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The Role Of Running Water Availability And Infection Prevention And Control Training In Enhancing Healthcare Workers' Practices: A Systematic Literature Review And Meta-Analysis

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Abstract

Infection prevention and control training and access to running water are essential components of infection prevention. However, gaps in their implementation have been linked to suboptimal practices among healthcare workers, highlighting the need for improved training programs and infrastructure to mitigate infection risks globally. The objective of this systematic review was to assess the role of running water availability and infection prevention and control training in enhancing healthcare workers' practices. A systematic review analyzed studies (2014–2024) on running water availability and infection prevention and control training's impact on healthcare workers' practices. A random-effects model calculated adjusted odds ratios, with heterogeneity and publication bias assessed using forest and funnel plots, respectively, highlighting the importance of these factors in improving infection prevention practices. We analyzed 171 abstracts, selecting 10 studies (7 on infection prevention and control training, 5 on running water) with a total of 3,818 healthcare workers. Infection prevention and control training improved good practices (AOR = 2.26; 95%CI = 2.01–2.53). Access to running water also enhanced practices (AOR = 1.96; 95%CI = 1.53–2.50). Publication bias was not significant. Infection prevention and control training and running water access significantly improve healthcare workers’ practices. Healthcare facilities should implement mandatory infection prevention and control training and ensure access to running water to enhance infection prevention practices, particularly in resource-limited settings. Further research is needed to address publication bias and assess long-term outcomes.

Keywords

Infection prevention and control, health personnel, running water, training

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BACKGROUND

Health-care-associated infections are among the most common adverse outcomes in care delivery, with both the endemic load and epidemics posing significant public health concerns (Allegranzi et al., 2011). In 2011, the World Health Organization reported that on average, 7% of patients in industrialized nations and 15% in low- and middle-income countries suffer from at least one health care-associated infection at any given time, with attributable mortality estimated at 10%(World Health Organization, 2011). There is evidence that many health-care-associated infections are preventable and entail prolonged hospital stays and distress for patients (Arefian et al., 2016, 2017; De Angelis et al., 2010; Stewardson et al., 2016).

As the hospital setting appears to play an essential role in the development of the disease (del Rio & Malani, 2020), achieving high compliance with Infection prevention and control (IPC) interventions necessitates behavioral and workplace adjustments. There are still gaps in the systems for putting the best evidence into practice. In this context, it is crucial to identify which implementation techniques based on dissemination interventions are the most effective to enhance healthcare personnel' compliance with IPC guidelines (Houghton et al., 2020; Lai et al., 2020; Shah et al., 2015). IPC strategies include early detection and source control, administrative controls, environmental and engineering controls, and personal protective equipment (World Health Organization, 2014).

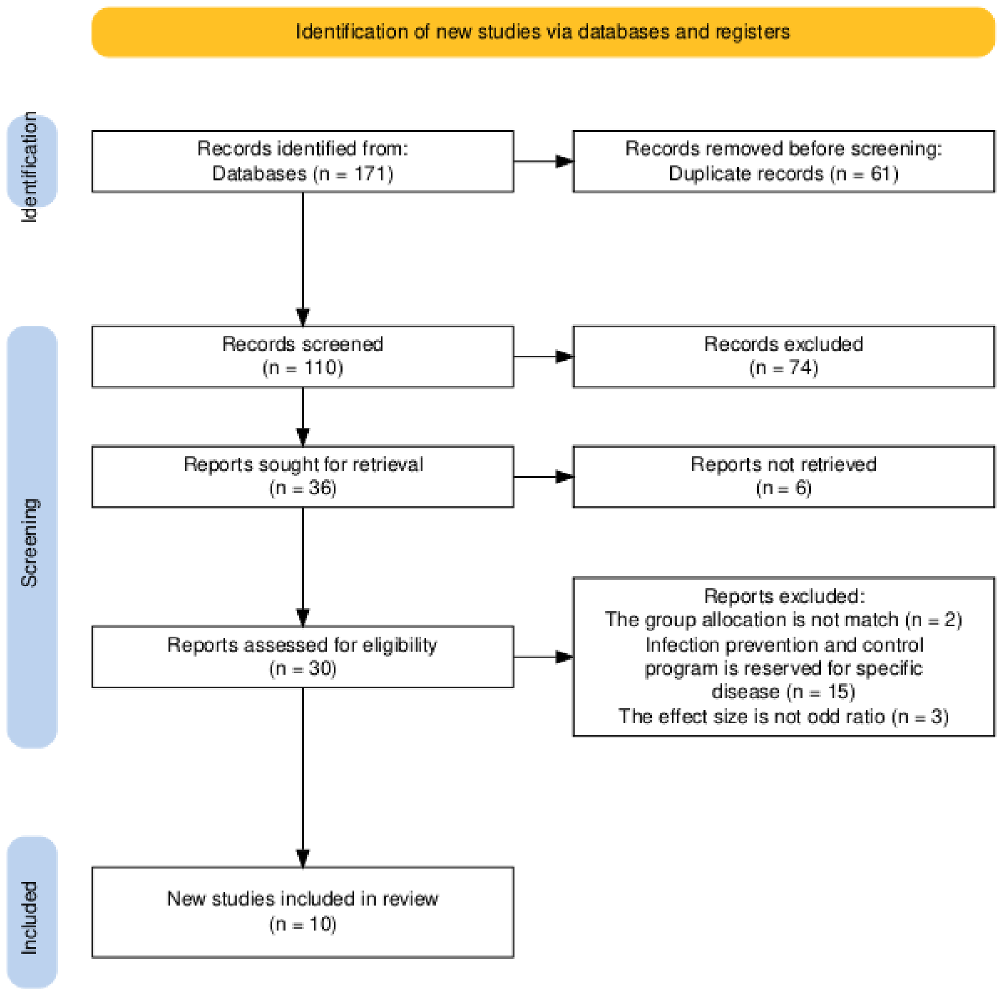
Interventions to increase adherence to IPC standards are relevant to global, national, and local contexts and can help to eliminate implementation gaps in the pandemic environment, as well as prepare for future health emergencies (Silva et al., 2021). A prior analysis indicates that healthcare workers identify a variety of factors that influence their ability and desire to apply IPC principles when treating respiratory infectious diseases. These include aspects of the recommendations itself, such as training and facility workers, particularly the availability of running water (Houghton et al., 2020).

Reviewing the significance of running water availability and IPC training is critical for identifying evidence-based methods that improve healthcare professionals' practices.

METHODS

Study selection

This study employs a systematic literature search to identify full-text articles examining the impact of running water availability and IPC training on improving healthcare workers' practices. The study selection process followed the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [Figure 1] (Haddaway et al., 2022). All studies included in this review were required to have been published between January 1, 2014, and December 31, 2024. To ensure a systematic approach, search terms were organized using a block chart addressing the Population, Exposure, Comparator, and Outcome (PECO) framework. A comprehensive search strategy was employed, using the following keywords in PubMed: ‘Infection prevention & control’/exp OR ‘Health personnel’/exp AND ‘Odd ratio’/exp OR ‘Cross-sectional’/exp. Additionally, the following detailed search string was applied in PubMed: ((“Infection prevention & control”[All Fields] OR (((“infection”[All Fields] OR “prevention”[All Fields]) AND “control”[All Fields])) OR “IPC”[All Fields])) AND (((“Health personnel”[All Fields] OR “healthcare workers”[All Fields]) OR “medical staff”[All Fields])) AND (((“Odd ratio”[All Fields] OR “odds ratio”[All Fields]) OR “cross-sectional”[All Fields])). To broaden the scope, Google Scholar was also searched, and chain searching was conducted for additional relevant studies. Duplicate records were removed using Mendeley Desktop version 2.128.0 (Copyright © 2024 Mendeley Ltd). The inclusion criteria required studies to focus on healthcare workers as the target population and on IPC training not limited to a specific disease, such as COVID-19 or HIV. Exclusion criteria included studies where the intervention and comparator were reversed, studies reporting unadjusted odds ratios, and non-original research such as conference abstracts, editorials, or letters. When in doubt, especially regarding the relevance of an abstract, the full text of the study was reviewed for confirmation.



Data extraction, analysis, and statistical methods

Key data extracted from studies deemed eligible included the authors, study aim, country, study design, sample size (N), population, exposure, and comparator. Data extraction was conducted manually and organized using a commercially available spreadsheet (Microsoft® Excel® for Office 365 MSO) as shown in Table 1. Statistical analyses were performed using Review Manager (RevMan) [Computer program], version 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).

To address the expected heterogeneity across studies, a fixed-effects model was employed. The results from the random-effects model were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI). Heterogeneity was quantified using the inconsistency index (I^2) and visually represented in a forest plot. Publication bias was assessed using Egger's regression test and depicted in a funnel plot using software JASP [Computer program], version 0.19.2.

Table 1. Characteristics of Primary Article

No	Author (year)	Aim of study	Study Design	Sample size (N)	Population	Exposure	Result
1.	Assefa et al. (2020)	To assess the associated factors influences practices of healthcare providers towards infection prevention and control	Cross-sectional	171	Healthcare workers	Received infection prevention and control training (AOR= 2.4; 95% CI= 1.01-4.75)	Good practice of infection prevention and control
2.	Babore et al. (2024)	To assess the variables associated with adherence regarding standard infection prevention and control procedures among healthcare workers	Cross-sectional	379	Healthcare workers	Received infection prevention and control training (AOR= 1.68; 95% CI= 1.04-2.72); Availability running water (AOR = 2.90; 95% CI= 1.62-5.31)	Good practice of infection prevention and control
3.	Bekele et al. (2020)	To assess associated factors among healthcare workers standard safety precaution	Cross-sectional	422	Healthcare workers	Received infection prevention and control training (AOR= 3.99; 95% CI= 1.46-10.9); Availability of running water (AOR= 2.68; 95% CI= 1.15-6.2)	Good practice of infection prevention and control
4.	Geberemariyam et al. (2018)	To assess associated factors of practices among healthcare workers with respect to infection prevention	Cross-sectional	648	Healthcare workers	Received infection prevention and control training (AOR = 5.31; 95% CI= 2.42-11.63)	Good practice of infection prevention and control
5.	Jemal et al. (2020)	To assess the associated factors regarding practice of infection prevention and control practice among the health workforce	Cross-sectional	361	Healthcare workers	Availability running water (AOR= 2.27; 95% CI= 1.18-4.35)	Good practice of infection prevention and control
6.	Mohammed et al. (2024)	To assess associated factors among healthcare workers regarding infection control	Cross-sectional	470	Healthcare workers	Availability of running water (AOR 1.50 (0.91, 2.45)	Good practice of infection prevention and control
7.	Tafere et al. (2024)	To assess associated factors among nurses' regarding practice of infection prevention	Cross-sectional	219	Nurses	Received infection prevention and control training (AOR = 2.2; 95% CI: 1.94-12.3)	Good practice of infection prevention and control
8.	Sahiledengle et al. (2018)	To assess associated factors among healthcare workers regarding infection prevention practices	Cross-sectional	629	Healthcare workers	Availability running water (AOR=1.68; 95%CI= 1.11-2.56)	Good practice of infection prevention and control
9.	Weldetinsae et al. (2023)	To assess healthcare providers compliance with infection prevention and control procedures	Cross-sectional	247	Healthcare workers	Received infection prevention and control training (AOR= 3.93; 95% CI= 1.46-10.58)	Good practice of infection prevention and control
10.	Yilma et al. (2024)	To assess associated factors Infection prevention and control practices	Cross-sectional	272	Healthcare workers	Received infection prevention training and control (AOR= 2.48; 95% CI= 1.36-4.52)	Good practice of infection prevention and control

RESULTS AND DISCUSSION

Characteristics of included studies

We analyzed 171 study abstracts, including 110 from PubMed and 61 from Google Scholar. After deleting duplicates, 110 studies were evaluated according to their title and abstracts. After removing 74 papers based on inclusion and exclusion criteria, 36 research were evaluated for eligibility using the title and abstracts. Following the full-text examination, an additional 26 papers were rejected. Finally, ten primary research's (seven for variable training in IPC and five for variable available running water) were chosen for full-text evaluation and inclusion in the analysis. The

Analysis

Subjects who received IPC training had higher rates of good practice compared to those who did not (AOR = 2.26; 95%CI = 2.01 to 2.53; $p < 0.00001$). The forest plot revealed no substantial variability between studies in variable training IPC (I^2=31%, Q-test: $p = 0.19$) [Figure 1]. Furthermore, the Egger's regression test results do not provide strong evidence for publication bias, as the asymmetry test p-value exceeds the common significance threshold ($z = 1.805$; $p = 0.071$) [Figure 2].

Figure 1. Forest plot of included studies in variable training. CI: confidence interval, I^2 :

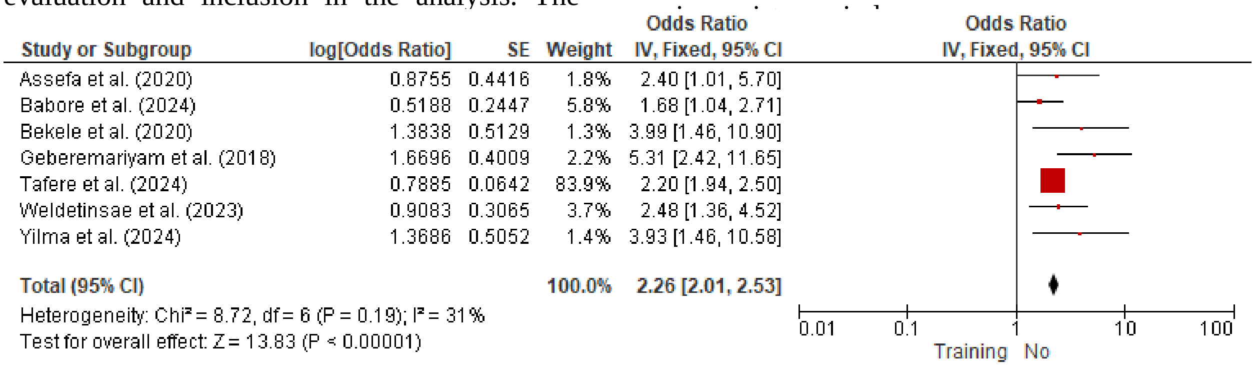
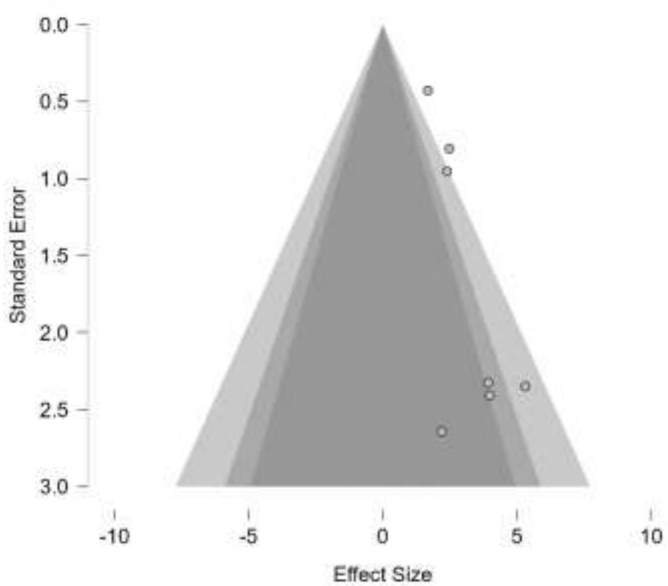
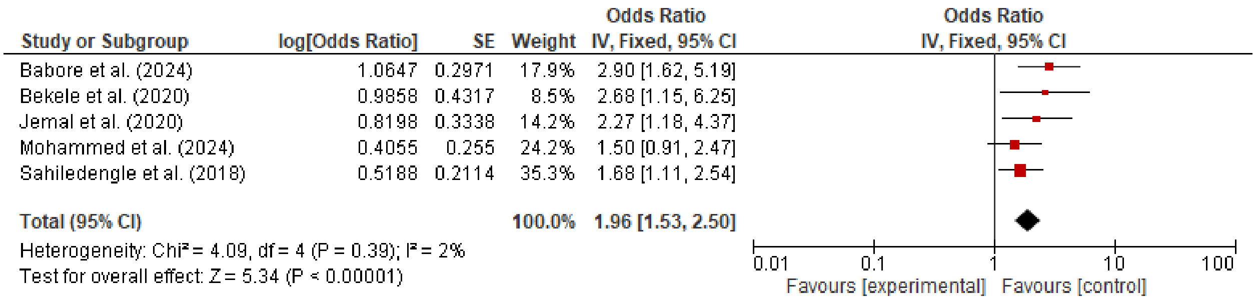


Figure 2. Funnel plot in variable training.



Participants who had access to flowing water had better IPC practice than those who had not (AOR = 1.96; 95%CI = 1.53 to 2.50; p < 0.00001). The forest plot revealed no substantial variation between studies in variable available running water (I^2=2%, Q-test: p = 0.39). [figure 3]. The Egger's regression test revealed considerable publication bias among the selected papers, with a significant funnel-plot asymmetry (z = 1.557; p = 0.119). [Figure 4].

Figure 3. Forest plot of included studies in variable available running water. CI: confidence interval, I^2 : inconsistency index.



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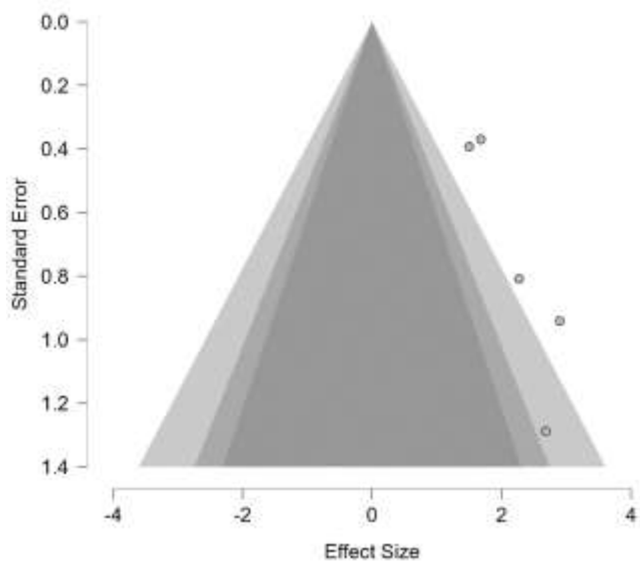

Discussion

Employing the best available data from a comprehensive literature search, this study calculated the relationship between two variables (training IPC and running water availability) and IPC practice among healthcare personnel. PRISMA was used to identify all of the studies, and the estimated effect sizes for training in IPC and availability of running water using a fixed effect model were 2.26 and 1.96, respectively. As far as we are aware, this is the first meta-analysis to look at how those variables relate to one another.

There is a significant correlation between the availability of running water and healthcare providers' good IPC practices in healthcare facilities, according to the results of this meta-analysis. These results were in line with previous study that stated facilities with consistent water access are better suited to comply to IPC protocols, such as handwashing and surface disinfection, which are critical for reducing healthcare-associated infections

(McGriff & Denny, 2020; Tseng et al., 2020). The provision of running water is a critical component of successful IPC procedures in healthcare institutions. Ensuring continuous water supply not only helps compliance with IPC rules, but it also improves healthcare professional satisfaction and patient safety (Fejfar et al., 2021).

This current meta-analysis also showed a clear effect between IPC training and the rise in good practices among healthcare workers. These findings were reinforced by a review, which found that IPC training greatly improves healthcare personnel' compliance with infection control measures like hand cleanliness and personal protective equipment (Silva et al., 2021). A study conducted by Woldeamanuel et al. (2024) also discovered that the safety officer training program was widely embraced and beneficial in increasing the implementation and comfort of sustaining IPC practices in clinical settings. Healthcare professionals lack basic IPC principles, thus personalized IPC training sessions can greatly improve their IPC practice. The formation of an active IPC committee could allow for periodic refresher and in-service training updates for medical professionals, as well as the reallocation of resources to implement regular IPC practices (Sumon et al., 2020). Training programs increase healthcare personnel' understanding and attitudes towards IPC, which has a favorable impact on their practices. Knowledge is associated with better attitudes, which are essential for effective IPC implementation (Alhumaid et al., 2021; Wang et al., 2023).

Our findings emphasize the importance of infection prevention and control training, as well as availability to running water, in increasing healthcare personnel' commitment to effective infection prevention procedures. Both interventions were linked to considerable improvements in practices, highlighting their value in healthcare institutions. These findings clearly support the establishment of mandatory infection prevention and control training programs for healthcare personnel, particularly in resource-constrained situations where such policies can be most effective. Ensuring regular availability to running water is also critical because it serves as the foundation for sustaining cleanliness standards, which are necessary for preventing healthcare-related diseases.

Notwithstanding these hopeful findings, more study is needed to address potential constraints, such as investigating the long-term viability of these interventions and mitigating any residual effects of publication bias. Future research should look into how these measurements interact with other factors, such as organizational culture and healthcare infrastructure, in order to maximize their impact. Addressing these gaps will improve our understanding and influence plans for strengthening infection prevention practices worldwide.

Declaration of conflicting interests

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