agencies.
Results: Environmental influences were most consistently represented (15–25%), while self-efficacy (5–15%) and observational learning (4–11%) were underemphasized. The WHO guidelines demonstrated greater progress, with self-efficacy content rising from 5% (2010) to 15% (2023). The CDC guidelines placed stronger emphasis on reinforcement (12%) but showed limited growth in self-efficacy and observational learning. Integration of multiple constructs within a single recommendation occurred in only 28% of all reviewed documents.
Conclusions: Digital health policies currently underapply behavioral science concepts. Future revisions should adopt SCT constructs rigorously, demand more leadership modeling, and leverage technology for feedback. This behavioral approach could bridge policy and practice for a more effective IPC program.

Key words: infection prevention and control; social cognitive theory; behavior change; guideline implementation.

J Infect Dev Ctries 2026; 20(4):584-591. doi:10.3855/jidc.22444

(Received 01 October 2025 – Accepted 05 November 2025)

Introduction

Healthcare-associated infections (HAIs) are a major global health challenge, threatening patient safety and burdening health care systems. Apparently, as cited by the World Health Organization's (WHO) Global Report on Infection Prevention and Control (IPC), 7–10% of inpatient patients in high-income countries and up to 15% in low- and middle-income countries (LIMCs) develop at least one HAI during admission, with millions of deaths attributable to avoidable causes occurring annually [1]. The most recent European Centre for Disease Prevention and Control (ECDC) point prevalence survey (2022–2023) also documented a rate of 6.5% of HAI among acute care hospital patients, with the most common HAIs being pneumonia, surgical site infections, and urinary tract infections [2].

Despite decades of guidance development by major global institutions such as the WHO and the U.S. Centers for Disease Control and Prevention (CDC), compliance with IPC practice remains suboptimal. There is WHO evidence indicating that essential components of IPC programs are not consistently implemented, especially in resource-limited facilities where staffing, infrastructure, and surveillance deficits still prevail [3]. Hand hygiene remains the cornerstone of infection prevention and control (IPC), and the necessity to decrease HAIs through its use is universally accepted. Nevertheless, compliance remains consistently below desired levels, with current meta-analyses suggesting average compliance rates of 30% to 52% in different clinical settings and professional teams, which is well short of the much-desired 60% mark [4-6]. The chronic implementation gap indicates that making technical guidance publicly available is insufficient to attain long-term compliance.

One explanation for this shortfall is that guidelines have historically concentrated on technical steps and undervalued organizational and behavioral determinants of adherence. IPC practices are executed by healthcare workers in complex environments shaped by workload pressures, cultural hierarchies, resource availability, and risk perceptions [7,8]. The COVID-19 pandemic also reaffirmed the priority of human behavior to IPC outcomes and success, as disparities in use of PPE, hand hygiene, and vaccination illustrate how compliance is as much determined by organizational and psychological factors as by technical knowledge [9,10].

Social Cognitive Theory (SCT), proposed by Bandura (1986), is a strong theoretical framework for predicting and changing health behaviors. The five principal constructs of SCT, including self-efficacy, observational learning, outcome expectations, environmental influences, and reinforcement [11], directly correspond to IPC issues. Self-efficacy, for instance, affects a nurse's confidence in donning PPE properly, despite time pressures, whereas observational learning deals with the senior staff members as role models for compliance. Reinforcement, through instantaneous auditing and feedback, can assist in supporting long-term compliance. Whether WHO and CDC recommendations routinely include such behavioral constructs, as a theoretical tool, remains uncertain.

In addition to individual-level theory, implementation science has also postulated models such as the Behavior Change Wheel [12] and organizational resilience models [13], which highlight the need to introduce elements such as capability, opportunity, motivation, and system adaptability into guideline development. Their incorporation into policymaking of IPC use would enhance resilience, especially in resource-poor healthcare systems where infection control interventions are still most at risk [7].

This study, therefore, aims to evaluate two sets of IPC guidelines (from the WHO and the CDC) within an SCT framework, evaluating where behavioral science constructs are embedded, identifying trends over time, and providing recommendations for the integration of theory-driven approaches in IPC guideline development in the future.

Literature Review

HAIs contribute significantly to global morbidity, mortality, and healthcare costs. The WHO estimates point toward millions of cases annually with an inordinate burden in LMICs [1]. The most recent point prevalence survey for Europe by the ECDC confirmed high infection rates in acute care facilities, headed by pneumonia, bloodstream infections, and surgical site infections [2]. Despite the broad dissemination of evidence-based IPC guidelines, practice fidelity with core practices is inconsistent. The WHO underscores that most countries fall short of minimum IPC program standards, limiting the effect of any technically sound advice [3].

Hand hygiene is one such example. While hand hygiene remains the cornerstone of infection prevention and control, recent systematic reviews show that mean compliance of healthcare workers is often less than 60%, with reported compliance rates ranging from 30% to slightly more than 50% depending on region, clinical environment, and professional group [4-6]. Poor adherence factors include heavy workload, misuse of gloves, limited resources, and weak institutional safety culture. These findings highlight the need for interventions that extend beyond mandating what healthcare workers are expected to do and instead create facilitative environments where sustainable and regular hand hygiene practice can be achieved.

Behavior change theories provide a framework for effectively addressing these shortcomings. SCT emphasizes reciprocal determinism—the dynamic interaction among personal, behavioral, and environmental determinants [11]. In IPC, this is reflected in the fact that self-efficacy, modeling by peers, and feedback systems significantly influence adherence. Interventions informed by SCT principles—i.e., leadership modeling, self-efficacy training, and performance feedback in real-time—have been shown to improve hand hygiene compliance substantially, up to 30–35% mentioned in certain studies [5,14].

Complementary frameworks support these results. The Behavior Change Wheel [12] establishes capability, opportunity, and motivation as the standards for long-term behavior change. Similarly, the WHO (2020) emphasized the role of behavioral aspects in vaccine uptake in the context of the COVID-19 pandemic, emphasizing that technical measures are only effective when accompanied by human motivation and trust [10]. Hong Kong's experience with COVID-19 also showed the importance of fast-tracked, adaptive IPC approaches supported by staff participation and leadership modeling [9].

Organizational resilience and culture are also playing a growing part in IPC effectiveness, aside from individual determinants. A systematic review published recently identified heterogeneity of conceptualization and measurement of resilience between different healthcare systems, but commonality between themes was found to be leadership commitment, empowerment of staff, and adaptive capacity [13]. These are utilized as part of the IPC, where organizational commitment and leadership modeling take central roles in closing the gap between guidelines and practice.

Challenges are especially important in resource-limited environments. Institutional challenges like infrastructure deficits, lack of staff training, and inadequate monitoring systems have been recognized by Abalkhail and Alslamah (2022) as the major barriers to pandemic IPC adoption [7]. These constraints make it necessary to integrate organizational and behavioral strategies into IPC guidelines for better feasibility and sustainability across different healthcare facilities.

Evidence suggests that the incorporation of SCT and other behavioral frameworks into IPC policies would make the biggest difference in adherence [15-17]. Some key hands-on activities are: modeled training and peer coaching (Self-efficacy), visible leadership modeling and peer checking (Observational learning), dashboards of falling infection rates, delivered immediately (Outcome expectations), best hand rub placement, ergonomically-designed PPE (Environmental influences), and instant feedback mechanisms and reward systems (Reinforcement).

These approaches, supported by implementation science and behavioral science, represent a fruitful path to closing the long-standing practice-IPC policy gap.

Methodology

Study Design

This study employed a *qualitative document analysis* (QDA) to determine the extent to which SCT constructs are integrated into leading IPC guidelines developed by the WHO and the CDC.

Data Sources and Document Selection

Guideline documents were obtained by purposive sampling to ensure representation of popular, widely disseminated IPC guidance published between 2010 and 2023. Selection criteria were:

1. Authorship: Documents or officially signed reports by the WHO and/or the CDC.
2. Scope: Recommendations providing universal infection prevention recommendations for healthcare settings (e.g., hand washing, isolation precautions, basic practices). Pathogen-specific or outbreak-related guidance was not included to facilitate comparison.
3. Availability: Accessible documents in full text on organizational websites.

According to the above criteria, 17 main sources were analyzed that included both the WHO and the CDC published literature. Among them, prominent WHO sources were also the WHO Guidelines on Hand Hygiene in Health Care (2009, revised 2021) and the WHO Minimum Requirements for IPC Programs (2023). Key CDC documents included were the CDC Core Practices for Infection Prevention and Control in Healthcare Settings (2023) and the CDC Guideline for Isolation Precautions (2007, revised 2023).

Further implementation materials (e.g., toolkits, FAQs, and annexes) referenced within the core guidelines were also analyzed to better understand if there was any implicit guidance on conduct.

Analytical Framework

The analysis was guided by Bandura's Social Cognitive Theory [11] in action through five constructs:

1. Self-efficacy: proposals for building confidence of healthcare staff in the implementation of IPC, e.g., formal hand hygiene instruction supplemented by peer mentoring schemes, prompting staff to adopt best practice across different settings.
2. Observational learning: included methods such as role modeling, peer pressure, or leadership demonstration, for example, ward rounds where nursing managers clearly demonstrate the correct donning and doffing of PPE to encourage imitation by junior staff.
3. Outcome expectations: were focused on the leadership that reinforces the anticipated advantages of IPC compliance, for example, associating improved hand hygiene with decreased catheter-associated infection rates on unit dashboards.
4. Environmental influences: it was based on consideration of organizational facilitators and barriers, i.e., having alcohol-based hand rub dispensers at each patient's bedside and ensuring leadership allocates resources for sufficient PPE supplies.
5. Reinforcement: we looked at methods to sustain behavior, including frequent compliance checks with immediate feedback and rewards for recognition of units that meet ≥ 80% compliance.

These constructs were selected deductively, being consistent with established behavioral theory but allowing inductive identification of emergent sub-themes.

Data Management and Coding

All documents were imported into NVivo 12 [18] for systematic coding and analysis. An iterative coding manual was developed with operational definitions, inclusion/exclusion rules, and exemplar text passages for each SCT construct. In order to maximize transparency, the coding scheme was piloted on two documents and then finalized before full use.

Two researchers separately coded a 20% sample of documents, achieving high inter-coder reliability

(Cohen's κ = 0.82) for a more effective and higher level of agreement [19]. Discrepancies were resolved through discussion, and the agreed final coding was applied to the entire dataset.

Analysis Strategy

The analytical process was completed in three stages. Firstly, each SCT construct was quantified in comparison with the coded text within every guideline by frequency and percentages. Secondly, comparisons were drawn between organizations (the WHO vs. the CDC), time points (earlier vs. newer versions), and document types (general IPC vs. topic-specific). Thirdly, key themes were interpreted to elicit strengths, gaps, and emerging trends. Constructs were also examined in isolation and within integrated behavioral frameworks.

Trustworthiness and Rigor

To ensure methodological rigor, the study followed established guidelines of qualitative content analysis [20]. Credibility was increased by double-coding, triangulation with other resources, and the use of well-tested SCT constructs. Dependability was maintained by transparent reporting of coding approaches and ongoing refinement of the analytical framework. Confirmability was ensured through audit trail documentation of coding decisions within NVivo. Transferability was facilitated by describing the study setting in depth, document selection, and analytic processes to enable replication in other policy contexts.

Ethical Considerations

All the data used were taken from publicly available guideline documents, and hence, ethical clearance was not required. However, the research adhered to responsible research practice through proper referencing and accurate representation of the documents assessed.

Results and Analysis

Overview of Document Characteristics

Seventeen guideline documents, produced by the WHO and the CDC between the years 2010 and 2023, were reviewed. They comprised both overall IPC frameworks (e.g., the WHO Guidelines on Hand Hygiene in Health Care; the CDC Core Practices for Infection Prevention) as well as separate technical area subjects (e.g., isolation precautions). The length of the considered documents ranged from 42 to 300 pages, reflecting differences in scope and detail. All the documents were intended for use either internationally or nationally across various healthcare environments and were designed primarily for healthcare administrators, infection preventionists, and clinical front-line staff.

Proportion of SCT Constructs

As demonstrated in Table 1, the proportion of SCT constructs from analysis of IPC guidelines showed that environmental factors had the highest representation (15–25%), reflecting a strong focus on infrastructural and organizational compliance enablers. At the other end, observational learning had the lowest rates (4–11%), which suggests minimal focus on leadership modeling and peer interventions. This disparity suggests guideline content is skewed toward structural determinants at the cost of the behavioral mechanisms required for long-term maintenance of adherence.

Comparative Analysis: the WHO vs. the CDC guidelines

Table 2 highlights that the WHO guidelines were more about self-efficacy (15%) and observational learning (11%) - they reflect greater attention to training and role modeling. In contrast, the CDC guidelines dedicated more attention to the reinforcement mechanisms (10–12%), doing so predominantly by way of formal monitoring and audit systems. These findings reflect differential organizational concern, with the WHO emphasizing capacity development and the CDC

Table 1. Proportion of SCT Constructs Identified Across All IPC Guidelines.

SCT Construct	Proportion of Total Recommendations (%)
Self-efficacy	5–15
Observational learning	4–11
Outcome expectations	10–20
Environmental influences	15–25
Reinforcement	7–12

Values represent the proportion of guideline content coded under each SCT construct relative to total recommendations.

Table 2. Comparative Emphasis on SCT Constructs in the WHO vs. the CDC Guidelines.

SCT Construct	WHO (%)	CDC (%)
Self-efficacy	Up to 15	Up to 8
Observational learning	Up to 11	Up to 6
Outcome expectations	10–20	9–14
Environmental influences	15–25	15–19
Reinforcement	7–9	10–12

Data represent the approximate percentage of content coded to each SCT construct in the most recent guideline versions (2010–2023).

emphasizing tracking accountability and monitoring compliance.

Temporal Trends

Table 3 shows that the greatest temporal change occurred in the WHO recommendations, with self-efficacy increasing threefold (5% in 2010 to 15% in 2023) and observational learning increasing from 4% to 11%, reflecting increasing emphasis on building confidence and role modeling over time. In contrast, the CDC guidance showed limited change in these constructs, but the most significant expansion in reinforcement systems (7% to 12%), as it would be anticipated with their focus on monitoring and auditing. Outcome expectations and environmental measures increased moderately across both organizations, which showed consistency, though less pronounced change in these areas.

Integration of Constructs

While 82% of documents mentioned at least one SCT construct, only 28% demonstrated integration of more than one construct within the same recommendation. The WHO's 2023 Minimum Requirements for IPC Programs, for example, combined environmental determinants (material availability) and outcome expectancies (reduction in infection burden), but rarely tied these up with reinforcement or observational learning. Such an isolated application limits the potential of reciprocal determinism, the simultaneous influence of personal, behavioral, and environmental determinants emphasized by SCT.

Critical Gaps Identified

Three significant gaps were discovered between guidelines:

1. Leadership Modeling Deficit: Measuring IPC behavior modeling and participation was seldom reported, and was present in ≤ 11% of articles. It is a missed opportunity, as observed compliance by senior visible staff has been shown to increase adherence up to 30%.
2. Restricted to Audits Feedback Mechanisms: Reinforcement interventions were audit-based only, with no mention of real-time, one-on-one feedback mechanisms known to sustain behavioral change.
3. Failure to Consider Behavioral Interdependencies: Constructs were considered in isolation, and little guidance was offered on how environmental modification, self-efficacy training, and reinforcement could be integrated for synergistic effects.

Emerging Exemplary Practices

Despite these gaps, there were some encouraging practices found:

1. The WHO's competency verification recommendation using simulation exercises specifically dealt with self-efficacy.
2. The CDC's application of unit-specific compliance goals demonstrated reinforcement methods tailored to organizational settings.
3. Both agencies increasingly used visual aids (e.g., dashboards, infographics) to communicate outcome expectations, that is, infection reduction data.

These events, though few in number, indicate a growing but piecemeal awareness of behavioral science in IPC policy formulation.

Table 3. Temporal Trends in SCT Construct Emphasis in WHO and CDC IPC Guidelines (2010–2023).

SCT Construct	WHO 2010 (%)	WHO 2023 (%)	CDC 2010 (%)	CDC 2023 (%)	Notable Change / Trend
Self-efficacy	5	15	3	8	The both agencies increased focus on staff confidence and competence; WHO's inclusion of simulation training and skill-based modules reflects a threefold rise in self-efficacy emphasis.
Observational learning	4	11	2	6	The WHO integrated structured mentorship, peer demonstration, and role-modeling programs; The CDC added limited updates mainly in e-learning visuals and examples.
Reinforcement	6	9	7	12	Reinforcement mechanisms expanded—especially CDC's emphasis on feedback loops, audits, and performance-based recognition; The WHO included more periodic feedback strategies.
Outcome expectations	12	20	9	14	The both agencies strengthened the link between IPC behavior and measurable outcomes (infection rates, patient safety metrics), highlighting behavioral accountability and institutional impact.
Environmental influences	18	25	15	19	Consistent growth in attention to system-level supports—facility design, supply availability, and leadership engagement—demonstrating sustained environmental integration in IPC frameworks.

Percentages represent the proportion of guideline recommendations coded under each SCT construct. Data are based on a comparative qualitative content analysis of the WHO and the CDC IPC guidelines (2010–2023).

Discussion

This study evaluated the application of SCT constructs in early IPC guidelines of the WHO and the CDC from 2010 to 2023. The findings provide evidence of incremental enhancement in the application of concepts in behavioral science, particularly in the most recent WHO guidelines, but also demonstrate persistent gaps and inconsistencies across organizations and over time.

Our analysis demonstrates that environmental determinants were the most uniformly occurring construct in recommendations, reflecting the continued focus on infrastructural and organizational enablers such as the availability of resources, design of facilities, and the availability of hand hygiene products. While these remain the most important components of IPC programs, their occurrence demonstrates a continued reliance on structural rather than behavioral determinants of compliance [1,3].

Conversely, self-efficacy and observational learning, both essential elements of SCT, were notably underrepresented, considering their established worth in producing enduring behavior change [11,12]. Significantly, the WHO guidelines, published from 2010 to 2023, recorded a threefold increase in mentions such as ‘self-efficacy’ and a considerable increase in mentions of ‘observational learning’, indicating a growing recognition of the need to enhance healthcare workers' confidence as well as the need to apply role modeling [1]. The CDC guidelines, in contrast, place comparatively less emphasis on such constructs and emphasize, instead, mechanisms of reinforcement such as compliance checking and benchmarking [2].

The fragmented integration of SCT constructs was another major finding. Although the overwhelming majority of documents included a minimum of one behavioral determinant, only 28% of them showed consistency across multiple constructs within a single recommendation. For example, guidelines commonly paired environmental modifications with outcome expectations but did not connect them with reinforcement or self-efficacy. Siloing, which defies the reciprocal determinism principle, dynamic interaction among self, environmental, and behavioral factors, upon which SCT draws [11], is how this appears to have occurred.

Poor adherence to core IPC practices, in particular hand hygiene, is strongly documented within the international literature. A systematic review found an overall compliance of less than 60%, despite its widespread recognition of its importance [4-6]. Our study adds to the understanding of this implementation gap by showing that current guidelines remain constrained in the use of behaviorally informed interventions. Similar results have been obtained in broader public health terms, where interventions designed without explicit theoretical underpinning consistently demonstrate weaker and less sustainable effects compared to those grounded in behavioral science [12].

The results validate the WHO's recognition of behavioral drivers in the COVID-19 pandemic, when uptake of vaccines and responsiveness to preventive interventions were influenced by risk perceptions, trust, and self-efficacy as profoundly as technical advice [10]. Outcomes from Hong Kong's COVID-19 response also demonstrated the importance of rapidity, adaptive IPC measures with staff engagement, as well as leadership role-modeling [9].

Besides individual-level factors, organizational culture and resilience are increasingly being regarded as central to IPC success. A recent review described variability in conceptualization and measurement of resilience across health systems, but always pointed towards leadership, empowered staff, and flexibility as key components of success [13]. Nevertheless, analysis in this paper revealed that leadership modeling, a known facilitator of adherence to IPC, was only practiced in ≤ 11% of reports examined.

Across poorer-resource settings, the management of behavioral science remains particularly concerning. Abalkhail and Alslamah (2022) had attributed institutional challenges such as weak infrastructure, limited training, and weak monitoring systems as the major barriers to IPC practice during pandemics [7]. As HAIs disproportionately affect such facilities [1], inclusion of SCT constructs in guidelines is not simply a question of increased compliance but also of a required advancement towards equity as part of the infection prevention outcomes.

Our findings highlight the need for integrating the Social Cognitive Theory (SCT) constructs in a more systematic manner into the current IPC guidelines. The leadership role-modeling needs to be explicit and foster a culture of safety [13]. The self-efficacy needs to be supported through scenario-based training and peer mentoring [4-6,11]. Observational learning in this case is guided by systematic role-modeling and leadership demonstration interventions [21,22], and reinforcement is strengthened when extended from audit alone to include feedback in real time, including rewarding mechanisms [22,23]. The inclusion of environmental, individual, and organizational determinants within combined frameworks represents a shift away from monitoring for compliance towards behaviorally grounded guideline development.

Also, guideline developers would have to collaborate with implementation science researchers to incorporate evidence-tested frameworks such as the Behavior Change Wheel [12] and resilience-based approaches [13]. Utilizing digital innovations such as mobile feedback systems, performance dashboards, and virtual reality training also offers the possibility to apply SCT principles across various healthcare settings [9].

Strengths and Limitations

This study is among the first of its kind to explore the IPC guidelines in depth from a behavioral science viewpoint, making comparisons of content between organizations and over time using SCT concepts. The employment of an open coding strategy, cross-checking of dual coders, and NVivo-supported analysis maximizes credibility and replicability [20,24].

However, some limitations must be noted. First, the analysis was restricted to published WHO and CDC reports, excluding local implementations or unpublished institutional guidelines. Second, notwithstanding high intercoder reliability, interpretation of behavioral constructs remains partially subjective. Third, guideline content was focused on in this research at the expense of implementation; thus, the effect of behavioral strategies on compliance was not tested. Future studies must incorporate document analysis with implementation studies and outcome measures to find out more about how recommendations derived from SCT function in practice.

Conclusions

This study used an analytical framework to examine the inclusion of SCT constructs in the WHO and the CDC IPC guidelines covering the period from 2010 through to 2023. Findings show that while behavioral components are increasingly being recognized, particularly in recent WHO updates, the emphasis is still vastly in the direction of environmental components. Constructs such as self-efficacy, observational learning, and reinforcement, which are important in sustaining behavior change, are given minimal mention.

Preeminence of technical and structural advice highlights a persistent disjunction between guideline content and any real compliance. Without deliberate attention to increasing healthcare workers' confidence, leadership modeling, and strategic reinforcement, IPC policies can fail to achieve their desired outcome.

Future guideline formulation will need to adopt theory-based methods with SCT constructs interwoven and reinforcing one another. Adoption of innovations like electronic feedback systems, simulation-based training, and organizational resilience strategies would further enhance the implementation process. Systematic use of behavioral science in application to IPC policy will enhance compliance, reduce healthcare-associated infections, and build resilient health systems.

Acknowledgements

Authors would like to thank the University of Tabuk for institutional support and research facilities. I am especially thankful to Dr. Naveed Ahmad and Mr. Assem Alhayajneh for their valuable assistance in analyzing CDC and WHO documents, which added much value to this research.

Corresponding author

Ahmad Sabbah PhD
Assistant Professor, Dept. of Assistance Medical Sciences,
Applied College, University of Tabuk
Tabuk, 47512, Saudi Arabia.
Tel: +966 58 108 0580
Email: asabbah@ut.edu.sa

Conflict of interest

No conflict of interest is declared.

References

1. World Health Organization (2022) Global report on infection prevention and control. Available: https://www.who.int/publications/i/item/9789240051164. Accessed: 13 August 2025.
2. European Centre for Disease Prevention and Control (2024) Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals – 2022–2023. Available: https://www.ecdc.europa.eu/sites/default/files/documents/healthcare-associated-point-prevalence-survey-acute-care-hospitals-2022-2023.pdf. Accessed: 13 August 2025.
3. Storr J, Twyman A, Zingg W, Damani N, Kilpatrick C, Reilly J (2017) Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. Antimicrob Resist Infect Control 6: 6. doi: 10.1186/s13756-016-0149-9.
4. Bajunaid RM, Saeed A, Bostaji M, Farsi NJ (2024) Hand hygiene compliance and improvement interventions in the eastern Mediterranean region: a systematic review and meta-analysis. Infect Prev Pract 6: 100363. doi: 10.1016/j.infpip.2024.100363.
5. Bredin D, O'Doherty D, Hannigan A, Kingston L (2022) Hand hygiene compliance by direct observation in physicians and nurses: a systematic review and meta-analysis. J Hosp Infect 130: 20-33. doi: 10.1016/j.jhin.2022.08.013.
6. Harun MGD, Anwar MMU, Sumon SA, Mohona TM, Hassan MZ, Rahman A, Abdullah SAHM, Islam MS, Oakley LP, Malpiedi P, Kaydos-Daniels SC, Styczynski AR (2023) Hand hygiene compliance and associated factors among healthcare

workers in selected tertiary-care hospitals in Bangladesh. J Hosp Infect 139: 220-227. doi: 10.1016/j.jhin.2023.07.012.
7. Abalkhail A, Alslamah T (2022) Institutional factors associated with infection prevention and control practices globally during infectious pandemics in resource-limited settings. Vaccines 10: 1811. doi:10.3390/vaccines10111811.
8. Curtis VA, Danquah LO, Aunger RV (2009) Planned motivated and habitual hygiene behaviour: an eleven country review. Health Educ Res 24: 655-673. doi: 10.1093/her/cyp002.
9. Cheng VC, Wong SC, Chen JH, Yip CC, Chuang VW, Tsang OT (2020) Escalating infection control response to the rapidly evolving epidemiology of coronavirus disease 2019 due to SARS-CoV-2 in Hong Kong. Infect Control Hosp Epidemiol 41: 493-498. doi: 10.1017/ice.2020.58.
10. World Health Organization (2020) Behavioural considerations for acceptance and uptake of COVID-19 vaccines: meeting report. Available: https://www.who.int/publications/i/item/9789240016927. Accessed: 15 August 2025.
11. Bandura A (1986) Social foundations of thought and action: a social cognitive theory. Englewood Cliffs NJ: Prentice-Hall 617 p.
12. Michie S, van Stralen MM, West R (2011) The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 6: 42. doi: 10.1186/1748-5908-6-42.
13. Ignatowicz A, Tarrant C, Mannion R (2023) Organizational resilience in healthcare: a review and descriptive narrative synthesis of approaches to resilience measurement and assessment in empirical studies. BMC Health Serv Res 23: 376. doi: 10.1186/s12913-023-09242-9.
14. Nagassar RP, Wallace-Sankarsingh S (2025) Hand hygiene basic compliance rate monitoring among healthcare workers of a public hospital in Trinidad and Tobago. Discov Public Health 22: 149. doi: 10.1186/s12982-025-00546-1.
15. Glowicz JB, Landon E, Sickbert-Bennett EE, Aiello AE, Dekay K, Hoffmann KK, Maragakis L, Olmsted RN, Polgreen PM, Trexler PA, Vanamringe MA, Wood AR, Yokoe D, Ellingson KD (2023) Strategies to prevent healthcare-associated infections through hand hygiene: 2022 update. Infect Control Hosp Epidemiol 44: 355-376. doi: 10.1017/ice.2022.304.
16. Lenglet A, van Deursen B, Viana R, Abubakar N, Hoare S, Murtala A, Okanlawon M, Osatogbe J, Emeh V, Gray N, Keller S, Masters P, Roolvink D, Davies J, Hickox K, Fotso A, Bil K, Ikenna Nwankwo C, Ahmad B, Caluwaerts A, Lessard I, Dimeglio S, Malou N, Kanapathipillai R, McRae M, Wong S, Hopman J (2019) Inclusion of real-time hand hygiene observation and feedback in a multimodal hand hygiene improvement strategy in low-resource settings. JAMA Netw Open 2: e199118. doi: 10.1001/jamanetworkopen.2019.9118.
17. Linnik L, Turan N, Polat Dünya C, Lahtinen K, Franck T, Valta M, Ayoğlu T, Akyüz N, Coutinho V, Paiva L, Brito I, Colomer-Pérez N, Giménez-Espert MC, Buigues C, Cauli O (2024) Association between hand hygiene knowledge and self-efficacy in nursing students: a multicenter cross-sectional study within the framework of the erasmus project. Nurs Rep 14: 1973-1986. doi: 10.3390/nursrep14030147.
18. QSR International Pty Ltd (2018) NVivo qualitative data analysis software version 12. Melbourne Australia: QSR International Pty Ltd. Available: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home. Accessed: 15 August 2025.
19. Landis JR, Koch GG (1977) The measurement of observer agreement for categorical data. Biometrics 33: 159-174. doi: 10.2307/2529310.
20. Hsieh HF, Shannon SE (2005) Three approaches to qualitative content analysis. Qual Health Res 15: 1277-1288. doi: 10.1177/1049732305276687.
21. Greene C, Wilson J (2022) The use of behaviour change theory for infection prevention and control practices in healthcare settings: a scoping review. J Infect Prev 23: 108-117. doi: 10.1177/17571774211066779.
22. Reinoso Schiller N, Motaharina G, König A, Benze G, Eichkorn J, Weber-Krüger M, Köster AM, Fischer L, Schulte E, Ellenrieder V, Scheithauer S (2025) More than rewards: insights into a hospital infection prevention and control gamification strategy. J Hosp Infect 160: 74-80. doi: 10.1016/j.jhin.2025.02.019.
23. Norman G (2023) Behaviour change techniques for guideline compliance in infection prevention and control: rapid evidence synthesis. ARC Greater Manchester National Institute for Health and Care Research. Available: https://arc-gm.nihr.ac.uk/media/Resources/ARC/Evaluation/RES/Bevaviour%20Change%20in%20IPC/Behaviour%20change%20techniques%20in%20IPC_RES_new_template.pdf. Accessed: 15 August 2025.
24. Bowen GA (2009) Document analysis as a qualitative research method. Qual Res J 9: 27-40. doi: 10.3316/qrj0902027.