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Review Article

The impact of educational interventions in improving safety practices of healthcare workers: A systematic review

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Abstract

Background: Healthcare workers encounter a variety of occupational hazards that predispose them to accidents and are at a high risk of exposure to bloodborne infection while carrying out their duties. The prevalence of exposures to highly infectious agents has further intensified the need to take occupational exposures to infections seriously in healthcare. And healthcare workers play pivotal in the prevention and control this infection. Therefore, it is important to educate and encourage health workers to practice safety precautions in healthcare settings, and make safety a top priority. Due to the importance of education in ensuring adequate preventive measures are taken in healthcare settings.

Objectives: Therefore, this paper undertakes a systematic review of the literature to "assess the impact of educational interventions in improving the safety practices" of healthcare workers.

Materials and Methods: Research databases such as PubMed, Google Scholar, Scopus, and Science Direct were systematically searched to obtain relevant literature published in the past few years until 2024. The selection criteria were based on the study objectives, and the quality of the studies reviewed were assed based of study design by a quality appraisal tool. Data were extracted using Microsoft Excel and subsequently analyzed with STATA (version 11).

Results: Out of 445 articles initially retrieved, 7 studies met the inclusion criteria and were included into the review. Overall, educational interventions generally had a positive impact on improving safety practices. Post-educational intervention assessments showed significant improvements in compliance with safety precautions in areas such as needle recapping, hand hygiene, wearing of gloves and PPE, management of sharps and needles, Disinfection and cleaning practices, and safe waste disposal. Despite improvements, challenges remained, such as the continued low practice of wearing gowns.

Conclusion: Educational interventions play a significant role in enhancing the practice of safety precautions among health workers and are necessary to protect HCWs from exposure to worksite hazards and in preventing blood-borne pathogen infections.

Keywords: Healthcare workers, Practices, Occupational safety and health, Bloodborne pathogen.

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1. Introduction

Healthcare workers are constantly exposed to numerous occupational hazards within healthcare settings, encompassing biological, chemical, ergonomic, physical, and stress-related factors, which can lead to illnesses and injuries.[1-5] Of particular concern worldwide is the exposure to blood and bodily fluids, which can transmit blood-borne pathogens such as HIV and Hepatitis B and C.[6] It is estimated there are 60 million cases of exposure to bloodborne infectious pathogens and is a worldwide concern.[7] Such exposure can occur through incidents like needle stick injuries or cuts from contaminated sharp instruments, as well as contact with patients' blood on mucous membranes. However, most of these exposures are due to percutaneous injury which accounts for over three-fifths of exposures among healthcare providers.[7] Globally, healthcare workers sustain approximately 2 million needle stick injuries annually, potentially resulting in infections with blood-borne pathogens. Overall, healthcare workers face a significant risk of exposure to bloodborne infections, which poses serious consequences for both their health and patient safety.[7,8]

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The existing body of literature highlights numerous factors influencing exposure to bloodborne infections in healthcare. These include lack of knowledge, inadequate safety practice, improper handling of medical equipment, non-compliance with simple infection prevention and control procedures, or lack of safety standards and resources for employees.[9]

Another issue that may contribute to exposure is the lack of proper safety education and infection-prevention training for health workers while employed in their specific jobs. Research indicates that inconsistent and insufficient education and training in infection control among healthcare workers and professionals contributes to continuous exposure to blood infection and remains a prevalent issue. This is supported by a study that identified a lack of infection-prevention training as a risk factor for exposure.[10] Another study by Julius, Salamat, Bukola, Joshua, and Deborah, observed that lack of regular training on standard precautions was a significant factor for contracting occupational infections and injuries.[11] Similarly, a study by noted that nurses who had no training exposure to blood and body fluids were six times more exposed than those nurses who had received the education.[12]

This mismatch in education and training of health workers concerning the practice of safety also contributes to a continuous lack of adherence to safety precautions and poses risks of infection with blood-borne pathogens to health workers. It has been established that a nexus exists between inadequate education and training and suboptimal execution of occupational health and safety protocols. This is supported by numerous studies that have investigated the adherence of health workers to universal precautions and safety practices worldwide. These studies observed that poor compliance with standard precautions among health professionals is linked with a lack of proper safety education and infection-prevention training.[13-18] Factors such as regular training programs on safety measures, and robust educational intervention programs on infection prevention significantly influence health workers' compliance with prevention strategies.[5,13,16,19-26]

Therefore, to mitigate these occupational exposures to bloodborne infection, and ensure adherence to safety protocols among healthcare workers, it is very important to provide education and incentives to encourage the adoption of standard precautionary measures. These include addressing key practices such as hand hygiene and the appropriate use of personal protective equipment, safe handling and disposal of sharps and clinical waste, and decontamination procedures[19,27–29]. Implementing educational intervention programs could mitigate needle stick injuries and other potential exposures, consequently reducing exposure to infections. This may also improve adherence to occupational health and safety standards, and mitigate health hazards among hospital workers, while prioritizing safety.[30,31]

As emphasized, providing education and training is indispensable for healthcare workers to effectively mitigate the risk of occupational diseases and accidents. Given the paramount importance of adherence of health workers to occupational safety and health practices, and the pivotal role of education and training as foundational elements for enhancing OSH, emphasizing the implementation of robust health and safety hazard prevention plans through systematic education for work, certified induction, refresher training, and specialized hospital-specific training, integrated within a framework of lifelong learning is essential. Therefore, this systematic review aims to evaluate existing studies that assess the effectiveness of educational intervention programs in improving health workers' adherence to occupational health and safety guidelines. By identifying, evaluating, and analyzing relevant research, this review seeks to highlight the critical role of educational interventions in improving safety practices among health workers. Furthermore, its findings are intended to address evidence gaps, thereby supporting policymakers, healthcare professionals, and other stakeholders in making informed, evidence-based decisions to effectively allocate resources to strengthen health and safety standards for all workers, and to institute systematic and comprehensive health and safety training and educational programs for health workers.[32]

2. Research Question

What is the impact of educational interventions on improving the safety practices of healthcare workers?

3. Objectives

1. What are the effects of educational interventions on the practice of hand hygiene among health workers?
2. If educational intervention is shown to have beneficial effects, what is the effect of the use of PPE such as gloves and gowns?
3. Does educational intervention result in improved management of sharps and needles?
4. Does educational intervention have positive effects on health workers' actions in case of accidental blood spillage?
5. Are there improvements in safety practices on waste management and disposal?

4. Materials and Methods

4.1. Protocol registration and reporting

The protocol of this systematic review has been registered in the International Prospective Register of Systematic Review and Meta-analysis (PROSPERO) with a registration number CRD42024618708. This systematic review is conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline.

4.2. Information sources and search strategy

A comprehensive search and document retrieval strategy were performed to find potentially relevant published and unpublished articles in the following electronic databases: PubMed, Scopus, Science Direct, and Google Scholar, Additionally, a manual search was undertaken to locate gray literature. Supplementary studies were discovered by reviewing the reference lists of all included articles. The electronic search strategy was guided by a well-structured combination of specific search terms such as: "Educational Intervention", "educational programs", "training programs", "Safety practices", "infection prevention", "infection control", "standard precaution", "Health workers", "healthcare personnel", "healthcare professionals". Alternative terms for the search elements were also taken into account. Boolean operators (AND, OR) were applied to construct search queries to yield relevant articles related to the research topic. The search covered literature published up to the year 2024. All identified and retrieved studies were organized and managed using EndNote X7 reference management software."

4.2. Eligibility criteria

The study inclusion and exclusion criteria were clearly defined using the relevant PICOS elements[33,34] hence, the inclusion criteria for this study were as follows: (1) Intervention studies that that evaluated changes in at least one safety practice such as hand hygiene, use of personal protective equipment (PPE), sharps (needle) management, disinfection procedures, and safe waste disposal—among healthcare workers; (2) studies employing quasi-experimental designs (e.g., before-after or pre-post), (3) research conducted specifically on healthcare workers; and (4) both published and unpublished works (including theses) were considered. The exclusion criteria included the following:" (1) studies conducted on populations other than healthcare workers (2) qualitative studies, Case reports, reviews, opinion papers, and editorials.

4.3. Study selection

The selection of studies from electronic databases was conducted in two stages

Stage 1: All the retrieved articles the through search strategy were imported into EndNote. The duplicate articles were removed, after which the reviewers screened the remaining articles based on their titles and abstracts. Full-text versions of potentially relevant articles were then assessed to determine their eligibility. Studies that did not meet the inclusion criteria were promptly excluded. To minimize the risk of over-inclusion, careful measures were taken during this stage. The clarity of the review question, along with the defined inclusion and exclusion criteria, facilitated the efficient identification and rejection of ineligible studies. Articles were rejected if: they are not relevant, and fail on one or more criteria such as population, intervention, outcome, or design (including those that address the topic of interest).

Stage 2: For studies that meet the inclusion criteria, the full paper was obtained for detailed assessment against the inclusion criteria

The PRISMA flow diagram to summarize the study selection processes.(**Figure 1**)

4.4. Data collection process

Data from all included studies were extracted using a standardized and pre-tested data extraction form. Study characteristics such as the author's name, geographic region, year of publication, study design, setting, participant details, sample size, data collection methods, sampling techniques, and outcome measures were systematically recorded. Outcome measures focused on various safety practices, including hand hygiene, correct use of gloves and gowns, sharps management, disinfection and cleaning procedures, and safe waste disposal.

4.5. Quality assessment

The methodological quality of each study was assessed, and the risk of bias was judged by the author, using the revised JBI critical appraisal tool for quasi-experimental studies.[35] This tool has been extensively utilized in literature to assess quantitative research studies.[36,37] The author conducted a quality assessment of the included articles independently. Any disagreements encountered during the quality assessment process were resolved through discussion with the involvement of the co-author. Studies that achieved a quality score above 60% were deemed to be of good quality and were included in the final systematic review.

4.6. Measurement of outcome variables

The outcome of this review was the safety practices of health workers towards infection prevention. The Infection prevention practices of health workers were assessed by observing changes in actual safety practices related to infection prevention and safety protocols such as hand hygiene and the use of personal protective equipment (e.g., gloves, gowns), management of sharps (needles), disinfection practices, and safe waste disposal. The primary outcome variable was defined as effective infection prevention practices across five categories, as reported in each original study.

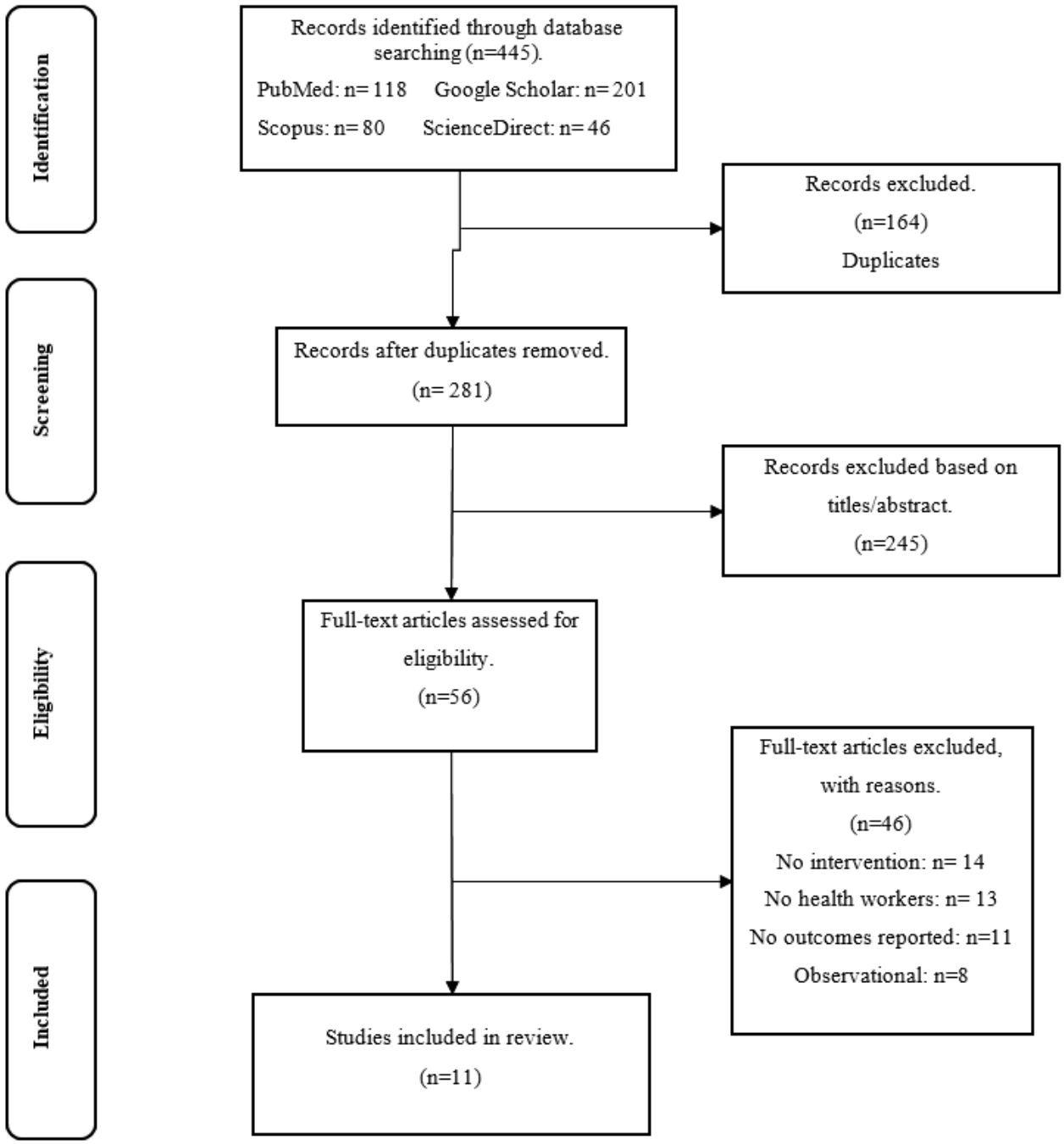

Figure 1: The flow diagram of the article selection and screening process

5. Results

5.1. Overview of selected studies

Through comprehensive searching, 445 articles were identified from the search databases (PubMed: n=118, Google Scholar: n=201, Scopus: n=80, ScienceDirect: n=46). One hundred-three duplicate studies were excluded, and the remaining 281 articles were screened based on their titles, abstracts, and full texts. Ultimately, 7 studies met the inclusion criteria and were incorporated into this systematic review. These 7 studies were used to synthesize data on infection prevention practices."

5.2. Characteristics of studies

All included studies employed a quasi-experimental design (before-after/pre-post) and were published between 2015 and 2024. Geographically, seven studies were conducted in Africa, five in Egypt,[38-42] and two in Nigeria,[43,44] while four were carried out in Asia, including one in China,[45] two in India,[46,47] and one in Nepal.[48] Most studies involved healthcare workers across various clinical departments; however, three studies focused exclusively on nurses,[42,48] and one study targeted only laboratory technicians.[47] Overall, the total number of participants included across all studies was 1038 health workers. This includes 159 Doctors, 630 Nurses,

and 69 Lab workers among others. All the included studies were published in peer-reviewed journals. The sample sizes of these studies varied, ranging from 40 to 170 participants.[38,47] Most of the studies employed self-administered questionnaires as their data collection method.[38-48] 3 used self-administered questionnaires with observation,[40-42] and one used a self-administered questionnaire with key informant interviews.[44] More than half of the included studies employed a simple random sampling technique.[38,39,43-47] Two convenience sampling,[40,48] one statified[42] sampling, one purposive,[41] and one cluster sampling.[45] (**Table 1**)

5.3. The effect of educational interventions

This systematic review included seven studies that examined the impact of educational intervention programs on healthcare workers' safety practices in preventing occupational exposure to blood-borne infections. Analysis of the data demonstrated that these interventions positively influenced compliance with safety protocols aimed at minimizing exposure to infectious pathogens. Safety practices were evaluated using various methods, including direct observations,[40-42] self-administered questionnaires,[38-48] key informant interviews,[44] or a combination of these approaches. The effects of the educational programs on healthcare workers' practices were categorized into five main areas: hand hygiene, use of personal protective equipment (such as gloves and gowns), sharps management (e.g., needles), disinfection or cleaning practices, and safe waste disposal. Hence, the following outcome measures were surveyed to evaluate the effect of the intervention.

5.4. Hand hygiene practices

After reviewing different articles, 5 Studies have reported significant differences between pre- and post-education interventions with improvement in hand hygiene practices among health workers as well as hand washing techniques.[38,40,42,47,48] This includes washing hands Before and after attending to each patient, washing hands after removing gloves, washing hands after handling contaminated items, removing watches and jewelry, soap application, rinsing hands from fingertips upwards and drying with a clean towel, etc. After educational intervention, the practice of safety practice improved for hand washing.

The studies demonstrated significant improvements in handwashing compliance following educational interventions, indicating their positive impact. For instance, one study reported a statistically significant increase in handwashing compliance, with the median score rising from Mdn = 20.0 before the intervention to Mdn = 50.0 after the intervention, accompanied by a large effect size ($p < 0.001$, $r = .78$).[40] Similarly, a significant increase ($p < 0.001$) in the practice of hand washing dealing with patients was reported post-health education from 34.6% to 67.9.[38] A significant improvement in practice ($p < .0001$) was observed following the educational session, particularly in correct hand hygiene behaviors. Notable improvements included washing hands with soap and water after collecting samples ($p < .02$), immediate handwashing after contact with blood, body fluids, or contaminated items ($p < .02$), and the routine use of alcohol-based hand rub for hand hygiene ($p < .04$).[47] However, no significant improvement was reported in washing hands after removing gloves.[42,47]

5.5. Use of personal protective equipment (PPE)

The effect of educational intervention on the adherence of use of personal protective equipment (PPE) was observed in seven studies.[38,40,42,43,45,47,48] The results demonstrated that the use of PPE such as gloves, masks, gowns, protective eyewear for routine clinical systems increased after the educational program compared with the use of PPE prior to implantation of the program. A notable improvement in the routine use of gloves was observed following the educational intervention. Specifically, 141 out of 153 participants (92%) were observed using gloves consistently post-intervention.[43] Similarly, there was a significant increase in glove use during waste handling, with compliance rising from 25.0% to 65.0% ($p < 0.001$).[38] Another study reported a significant difference in glove-wearing compliance before and after the intervention, with the median score increasing from Mdn = 25.0 pre-intervention to Mdn = 66.7 post-intervention, accompanied by a large effect size ($p < 0.001$, $r = .74$).[40] Additionally, the implementation of the educational program significantly improved the practice scores related to glove use, which increased from a range of 44.44 to 100.00 (Mean = 73.26 ± 4.45 SD) before the intervention to 80.55 to 100.00 (Mean = 92.00 ± 2.09 SD) after the intervention, with a statistically significant difference ($p = 0.000$).[48] However, wearing gowns remained the least practiced safety measure among healthcare workers, showing no statistically significant change between the pre- and post-intervention periods.[40] Emphasizing the need for continuous education on standard precautions to address areas for improvement in wearing gowns in future training.

5.6. Management of sharps (needles)

Seven studies in this review examined the effect of education on the handling of sharp needles against percutaneous injuries.[38,40-43,47,48] These studies reported that the behavior of health workers changed positively as far as taking measures against sharp and needle stick injuries after educational training. And statistically significant difference regarding compliance with avoiding recapping needles was reported. For instance, on the practice of universal precautions of proper handling of needles, before educational intervention, the mean score for handling needles was reported to be 70.53±0.34 (mean ±SD). After educational intervention, the handling of needles improved to 87.78±0.25 (mean ±SD). Similarly, there was a significant improvement ($P< 0.001$) in the measures against "recapping of a needle "among health workers before and after educational intervention.[38] Also,

reports on compliance with safety practices after educational intervention revealed safety measures against "recapping of needles" had the best median score of all safety practices observed (Mdn=100) post-intervention phase with a large effect (P<0.001 r=39).[40] Furthermore, significant improvements (p-value <0.001*) in safety practice were detected after one month of educational intervention at 9.96±0.41 Post-intervention (mean ±SD).[41] Finally, health education was also shown to have significantly improved workers' practice regarding sharp waste disposal,[38] where the percentage of workers who practiced safe disposal of sharps and needles increased from 55.1% (n=86) to 78.7% (n=123).

5.7. Disinfection and cleaning practices

Two studies included in this review examined the effect of educational programs on practice regarding disinfection and cleaning. There was a highly significant improvement in the actions against accidental spillage (disinfection). Moreover, health workers' practice regarding instruments/equipment processing (Cleaning) also increased at the post-program stage.[42] It also was observed that the recommended first action and correct responses of protective and control measures after accidental exposure of the body to biohazards within health care facility were taken, with statistically significant improvement among the disinfection and cleaning practices.

5.8. Safe waste disposal

In the studies analyzed, the effect of educational programs on practices on waste management and disposal was observed in five studied. As observed, health workers' practices regarding safe waste disposal were statistically significantly improved in post post-program phase. For instance, a significant improvement was observed (p=.01) in the disposal of biomedical waste in appropriate color-coded containers after education intervention from 75% (n=30) to 95% (n=38).[47] A similar trend was observed in a self-reported practice for infectious waste collection and disposal.[40] The study indicated that there was a statistically significant improvement from pre- (Mdn=33.3) and post-intervention waste disposal (Mdn=100) with a large effect size (p<0.001 r=.53).[40] Furthermore, a significant improvement (p<0.001) in worker's practice regarding sharp waste disposal after health education was also observed,[38] where the percentage increased from 55.1% (n=86) to 78.85 (n=123). The same trend was also observed in another study, which indicated a significant increase in the post-intervention practice scores by about 20% (p<0.001).[39] This finding may be due to active participation in training programs that positively affected health workers' practices regarding safe waste disposal.

5.9. Effect of educational intervention based on profession

When observing the variations in outcomes based on professional groups such as nurses, doctors, and laboratory technicians, one of the studies revealed that nurses significantly had better self-reported practice score than that achieved by doctors and assistant nurses.[41] Nurses in this study found to have a significant better self-reported compliance score than that achieved by doctors and assistant nurses which is in agreement with the results of Labrague et al. and Kim et al. who reported that student nurses have a high compliance of standard precautions.[49,50] Similar data were found in another study with nursing staff.[51]

Table 1: Provides details regarding the 7 studies included in this review

Author	Year of Publication	Title	Pre-intervention	Post-intervention
Lin, Hua	2020	A management program for preventing occupational blood-borne infectious exposure among operating room nurses	**Practices:** baseline results showed that the lowest preventive behavior scores were for wearing gloves while giving intravenous or subcutaneous injections.	It was found that the 6-month program significantly improved OBE preventive behavior. The average scores for preventive behavior after the intervention were higher than those before the intervention, and these differences were significant (t ¼ 53.94, respectively; P< 0.05).
Akamike, Ifeyinwa Chizoba	2020	Evaluation of the effect of an educational intervention on knowledge and adherence to HIV guidelines among frontline health workers in Alex Ekwueme Federal University Teaching Hospital Abakaliki, Nigeria	**Practice:** This study also revealed that all the respondents had good practice of the guidelines at pre-intervention. The total mean score for practice was 4.5 and a standard deviation of 0.5.	The intervention in this study proved effective in enhancing compliance with HIV practice guidelines.

Table 1 Continued….

Mohamed, Rehab Ali	2016	Effect of Education Intervention on Prevention of Bloodborne Infections for Health Care Workers in Family Medicine Centers, Suez Canal University in Ismailia City, Egypt	**Practice:** A statistically significant improvement in compliance was observed for 6 out of the 7 standard precautions (SPs) studied between the pre- and post-intervention phases. The highest median (Mdn) compliance scores were recorded for "no needle recapping" (Mdn = 100) both before and after the intervention, showing a large effect size ($p < 0.001$, $r = .78$), and for "waste disposal" (Mdn = 100) in the post-intervention phase, also with a large effect size ($p < 0.001$, $r = .53$). "Wearing gowns" remained the least practiced precaution among healthcare workers, with no statistically significant difference observed between the pre- and post-intervention periods.	**Practice:** There was a statistically significant improvement in compliance with 6 out of the 7 standard precautions (SPs) following the intervention. The highest median (Mdn) scores were observed for "no needle recapping" (Mdn = 100) in both the pre- and post-intervention phases, with a large effect size ($p < 0.001$, $r = .78$), and for "waste disposal" (Mdn = 100) in the post-intervention phase, also showing a large effect size ($p < 0.001$, $r = .53$). "Wearing gowns" remained the least adhered to practice among healthcare workers, with no statistically significant difference between pre- and post-intervention compliance.
Bassyouni, Rasha H.	2016	The fundamental role of educational intervention in improving health care workers' knowledge, attitude, and practice towards infection control precautions	**Practice:** 80.8% had desirable good practice. Self-reported practice in this study was unsatisfactory for re-sheathing of needles as 67.29% recap needles. Sixty-seven percent (67.2%) recap needles.	High significant improvements in practice were detected after one month of educational intervention.
Shrestha, Indra	2015	Impact of Educational Intervention on Knowledge and Practice of Universal Precautions among Nurses	**Practice:** The individual practice score revealed that 12 had a moderate level (60.0% to 80.0%) of practice in the pre-test	Educational intervention had a significant role in increasing the level of practice of universal precaution among nurses. **Practice:** After the educational intervention the practice of UP improved for handling of needles, washing hands, and use of gloves, and 12 had a high level (>80.0%) of practice in the post-test respectively.
Mehta, Abhishek	2020	Impact of Educational Intervention on Knowledge, Attitudes, and Practices of Laboratory Technicians regarding Universal Work Precautions at a Tertiary Health Care Center in Central India	Before the training, the majority of participants (60%) demonstrated poor levels of practice, 30% showed moderate levels, and only 10% exhibited good practice. Following the training, 40% of participants achieved a good level of practice, 35% displayed moderate levels, and just 25% remained at a poor level of practice.	After training, 40% of the study subjects were found to exhibit a good level of practice, 35% showed moderate levels, and only 25% showed poor levels of practice.

Table 1 Continued….				
Heba Nasser Rayan	2021	Effect of Training Program Regarding Occupational Health Hazards on Nurse Interns' Knowledge and Practice	A minority (33.0%) had a satisfactory practice level regarding occupational health hazards at the preprogram phase.	There was a highly significant improvement in total nurse practice during the program phases (94.5%), and a slight decline (85.7%) in the follow-up phase however the levels remained significantly high compared with the preprogram phase.

6. Discussion

This review intended to highlight the effectiveness of educational interventions in improving safety practices of healthcare workers regarding exposure to blood-borne infections across diverse geographical contexts. By employing a systematic approach, this review identified numerous studies that implemented a targeted educational intervention to increase safety practice levels of health workers regarding occupational health hazards. As evident from the results of these studies, there was a remarkably significant improvement in the practice of safety precautions after the implementation of the educational intervention/training sessions. Educational interventions yielded positive results, with significant improvements observed in post-intervention practices across several studies. These improvements encompassed various aspects of safety precautions, including hand hygiene practices, needle recapping avoidance, use of personal protective equipment (PPE), waste disposal, and disinfection/cleaning practices. Highlighting the efficacy of educational interventions in enhancing practices related to safety precautions among health workers. These findings support the effectiveness of educational interventions as a predominant strategy to address deficiencies in practices among healthcare workers and its importance in reinforcing safe practices in healthcare settings.

Educational intervention has emerged as one of the prevalent approaches to improving the practices of healthcare workers and ensuring their compliance with safety regulations. These interventions, which are predominantly focused on improving workers' practices, play a significant role in strengthening safety precaution practices among health workers, thereby contributing to the prevention of blood-borne pathogen infections. It improves knowledge and instills a positive attitude towards universal precaution in health workers, which translates into behavioral changes in attitude and practices that would help reduce the incidence of exposure to blood infections and hospital-acquired infections. This is supported by Arcanjo et al. found a strong positive correlation between the implementation of educational intervention and the improvement of knowledge and change in preventive practices about occupational risks by nursing professionals in the experimental group.[52] Also, the Elbilgahy et al. study demonstrated the effect of educational intervention in improving nurses' knowledge and practice, as it was reported that, a significant difference among knowledge and practice pre/post-implementing nursing guidelines about hazards prevention was observed.[53] Remarkably, educational interventions have exhibited a significant positive impact on enhancing workers' practices concerning blood-borne pathogens, consequently mitigating exposure risks. This is supported by Afdar and Abad who reviewed 26 studies involving diverse healthcare worker populations and various educational programs, finding a statistically significant reduction in infection rates in 21 of the studies following the interventions.[54]

These positive outcomes in safety practices highlight the effectiveness of educational programs focused on occupational hazards and infectious disease exposure. Such programs enhance knowledge, which fosters a positive attitude and ultimately leads to improved behavior and safer practices. However, the implementation of these interventions may be constrained by certain limitations and associated costs, despite their demonstrable efficacy. Hence, a cost-effective analysis is warranted to inform decision-making regarding the adoption of educational interventions.

7. Conclusion

According to the study findings, it can be concluded that the implementation of educational interventions leads to a significant improvement in safety precaution practices among health workers regarding occupational exposures to hazards and blood infection, thereby contributing to the prevention of blood-borne pathogen infections.

8. Recommendation

According to the findings from this study, it is recommended that education training and intervention programs be provided for health workers regarding occupational hazards, especially on the protective measures against exposures to blood and body fluids. Also, the dissemination and development of policies and rules of safety practices among health workers is suggested, as well as the availability of psychological counseling and therapy for health workers is recommended.

9. Limitations

There are some limitations to this review that warrant consideration.

9.1. Limited number of included studies

A notable limitation is the small number of studies included in the final review. Only 7 out of 445 initially identified articles met the inclusion criteria. This limited pool of evidence restricts the generalizability of the findings across broader healthcare settings and populations. While the review aimed to maintain methodological rigor by focusing on quasi-experimental studies with clear pre- and post-intervention data on safety practices, such stringent criteria may have inadvertently excluded other relevant studies that could contribute meaningful insights, such as observational studies or mixed-methods research. Future systematic reviews may consider expanding the inclusion criteria to incorporate high-quality observational or cohort studies and interventions targeting a broader range of healthcare workers or safety practices. This would provide a more comprehensive understanding of the effectiveness and adaptability of educational interventions across diverse healthcare contexts.

9.2. Over-reliance on self-reported data

A significant limitation in the included studies is the widespread reliance on self-administered questionnaires to assess healthcare workers' practices. While this method is cost-effective and convenient for data collection, it is prone to response bias, particularly social desirability bias, where participants may overreport adherence to safety practices to align with perceived expectations. As a result, reported improvements in post-intervention safety behaviors may not accurately reflect actual changes in real-world practice. This overreliance on self-reporting limits the reliability of outcome measures and may overestimate the effectiveness of educational interventions. To strengthen the validity of future studies, it is strongly recommended that direct observational methods be employed—either alone or in combination with questionnaires. Checklist-based onsite assessments can provide a more accurate and objective evaluation of behavior change and adherence to standard precautions in clinical settings.

9.3. Study design limitations

Additionally, all the studies included in this review were quasi-experimental in design and lacked control groups, which presents a limitation in terms of internal validity. Without a control group, it becomes difficult to attribute observed improvements in safety practices solely to the educational interventions, as other confounding factors—such as concurrent policy changes, increased supervision, or broader institutional efforts—may have contributed to the outcomes. This limits the ability to draw causal inferences about the effectiveness of the interventions. While pre- and post-intervention comparisons offer valuable insights, they are more vulnerable to threats such as maturation effects, selection bias, and the Hawthorne effect. To strengthen the evidence base, future studies should consider incorporating randomized controlled trials (RCTs) or controlled before-and-after designs, which offer greater methodological rigor and improve confidence in the attribution of observed effects to the intervention itself.

9.4. Geographical limitations

Another important limitation of this review is the geographic concentration of the included studies. All seven studies were conducted in low- and middle-income countries (LMICs), specifically within Africa and Asia, with no representation from high-income countries (HICs). This regional focus may limit the applicability of findings to healthcare systems in more developed settings, where baseline infrastructure, resource availability, infection control protocols, and institutional culture may differ significantly. Educational interventions that prove effective in LMICs may require adaptation to be relevant or impactful in HICs, where safety practices and training protocols may already be more advanced or institutionalized. Therefore, caution should be exercised when extrapolating these findings to high-income healthcare systems, and future research should include studies across a wider range of geographic and economic contexts to enhance the generalizability of results.

Despite these limitations, this review provides valuable insights into effective strategies for enhancing healthcare workers' practices related to blood-borne infection exposure, ultimately promoting occupational safety and reducing the risk of infectious disease transmission. By highlighting the effectiveness of educational interventions and identifying gaps for future investigation, this review offers a foundation for guiding policy development and improving practices in occupational health and safety.

10. Source of Funding

None.

11. Conflict of Interest

None.

References

1. International Labour Organization. Joint United Nations Programme on HIV/AIDS. The joint WHO-ILO-UNAIDS policy guidelines on improving health workers' access to HIV and TB prevention, treatment, care and support services: a guidance note [Internet]. Geneva: International Labour Organization; 2011. Available from: https://www.ilo.org/publications/joint-who-ilo-unaids-policy-guidelines-improving-health-workers-access-hiv.
2. Wilburn SQ, Eijkemans G. Preventing needlestick injuries among healthcare workers: a WHO-ICN collaboration. *Int J Occup Environ Health*. 2004;10(4):451–6.
3. World Health Organization, WHO, World Health Organization. Occupational safety and health in public health emergencies: Ginebra, Suiza: World Health Organization. 2018.

4. Aluko OO, Adebayo AE, Adebisi TF, Ewegbemi MK, Abidoye AT, Popoola BF. Knowledge, attitudes and perceptions of occupational hazards and safety practices in Nigerian healthcare workers. *BMC Res Notes*. 2016;9:71.
5. Giardina M, Cantone MC, Tomarchio E, Veronese I. A review of healthcare failure mode and effects analysis (HFMEA) in radiotherapy. *Health Phys*. 2016;111(4):317–26.
6. Gorman T, Dropkin J, Kamen J, Nimbalkar S, Zuckerman N, Lowe T, et al. Controlling health hazards to hospital workers. *New Solut*. 2013;23(Suppl):1–167.
7. Auta A, Adewuyi EO, Tor-Anyiin A, Aziz D, Ogbole E, Ogbonna BO, et al. Health-care workers' occupational exposures to body fluids in 21 countries in Africa: systematic review and meta-analysis. *Bull World Health Organ*. 2017;95(12):831–41.
8. Tukur D, Aliyu A, Lawal A, Oyefabi AM. An epidemiological study of needlestick injury among healthcare workers in Ahmadu Bello University Teaching Hospital, Zaria, Nigeria. *West Afr J Med*. 2014;33(4):234–8
9. Nwankwo MC. Occupational health hazards and health outcomes among health workers, the determinants and compliance to safety standards in the health facilities in Kigali City, Rwanda [dissertation]. Kigali City, Rwanda: Jomo Kenyatta University of Agriculture and Technology; 2018. Available from: http://ir.jkuat.ac.ke/bitstream/handle/123456789/4891/Chinenye%2C%20Nwankwo%20Mercy%20%20PhD%2C%202018.CORRECTED.pdf?sequence=1&isAllowed=y
10. Yasin J, Fisseha R, Mekonnen F, Yirdaw K. Occupational exposure to blood and body fluids and associated factors among health care workers at the University of Gondar Hospital, Northwest Ethiopia. *Environ Health Prev Med*. 2019;24(1):18.
11. Maitanmi JO, Abdulkareem SO, Maitanmi BT, Ogungbesan JO, Onisile DF. Factors influencing standard precaution practices among nurses in Lagos State University Teaching Hospital, Ikeja, Lagos State, Nigeria. *Afr J Health Nurs Midwifery*. 2021;4(5):14–25.
12. Belachew YB, Lema TB, Germossa GN, Adinew YM. Blood/body fluid exposure and needle stick/sharp injury among nurses working in public hospitals; Southwest Ethiopia. *Front Public Health*. 2017;5:299.
13. Hosoglu S, Akalin S, Sunbul M, Otkun M, Ozturk R. Healthcare workers' compliance with universal precautions in Turkey. *Med Hypotheses*. 2011;77(6):1079–82.
14. Hanafi MI, Mohamed AM, Kassem MS, Shawki M. Needlestick injuries among health care workers of University of Alexandria Hospitals. *East Mediterr Health J*. 2011;17(1):26–35.
15. Nugmanova Z, Patel N, Nurbakhyt A, Akhmetova GM, Kovtunenko N, Trumova Z, et al. Universal precautions in Central Asia: the need for multiple strategies in this window of opportunity. *J Hosp Infect*. 2015;89(3):197–201.
16. Darawad MW, Al-Hussami M. Jordanian nursing students' knowledge of, attitudes towards, and compliance with infection control precautions. *Nurse Educ Today*. 2013;33(6):580–3.
17. Kuwabara T, Chayama K, Tanaka S, Oka S, Hiyama T, Yoshihara M. Compliance with standard precautions among gastrointestinal endoscopists and endoscopy nurses in Japan. *Am J Infect Control*. 2012;40(1):80.
18. Beyamo A, Dodicho T, Facha W. Compliance with standard precaution practices and associated factors among health care workers in Dawuro Zone, South West Ethiopia, cross sectional study. *BMC Health Serv Res.* 2019;19(1):381.
19. Hakim SA, Mohsen A, Bakr I. Knowledge, attitudes and practices of health-care personnel towards waste disposal management at Ain Shams University Hospitals, Cairo. *East Mediterr Health J*. 2014;20(5):347–54.
20. Powers D, Armellino D, Dolansky M, Fitzpatrick J. Factors influencing nurse compliance with Standard Precautions. *Am J Infect Control*. 2016;44(1):4–7.
21. Balkhy HH, El Beltagy KE, El-Saed A, Sallah M, Jagger J. Benchmarking of percutaneous injuries at a teaching tertiary care center in Saudi Arabia relative to United States hospitals participating in the Exposure Prevention Information Network. *Am J Infect Control*. 2011;39(7):560–5.
22. Alemie GA. Exploration of healthcare workers' perceptions on occupational risk of HIV transmission at the University of Gondar Hospital, Northwest Ethiopia. *BMC Res Notes*. 2012;5:704.
23. Guilbert JJ. The World Health Report 2006: working together for health. *Educ Health (Abingdon)*. 2006;19(3):385–7.
24. Gulifeiya A, Rahmah MA. Nurses awareness and attitude towards hiv/aids and universal precautions: a cross-sectional study in UKMMC. *J Community Health*. 2008;14(2):36–45.
25. Lam SC. Universal to standard precautions in disease prevention: preliminary development of compliance scale for clinical nursing. *Int J Nurs Stud*. 2011;48(12):1533–9.
26. Nagao Y, Baba H, Torii K, Nagao M, Hatakeyama K, Iinuma Y, et al. A long-term study of sharps injuries among health care workers in Japan. *Am J Infect Control*. 2007;35(6):407–11.
27. De Carli G, Abiteboul D, Puro V. The importance of implementing safe sharps practices in the laboratory setting in Europe. *Biochem Med (Zagreb)*. 2014;24(1):45–56.
28. NHS Professionals. POL6 NHS Professionals Infection Control Policy Clinical Governance V 5 May 2018 [Internet]. Watford: NHS Professionals; 2018. Available from: https://www.nhsprofessionals.nhs.uk/-/media/hosted-documents/pol6---infection-control-policy-v5-may-2018.pdf
29. Fayaz SH, Higuchi M, Hirosawa T, Sarker MAB, Djabbarova Z, Hamajima N. Knowledge and practice of universal precautions among health care workers in four national hospitals in Kabul, Afghanistan. *J Infect Dev Ctries*. 2014;8(4):535–42.
30. McDiarmid MA. Hazards of the health care sector: looking beyond infectious disease. *Ann Glob Health*. 2014;80(4):315–9.
31. Orme NM, Rihal CS, Gulati R, Holmes DR Jr, Lennon RJ, Lewis BR, et al. Occupational health hazards of working in the interventional laboratory: a multisite case control study of physicians and allied staff. *J Am Coll Cardiol*. 2015;65(8):820–6.
32. Vredenburgh AG. Organizational safety: which management practices are most effective in reducing employee injury rates? J Safety Res. 2002;33(2):259–76.
33. Tarsilla M. Cochrane Handbook for Systematic Reviews of Interventions. *J Multidiscip Eval.* 2010;6(14):142–8.
34. Tacconelli E. Systematic reviews: CRD's guidance for undertaking reviews in health care. *Lancet Infect Dis*. 2010;10(4):226.
35. Barker TH, Habibi N, Aromataris E, Stone JC, Leonardi-Bee J, Sears K, et al. The revised JBI critical appraisal tool for the assessment of risk of bias for quasi-experimental studies. *JBI Evid Synth*. 2024;22(3):378–88.
36. Genberg BL, Shangani S, Sabatino K, Rachlis B, Wachira J, Braitstein P, et al. Improving engagement in the HIV care cascade: a systematic review of interventions involving people living with HIV/AIDS as peers. *AIDS Behav*. 2016;20(10):2452–63.
37. Shangani S, Escudero D, Kirwa K, Harrison A, Marshall B, Operario D. Effectiveness of peer-led interventions to increase HIV testing among men who have sex with men: a systematic review and meta-analysis. *AIDS Care*. 2017;29(8):1003–13.
38. El-Leithy W, El-Tokhy M, Sheta H. Effect of health education program about blood borne pathogens (BBPs) transmission on primary health care workers in Ismailia City (an intervention study). *Egypt J Occup Med*. 2013;37(2):121–39.
39. Saleh DA, Elghorory LM, Shafik MR, Elsherbini EE. Improvement of knowledge, attitudes and practices of health care workers towards the transmission of blood-borne pathogens: an intervention study. *J Egypt Public Health Assoc*. 2009;84(5-6):423–41.
40. Mohamed RA, Nour-Eldein H. Effect of education intervention on prevention of bloodborne infections for health care workers in family medicine centers, Suez Canal University in Ismailia City, Egypt. *World Fam Med J/Middle East J Fam Med*. 2016;14(2):4–13.
41. Bassyouni RH, Wegdan AA, El-Sherbiny NA. The fundamental role of educational intervention on improving health care workers' knowledge, attitude and practice towards infection control precautions. *Int J Infect Control*. 2016;12(3):1–11.

42. Rayan HN, Adam SM, Abdrabou HM. Effect of training program regarding occupational health hazards on nurse interns' knowledge and practice. *Medico-legal Update*. 2021;21(2):614–6.
43. Enwere OO, Diwe KC. Knowledge, perception and practice of injection safety and healthcare waste management among teaching hospital staff in south east Nigeria: an intervention study. *Pan Afr Med J*. 2014;17:218.
44. Akamike IC, Okedo-Alex IN, Uneke CJ, Uro-Chukwu HC, Chukwu OE, Ugwu NI, et al. Evaluation of the effect of an educational intervention on knowledge and adherence to HIV guidelines among frontline health workers in Alex-Ekwueme Federal University Teaching Hospital Abakaliki, Nigeria. *Afr Health Sci*. 2020;20(3):1080–9.
45. Lin H, Wang X, Luo X, Zhen Qin. A management program for preventing occupational blood-borne infectious exposure among operating room nurses: an application of the PRECEDE-PROCEED model. *J Int Med Res*. 2020;48(1):300060519895670.
46. Suchitra JB, Devi NL. Impact of education on knowledge, attitudes and practices among various categories of health care workers on nosocomial infections. *Indian J Med Microbiol*. 2007;25(3):181–7.
47. Mehta A, Diwakar MK. Impact of educational intervention on knowledge, attitudes, and practices of laboratory technicians regarding universal work precautions at a tertiary health care center in Central India. *Appl Biosaf*. 2021;26(Suppl 1):S27–33.
48. Shrestha I. Impact of educational intervention on knowledge and practice of universal precautions among nurses. *J Patan Acad Health Sci*. 2015;1(1):57–60.
49. Labrague LJ, Rosales RA, Tizon MM. Knowledge and compliance of standard precautions among student nurses. *Int J Adv Nurs Stud*. 2012;1(2):84–97.
50. Kim KM, Kim MA, Chung YS, Kim NC. Knowledge and performance of the universal precautions by nursing and medical students in Korea. *Am J Infect Control*. 2001;29(5):295–300.
51. Chittaro M, Calligaris L, Farneti F, Faruzzo A, Panariti M, Brusaferro S. Healthcare workers' compliance with hand hygiene after the introduction of an alcohol-based handrub. *Int J Infect Control*. 2009;5(1):1–8.
52. Arcanjo RVG, Christovam BP, Souza NVD de O, Silvino ZR, da Costa TF. Knowledge and practices of nursing workers on occupational risks in primary health care: an intervention trial. *Enfermeria Global*. 2018;17(3).
53. Elbilgahy AA, Shereen AE, Magda AAEA. Occupational hazards and safety nursing guidelines for pediatric nurses in the health care setting. *J Health Med Nurs*. 2019;59:73–82.
54. Safdar N, Abad C. Educational interventions for prevention of healthcare-associated infection: a systematic review. *Crit Care Med*. 2008;36(3):933–40.

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