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EVALUATING EDUCATIONAL INTERVENTIONS FOR INFECTION PREVENTION IN MATERNITY CARE: A SYSTEMATIC REVIEW USING KIRKPATRICK'S MODEL

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Abstract

Background: Healthcare-associated infections (HAIs) remain a major patient safety concern in maternity care, where mothers and newborns are particularly vulnerable. While training of healthcare professionals is widely recognized as a key component of infection prevention and control (IPC), existing studies have predominantly focused on clinical outcomes, with limited attention to the pedagogical design and educational evaluation of training interventions. **Methods:**A systematic review was conducted in accordance with the PRISMA 2020 guidelines. PubMed, ScienceDirect, the Cochrane Library, and Google Scholar were searched for studies published between January 2000 and December 2024. Eligible studies evaluated educational or training interventions related to infection prevention in maternity or obstetric settings and reported educational outcomes. Data were extracted and synthesized using a narrative thematic approach. Educational outcomes were classified according to Kirkpatrick's four-level evaluation model. **Results:** Fourteen studies met the inclusion criteria. Training interventions employed a range of pedagogical approaches, including lectures, workshops, simulation-based education, and blended learning. Interactive and experiential methods were more frequently associated with positive learning and behavioral outcomes than didactic approaches alone. Only a subset of studies explicitly integrated educational or behavioral theories, such as Adult Learning Theory, Social Cognitive Theory, or the Health Belief Model. Most studies assessed outcomes at Kirkpatrick Level 2 (learning) and Level 3 (behavior), while learner reactions (Level 1) and long-term organizational or patient-level outcomes (Level 4) were infrequently evaluated. Considerable variability was observed in evaluation tools, with limited use of validated educational instruments. **Conclusion:** This review demonstrates that the effectiveness of infection prevention training in maternity care depends largely on pedagogical quality and evaluation strategies, rather than training exposure alone. Theory-informed, interactive educational interventions combined with structured evaluation frameworks are essential to enhance learning, promote sustainable behavior change, and support maternal and neonatal safety. Future research should prioritize standardized and longitudinal educational evaluation to strengthen evidence-based training in health professions education.

Keywords : Educational evaluation ;Healthcare-associated infections; Health professions education; Infection prevention training; Maternity care; Pedagogical methods.

Introduction

Healthcare-associated infections (HAIs) remain a major patient safety concern worldwide and are associated with increased morbidity, mortality, and healthcare costs, particularly in maternity settings where mothers and newborns are highly vulnerable populations. Infection prevention and control (IPC) relies not only on organizational measures and clinical protocols, but also on the effective training of healthcare professionals and their ability to translate knowledge into safe clinical practice [1,2]. Over the past two decades, educational interventions have been widely implemented to improve healthcare workers' adherence to IPC measures, including hand hygiene, aseptic

techniques, and appropriate use of personal protective equipment. While many studies report favorable clinical outcomes, such as reduced infection rates or improved compliance with hygiene protocols, fewer investigations critically examine *how* these training programs are designed, delivered, and pedagogically evaluated [3,4]. This gap is particularly evident in maternity and obstetric care, where training must address complex clinical environments, interprofessional teamwork, and time-sensitive decision-making.

Educational theory suggests that the effectiveness of professional training depends not only on content but also on pedagogical approaches, learning models, and assessment strategies. Adult learning theory emphasizes learner-centered approaches, experiential learning, and reflective practice, while behavior-oriented frameworks such as Social Cognitive Theory and the Health Belief Model highlight the importance of self-efficacy, perceived risk, and reinforcement mechanisms in promoting behavior change [5–7]. However, the extent to which these theoretical models are explicitly integrated into infection prevention training programs remains insufficiently synthesized.

Equally important is the evaluation of educational outcomes. In health professions education, training effectiveness is commonly assessed through indicators such as knowledge acquisition, skills performance, attitudes, behavioral change, and, less frequently, long-term practice transformation. Frameworks such as Kirkpatrick's model provide a structured approach to evaluating learning interventions across multiple levels, from learner satisfaction to behavioral change in clinical practice [8]. Nevertheless, previous research suggests that many educational interventions rely on short-term, non-validated assessment tools, limiting the robustness and comparability of findings across studies [9,10].

Recent reviews in health professions education have emphasized the need for systematic analyses focusing on pedagogical design and evaluation methods rather than solely on clinical or organizational outcomes [11–13]. In the field of infection prevention, most reviews prioritize epidemiological impact and public health effectiveness, with limited attention to educational processes and assessment instruments. This imbalance restricts the ability of educators and policymakers to identify best pedagogical practices and to design training programs grounded in sound educational evidence. In maternity care, where infection prevention training must be adapted to specific clinical risks and professional roles, understanding how educational interventions are evaluated is particularly critical. A systematic synthesis of pedagogical methods, educational models, evaluation tools, and learning indicators used in infection prevention training could contribute to improving the quality, rigor, and sustainability of educational programs for healthcare professionals. To date, few studies have systematically examined infection prevention training in maternity care from an educational evaluation perspective, using explicit pedagogical frameworks and validated learning indicators.

Therefore, the aim of this systematic review is to examine educational interventions for infection prevention in maternity settings, with a specific focus on pedagogical methods, educational models, assessment tools, and learning indicators used to evaluate training effectiveness among healthcare professionals. By shifting the emphasis from clinical outcomes to educational evaluation, this review seeks to inform future training design and contribute to the advancement of evidence-based health professions education.

Methods

Study design and reporting standards

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The methodological approach was explicitly oriented toward educational evaluation, with a focus on how infection prevention training interventions are designed, implemented, and assessed in maternity and obstetric care settings.

Kirkpatrick's four-level model of training evaluation was used as the conceptual framework to classify and interpret educational outcomes across studies, encompassing learner reaction, learning outcomes, behavioral change, and organizational or patient-level results.

Search strategy

A comprehensive literature search was conducted in PubMed, ScienceDirect, the Cochrane Library, and Google Scholar. The search covered studies published between January 2000 and December 2024. Search terms combined controlled vocabulary and free-text keywords related to healthcare-associated infections, maternity or obstetric care, education and training, pedagogical methods, educational models, evaluation tools, learning outcomes, and assessment frameworks. Boolean operators were used to refine the search strategy. The detailed search strategy applied to each database, including keywords and Boolean combinations, is presented in **Table 1**.

Table I: Summary of included studies

Study (Author, Year)	Country / Setting	Target population	Pedagogical methods	Educational model / theory	Evaluation tools	Learning indicators	Kirkpatrick level(s)
Mahdizadeh et al., 2021 [13]	Iran; Hospital	Nurses	Structured training sessions	Social Cognitive Theory	Theory-based questionnaire	Knowledge, self-efficacy, preventive behavior	Level 2; Level 3
Jeihooni et al., 2018 [14]	Iran; Hospital	Nurses	Educational program (interactive sessions)	Health Belief Model	HBM-based questionnaire	Knowledge, attitudes, preventive behaviors	Level 2; Level 3
Helder et al., 2010	Netherlands; NICU	Nurses	Multimodal education + feedback	Not specified	Observation, infection surveillance	Hand hygiene compliance, infection rates	Level 3; Level 4
Saffari et al., 2019	Iran; ICU	Nurses	Educational text messaging	Not specified	Pre/post KAP questionnaire	Knowledge, attitudes, practices	Level 2
Ziv et al., 2000 [17]	USA; Clinical training	Health professionals	Simulation-based education	Experiential learning (implicit)	Performance-based assessment	Skills acquisition, safety behaviors	Level 2; Level 3
Chaker et al., 2024 [18]	International; Online	Healthcare professionals	Online continuing education	Adult learning principles (implicit)	Review of evaluation methods	Knowledge, skills	Level 2
Borycki, 2015	International	Health professionals	Technology-enhanced training	Educational technology framework	Review of evaluation approaches	Learning outcomes	Level 2
Durduran et al., 2020	Turkey; University hospital	Caregivers, cleaning staff	Training sessions	Not specified	Knowledge test, observation	Knowledge, waste management practices	Level 2; Level 3
Wu et al., 2023	China; ICU	New medical staff	Standardized training system	Delphi-based educational design	Competency assessment	Skills, compliance	Level 2; Level 3
Malick & Fulbert, 2022	Côte d'Ivoire; Hospital	Healthcare workers	Hygiene training	Not specified	Questionnaire, observation	Knowledge, practices	Level 2; Level 3
d'Almeida et al., 2017	Benin; Neonatal unit	Nurses	Hand hygiene training	Not specified	Observation checklist	Hand hygiene compliance	Level 3
Uchan, 2010	France; Surgical setting	Healthcare staff	Educational guidelines	Not specified	Compliance assessment	Practice adherence	Level 3
Raza et al., 2009 [15]	International	Health professionals	Continuous medical education	CME framework	Review of educational outcomes	Knowledge, practice improvement	Level 2
Sánchez-Polo et al., 2019 [16]	International	Health professionals	Continuous learning strategies	Knowledge management model	Organizational learning indicators	Knowledge transfer, skills	Level 2

Eligibility criteria

Study eligibility was defined according to the PICOS framework, specifying the population, intervention, comparison, outcomes, and study design. Studies were eligible if they evaluated an educational or training intervention related to infection prevention or control and were conducted in maternity, obstetric, or maternal–neonatal care settings. Included studies were required to report educational evaluation outcomes, such as learner satisfaction, knowledge acquisition, skills development, attitudes, self-efficacy, or behavioral change in clinical practice.

Studies were also included if they employed explicit or implicit assessment tools that could be mapped to at least one level of Kirkpatrick's evaluation model. Only full-text articles published in English or French were included. Studies focusing exclusively on clinical outcomes without educational evaluation components, as well as editorials, narrative reviews, and opinion papers, were excluded. The detailed inclusion and exclusion criteria are summarized in **Table 2**.

Table II :PICOS inclusion/exclusion criteria

PICOS element	Inclusion criteria	Exclusion criteria
Population (P)	Healthcare professionals involved in maternity, obstetric, or maternal–neonatal care settings (including midwives, nurses, physicians, and multidisciplinary teams).	Studies involving students only, non-healthcare personnel, or healthcare workers outside maternity or obstetric contexts.
Intervention (I)	Educational or training interventions related to infection prevention and control (IPC), including continuing education programs, in-service training, simulation-based learning, blended or online education, and theory-based educational programs.	Interventions without an educational or training component, purely organizational or policy interventions, or clinical protocols implemented without associated training.
Comparison (C)	Pre-training versus post-training evaluations, comparison with usual practice, no training, or alternative educational approaches; studies without a formal comparison group were included if educational outcomes were reported.	Studies with no evaluative comparison or without any assessment of educational impact.
Outcomes (O)	Primary outcomes: educational outcomes such as knowledge acquisition, skills development, attitudes, self-efficacy, learner satisfaction, and behavioral change in clinical practice. Secondary outcomes: clinical indicators (e.g., compliance with hygiene measures or infection rates) when reported in relation to training interventions.	Studies reporting only clinical or epidemiological outcomes without any educational evaluation or learning-related indicators.
Study design (S)	Quantitative, qualitative, or mixed-methods studies evaluating educational interventions, including quasi-experimental studies, before–after designs, cross-sectional evaluations, Delphi-based educational designs, and systematic or scoping reviews with a strong educational evaluation component.	Editorials, opinion papers, narrative reviews without evaluation, case reports, and studies lacking sufficient methodological detail.

Study selection process

All identified records were screened following a two-step selection process. First, titles and abstracts were screened to remove duplicates and clearly irrelevant studies. Second, full-text articles were assessed for eligibility based on the predefined inclusion and exclusion criteria.

The overall study selection process and reasons for exclusion at each stage are illustrated in Figure 1, in accordance with PRISMA 2020 recommendations.

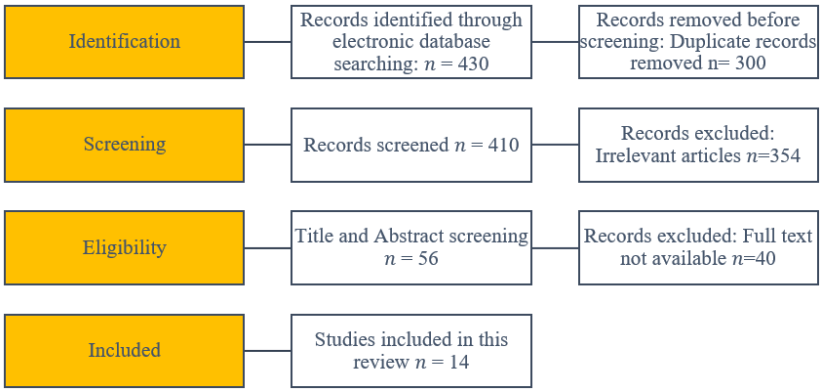

Figure 1 : PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.

Data extraction

Data were extracted using a standardized form designed for educational evaluation analysis. Extracted variables included publication details, study design, clinical setting, participant characteristics, and description of the training intervention. Particular attention was given to pedagogical methods, educational models or theoretical frameworks, evaluation tools, and learning indicators. Educational outcomes were classified according to the corresponding levels of Kirkpatrick's model.

Data items

The primary outcomes of interest were educational outcomes, including knowledge acquisition, skills development, attitudes, self-efficacy, and behavioral change. Clinical indicators, such as compliance with hygiene measures or healthcare-associated infection rates, were considered

secondary outcomes when reported in direct relation to training interventions.

Risk of bias assessment

Given the heterogeneity of study designs and evaluation methods, no formal quantitative risk-of-bias tool was applied. Methodological quality was assessed qualitatively based on predefined criteria, including clarity of study objectives, description of the educational intervention, appropriateness of evaluation tools, and internal consistency of reported outcomes. Studies with insufficient methodological detail were excluded during the selection process.

Results

Study selection and general characteristics

The systematic search identified 430 records through database searching and manual screening. After removal of duplicates and title and abstract screening, 56 full-text articles were assessed for eligibility. Following application of the predefined inclusion criteria, 14 studies were included in the final qualitative synthesis **(Figure1)**.
The included studies were published between 2000 and 2024 and originated from low-, middle-, and high-income countries, reflecting diverse healthcare and educational contexts. Study designs included quasi-experimental studies, before–after interventions, cross-sectional evaluations, Delphi-based educational designs, and reviews with a strong educational focus. Most studies targeted nurses, midwives, or multidisciplinary healthcare teams working in maternity, neonatal, or obstetric care settings. The main characteristics of the included studies are summarized in **Table III** .

Table III. Summary of included studies evaluating educational interventions for infection prevention

Author (Year)	Country	Population	Method (Design)	Data Collection	Data Analysis	Key Findings
Mahdizadeh et al. (2021)	Iran	Nurses	Quasi-experimental study	Social Cognitive Theory–based questionnaire (pre/post)	Pre–post comparative analysis	Significant improvement in knowledge, self-efficacy, and preventive behaviors
Jeihooni et al. (2018)	Iran	Nurses	Before–after study	Health Belief Model–based questionnaire	Comparative statistical analysis	Improvement in knowledge, attitudes, and preventive behaviors
Helder et al. (2010)		Nurses (NICU)	Before–after intervention	Observational audit and infection surveillance	Descriptive and comparative analysis	Improved hand hygiene compliance and reduced infection rates
Saffari et al. (2019)	Iran	Nurses (ICU)	Quasi-experimental study	Pre/post KAP questionnaire (educational text messages)	Comparative analysis	Increased knowledge and improved practices
Ziv et al. (2000)	United States	Healthcare professionals	Educational intervention	Simulation-based performance assessment	Descriptive analysis	Improved clinical skills and safety behaviors
Chaker et al. (2024)	International	Healthcare professionals	Systematic review (online education)	Analysis of included studies	Narrative synthesis	Online training improves knowledge and skills
Borycki (2015)	International	Healthcare professionals	Narrative review	Analysis of educational evaluation tools	Qualitative analysis	Educational technologies enhance learning outcomes
Durduran et al. (2020)	Turkey	Hospital staff	Before–after study	Knowledge tests and observational assessment	Comparative analysis	Improved waste management practices
Wu et al. (2023)	China	Newly recruited healthcare staff	Delphi-based study with intervention	Competency assessment	Comparative analysis	Improved competencies and guideline compliance
Malick & Fulbert (2022)	Côte d'Ivoire	Healthcare professionals	Before–after study	Questionnaire and observation	Descriptive analysis	Improved hygiene practices

Author (Year)	Country	Population	Method (Design)	Data Collection	Data Analysis	Key Findings
d'Almeida et al. (2017)	Benin	Nurses (neonatal unit)	Educational intervention	Observational checklist	Descriptive analysis	Increased hand hygiene compliance
Uchan (2010)	France	Healthcare staff	Observational study	Compliance audit	Descriptive analysis	Improved adherence to recommendations
Raza et al. (2009)	International	Healthcare professionals	Narrative review (CME)	Analysis of continuing medical education programs	Narrative synthesis	Continuing medical education improves knowledge and practice
Sánchez-Polo et al. (2019)	International	Healthcare professionals	Organizational study	Educational performance indicators	Qualitative analysis	Continuous learning facilitates knowledge transfer

Pedagogical methods

As shown in Table IV, a variety of pedagogical methods was reported across the included studies. Traditional didactic lectures were frequently combined with interactive approaches such as workshops, case-based discussions, simulation-based training, and blended learning modalities. Simulation-based education was particularly prominent in high-risk clinical environments, including maternity and neonatal intensive care units, where experiential learning was used to enhance procedural skills and decision-making.

Educational models and theoretical frameworks

Only a subset of the 14 studies explicitly reported the use of educational or behavioral theories (**Table IV**. Adult learning theory, Social Cognitive Theory, and the Health Belief Model were the most frequently cited frameworks. These models were used to structure training content and target determinants of behavioral change, such as self-efficacy and risk perception. Several studies implicitly applied educational principles without explicitly referencing a theoretical framework, limiting reproducibility.

Evaluation tools and learning indicators

As detailed in **Table IV**, evaluation tools varied considerably across studies. Common methods included pre- and post-training knowledge tests, self-administered questionnaires assessing attitudes and perceptions, observational audits of clinical practices, and compliance monitoring using standardized checklists. Only a minority of studies reported the use of validated educational instruments. Learning indicators most frequently assessed were knowledge acquisition, attitudes, and short-term behavioral change.

Classification according to Kirkpatrick's model

When classified using Kirkpatrick's framework, most studies reported Level 2 (learning) and Level 3 (behavior) outcomes. Level 1 outcomes (learner reaction) were inconsistently assessed, while Level 4 outcomes (organizational or patient-level impact) were reported in a limited number of studies and were generally secondary to educational objectives.

Discussion

This systematic review aimed to examine how educational approaches used in healthcare worker training are evaluated and how they influence learning and professional practice in the prevention of healthcare-associated infections in maternity settings. The findings demonstrate that training interventions are widely implemented, yet their pedagogical evaluation remains heterogeneous and often incomplete, particularly in low- and middle-income countries.

Overall, the included studies confirm that training effectiveness is strongly associated with the pedagogical methods employed. Interventions relying solely on didactic lectures showed limited impact on sustained behavioral change, whereas interactive and experiential approaches, such as simulation-based learning and skills-based workshops, were consistently associated with better learning outcomes. These findings are consistent with adult learning theory, which emphasizes active participation, contextual relevance, and experiential learning as key drivers of knowledge retention and skill transfer [5,17].

The use of educational and behavioral models emerged as a major strength in several studies. Training programs grounded in Social Cognitive Theory and the Health Belief Model demonstrated clearer alignment between learning objectives, teaching strategies, and evaluation tools. These models facilitated improvements in self-efficacy, risk perception, and motivation, which are essential precursors to behavioral change in clinical practice [6,7,13,14]. However, nearly one-third of the

included studies did not explicitly reference any educational framework, limiting the interpretability and reproducibility of their findings from a pedagogical standpoint.

From an evaluation perspective, most studies focused on learning and behavioral outcomes, corresponding to Levels 2 and 3 of Kirkpatrick's model. Improvements in knowledge, attitudes, and skills were commonly measured using questionnaires and self-reported instruments, while behavioral changes were assessed through observational audits or compliance checklists. Although these approaches provide valuable insights into training effectiveness, they also highlight a methodological gap in the evaluation of training reactions (Level 1) and long-term organizational impact (Level 4).

Only a limited number of studies attempted to link educational interventions to institutional indicators such as infection rates or compliance metrics. While these outcomes are often considered the ultimate goal of infection prevention programs, they were rarely evaluated using robust educational evaluation designs. This finding underscores the need to distinguish clearly between clinical outcomes and educational outcomes, and to adopt evaluation strategies that adequately capture both dimensions.

Another important finding relates to the limited standardization of evaluation tools. Although several studies used validated instruments, such as Knowledge–Attitudes–Practices questionnaires or theory-based scales, others relied on ad hoc or non-validated measures. This variability reduces comparability across studies and hampers the synthesis of evidence regarding educational effectiveness. The adoption of standardized, validated educational assessment tools would strengthen future research and support benchmarking across institutions.

Contextual constraints also play a significant role in shaping training effectiveness. Studies conducted in resource-limited settings highlighted challenges such as staff shortages, high workload, and limited access to equipment, all of which can undermine both training delivery and evaluation. In such contexts, simulation-based education and blended learning approaches appear particularly relevant, as they allow skills acquisition without compromising patient safety and can be adapted to local constraints [17,18].

Despite its contributions, this review has several limitations. The heterogeneity of study designs, training content, and evaluation methods limits direct comparison and precludes meta-analysis. In addition, the relatively small number of studies explicitly focused on educational evaluation in maternity settings restricts the generalizability of findings. Publication bias and restricted access to some full texts may also have influenced the completeness of the evidence base.

Nevertheless, this review provides important insights into how training interventions in infection prevention are designed and evaluated from a pedagogical perspective. It highlights the urgent need for theory-informed educational design, standardized evaluation frameworks, and longitudinal assessment strategies to better understand how learning translates into sustained professional practice.

Conclusion

This systematic review highlights the central role of pedagogically structured training programs in strengthening infection prevention practices in maternity care. Beyond their clinical objectives, educational interventions that are grounded in explicit learning theories, rely on active and experiential teaching methods, and incorporate robust evaluation tools demonstrate greater effectiveness in improving healthcare workers' knowledge, skills, and professional behaviors.

The findings indicate that most existing studies assess training impact at the levels of learning and behavior, while fewer address learners' reactions or long-term organizational outcomes. This imbalance underscores the need for comprehensive educational evaluation frameworks, such as Kirkpatrick's model, to guide the design, implementation, and assessment of training interventions in infection prevention.

To enhance the educational value and sustainability of infection prevention programs in maternity settings, future initiatives should prioritize theory-informed instructional design, standardized and validated assessment instruments, and longitudinal evaluation strategies. In resource-limited contexts, simulation-based and blended learning approaches offer promising, adaptable solutions for improving learning outcomes without compromising patient safety. Overall, this review supports the integration of education-focused evaluation strategies into infection prevention training as a critical lever for improving professional practice, strengthening institutional learning cultures, and ultimately enhancing the quality and safety of maternal and neonatal care.

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