

## Systematic review

Education interventions and emergency nurses' clinical practice behaviours: A scoping review<sup>☆</sup>Julie Considine<sup>a,b,c,\*</sup>, Ramon Z. Shaban<sup>d,e,f</sup>, Margaret Fry<sup>g,h</sup>, Kate Curtis<sup>d,i</sup><sup>a</sup> School of Nursing and Midwifery, Deakin University, Geelong, Victoria, Australia<sup>b</sup> Centre for Quality and Patient Safety Research in the Institute for Health Transformation, Deakin University, Geelong, Victoria, Australia<sup>c</sup> Centre for Quality and Patient Safety Research – Eastern Health Partnership, Box Hill, Victoria, Australia<sup>d</sup> Susan Wakil School of Nursing and Midwifery, The University of Sydney, Camperdown, New South Wales, Australia<sup>e</sup> Sydney Institute for Infectious Diseases and Biosecurity, Faculty of Medicine and Health, The University of Sydney, Camperdown, New South Wales, Australia<sup>f</sup> Centre for Population Health and New South Wales Biocontainment Centre, Western Sydney Local Health District, Westmead, New South Wales, Australia<sup>g</sup> Faculty of Health, University of Technology Sydney, New South Wales, Australia<sup>h</sup> Northern Sydney Local Health District, St Leonards, New South Wales, Australia<sup>i</sup> Illawarra Shoalhaven Local Health District, Wollongong, New South Wales, Australia

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## ABSTRACT

**Background:** Many education interventions in emergency nursing are aimed at changing nurse behaviours. This scoping review describes and synthesises the published research education interventions and emergency nurses' clinical practice behaviours.

**Methods:** Arksey and O'Malley's methodological framework guided this review, which is reported according to Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR). CINAHL, MEDLINE complete, ERIC, and Psycinfo were searched on 3 August 2023. Two pairs of researchers independently conducted all screening. Synthesis was guided by the Behaviour Change Wheel and Bloom's Taxonomy of Educational Objectives.

**Results:** Twenty-five studies were included. Educational interventions had largely positive effects on emergency nurses' clinical practice behaviours. Ten different interventions were identified, the most common was education sessions (n = 24). Seven studies reported underpinning theoretical frameworks. Of the essential elements of behaviour change, seven interventions addressed capability, four addressed motivation and one addressed opportunity. Mapping against Bloom's taxonomy, thirteen studies addressed analysis, eleven studies addressed synthesis and two studies addressed evaluation.

**Conclusion:** Few studies addressed elements of behaviour change theory or targeted cognitive domains. Future studies should focus on controlled designs, and more rigorous reporting of the education intervention(s) tested, and theoretical underpinning for intervention(s) selected.

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## Introduction

Many practice changes in emergency nursing are implemented using education interventions aimed at improving patient care by changing nurse behaviours [1–3]. However, effecting sustained behaviour change in a complex and dynamic environment such as the emergency department (ED) is particularly challenging [4]. The challenging nature of emergency nursing practice reinforces the importance of basing education interventions on robust, evidence-

based theoretical frameworks related to pedagogical approach, implementation science, and behaviour change.

Emergency nurses are responsible for the initial and ongoing assessment, management and safety of patients of all ages with varying degrees of severity and urgency of illness or injury in a complex and unpredictable environment [5]. Over recent decades, there have been significant evidence-based practice changes in emergency nursing aimed at optimising patient outcomes, promoting comfort, and expediting care. Examples of such changes

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include judicious use of supplemental oxygen and avoidance of hyperoxia in patients with acute coronary syndrome or stroke [6,7], increased focus on prevention, recognition and management of delirium in ED patients [8], and nurse initiated interventions such as medications, pathology testing and imaging [9–12].

Evidence-based practice optimises patient outcomes and use of healthcare resources, and protects patients from unnecessary or harmful interventions [13]. However, it is estimated that it takes, on average, 17 years to implement research evidence into practice [14] and the traditional approach of relying on education to change clinicians' behaviour has been called into question [13]. The published research related to the effect of education interventions on emergency nurses' clinical practice behaviours has not been systematically assessed, thus a comprehensive understanding of educational interventions used in emergency nursing is required.

### Objective

The aim of this scoping review was to describe and synthesise the extent, range and nature of published research related to the effect of education interventions on emergency nurses' clinical practice behaviours. Of specific interest were the number and types of education interventions; effect on clinical practice behaviours; and elements of behaviour change and targeted cognitive domains used or reported.

### Methods

#### Design

This scoping review was guided by Arksey and O'Malley's methodological framework [15] and reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) [16].

#### Eligibility criteria

The population of interest were emergency nurses, the concepts of interest were education interventions and clinical practice behaviours, and the context was the emergency department (Table 1). Studies were included if they detailed education interventions delivered to emergency nurses, reported an outcome of clinical practice behaviours, and had a comparison group. Definitions of key terms related to this scoping review are shown in Table 1. All study types were included (including pre-post (or before and after) studies, controlled cohort, randomised controlled trials). Studies published in languages other than English were excluded as were editorials, letters, commentaries, opinion papers, case studies and case reports.

#### Information sources and search

The following databases were searched on 3 August 2023: Cumulative Index of Nursing and Allied Health literature (CINAHL), MEDLINE complete, Education Resources Information Center (ERIC) and Psycinfo. All databases were searched from their inception with no date limiters but a language limiter of English. The full search strategy is available in Appendix 1.

#### Selection of sources of evidence

Citations were uploaded into EndNote 20.0™ and duplicates removed. Title and abstract screening and full text screening were conducted by two pairs of researchers (JC and RZS, MF and KC) using

the Rayyan [17] software program. Disagreements were resolved by discussion and consensus.

#### Data charting

Data were charted by a single author (JC) and ratified by all co-authors. The characteristics of each study charted included the author(s), year of publication, country, aim, study design, underpinning theoretical framework, population, education intervention, area of focus, clinical practice behaviours examined, data collection methods and main findings. Allocation of the Behaviour Change Wheel [18,19] components and Bloom's Taxonomy [20] cognitive domains was achieved using the definitions in Table 2 and team consensus.

#### Synthesis

The Behaviour Change Wheel [18,19] and Bloom's Taxonomy [20] of educational objectives were the underpinning theoretical frameworks for synthesis of results given that behaviour change using education was the focus of this scoping review. The Behaviour Change Wheel represents three essential conditions for behaviour change: capability, opportunity, and motivation (COM-B). [18,19] 'Capability' includes physical (physically able to perform the behaviour) and physiological (knowledge and understanding) capability; 'opportunity' includes physical (environment, time and resources) and social (interpersonal skills, social norms) opportunity; and 'motivation' includes reflective (self-conscious intentions and beliefs) and automatic (emotional wants and needs) motivation [18]. The Behaviour Change Wheel details nine intervention functions (education, persuasion, incentivisation, coercion, training, restriction, enablement, environmental restructuring, modelling and enablement) that leverage personal agency and external influences to optimise COM-B (Table 2). There are also seven policy categories that enable the intervention functions [18,19] and 93 behaviour change techniques defined as "an active component of an intervention designed to change behaviour" [18]. The Behaviour Change Wheel [18,19] thus provides a comprehensive and theory-informed framework by which to examine the specific elements of behaviour targeted in the included studies.

Bloom's Taxonomy of educational objectives defines six major cognitive domains: knowledge, comprehension, application, analysis, synthesis, and evaluation. These domains progress from simple lower order thinking with low level uncertainty to complex higher order thinking with higher levels of uncertainty (Table 2) [20]. Emergency nurses typically follow a trajectory of clinical progression during which the acuity and complexity of the patients for whom they care increases [21]. Requisite to this clinical progression, is increasing complexity of knowledge, skills, and decision-making [21]. Most educational interventions are aimed at increasing knowledge or skills to effect change in emergency nurses' clinical practice behaviours, so Bloom's Taxonomy of educational objectives [20] provides a method by which to objectively categorise the intended learning outcomes of included studies.

### Results

After removal of duplicates, our search returned 3724 publications and three additional publications were identified through hand searching. In total, 74 full text publications were screened for eligibility, of which 25 were included (Fig. 1).

#### Characteristics of sources of evidence

The characteristics of included studies are summarised in Table 3 (refer to Supplementary Table 1 for detailed data charting). Twelve

studies were from United States of America, [22–33] seven from Australia, [34–40] three from Canada, [41–43] two from Iran [44,45] and one from Switzerland [46]. Studies were published between 1996 [29,30] and 2021 [25,33,35,36,39].

Major topic areas studied were: i) pain assessment and management including procedural pain relief (n = 8) [22–24,34,37,41,44,46]; ii) infection prevention and control, sepsis and antibiotic administration (n = 6) [25–29,45]; iii) patient assessment and documentation (n = 4) [30,35,38,39]; iv) triage (n = 4) [31,40,42,43]; v) risk screening (n = 2) [33,36]; and vi) medication safety (n = 1). [32].

There was one multisite cluster randomised controlled trial [38] and one randomised study [42]. The remaining 23 studies used pre-post test designs [22–37,39–41,43–46]. The maximum time between pre and post-test was variable: 2 weeks [29,32], 1 month [30,31,43], 2 months [26,44,46], 4 months [28], 6 months [22,37,40,41,45], 12 months [23–25,33] and 2 years [27,35,36,47]. In one study, the pre-post test interval was not reported [34]. Only two studies reported collecting data at two post-test time points: in both studies the maximum post-test interval was 6 months [41,45].

*Results of individual sources of evidence*

The effect of educational interventions on emergency nurses' clinical practice behaviours was variable, but largely positive (Table 3 and Supplementary Table 1). Thirteen studies reported statistically significant improvements in clinical practice behaviours [24,26,28,32,35,39–44,46], seven studies reported clinically important practice improvements that were not statistically significant, [29,37] and four studies reported practice improvements but did not test for statistical significance [22,24,25,27]. Four studies reported mixed results with statistically significant [36] or clinically important improvements in some elements and regression or no change in others [30,34,38]. In one study, there was no change [45] and in one study the effect on clinical practice behaviours could not be determined [31]. No study reported an overall negative effect. The number of interventions per study ranged from one [24,27,34,41,44] to eight [35,39] (Table 4 and Supplementary Table 2), the most common of which were education sessions (n = 24), [22–28,30–46] followed by posters (n = 8) [22,29,35–39,46] and reference cards (n = 6). [30,35,37–39,46].

In the studies reporting education session format, four reported face-to-face workshops or interactive sessions, [35,39,44,45] eight reported face-to-face didactic sessions, [26,30,31,37,38,40,43,46] three reported using simulation [31,32,34] and one reported educating nurses during meetings & huddles [22]. Four studies reported using online tutorials, [42] reference materials, [26] or video presentations. [30,38] The education session duration ranged from 30

[37,38,41] to 90 min, [44] three [43] to four hours, [30,31,40] or a half-day. [35,39] Duration of education was not reported in six studies [22,24,26,42,45,46] and eight studies did not report the duration or format of education sessions [25,27,29,32,33,36]. In six studies, the education sessions were tailored to the findings of needs analyses and, or site-specific barriers [22,35,38–41].

The majority of studies (n = 21) collected data using record audit [22–28,30,31,34–43,46,48]. In four studies data were collected via observations of practice: in three studies observations occurred in the ED [29,44,45] and the fourth study occurred in a simulation laboratory [32].

*Synthesis of results*

Underpinning theoretical frameworks were reported in seven studies. One study reported using the following methodological frameworks: Standards for QQuality Improvement Reporting Excellence (SQUIRE), REporting of studies Conducted using Observational Routinely collected health Data (RECORD), and Template for Intervention Description and Replication (TIDieR) guidelines [25]. Five studies reported using behaviour change frameworks: transtheoretical model of five stages of behaviour change [45], behaviour change wheel, [35,39] and Theoretical Domains Framework [36,38]. One study reported using a pedagogical education framework, the Jeffries Simulation Model [34] and one study reported using Benner's Novice to Expert skills acquisition framework [31].

Two studies reported using quality improvement frameworks: one used the Institute for Healthcare Improvement's QI improvement model [27] and the other did not report the specific framework used [33]. In three studies, interventions were evaluated using APEASE criteria (Acceptability, Practicability, Effectiveness, Affordability, Side-effects, and Equity) [35,39] or the PRECEDE-PROCEED model (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation- Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development) [30]. Seven studies used clinical practice guidelines: World Health Organisation Pain steps, [46] Emergency Nurses' Association Core Curriculum, [24] American College of Emergency Physicians Detect, Act, Reassess, Titrate (DART) tool, [26] Medicaid Sepsis Core Measure, [28] Center for Disease Control guidelines, [29] Canadian Triage Acuity Scale (CTAS) mental health guidelines, [43] Mental Health Triage Scale [40] and National Triage Scale [40].

There was no obvious relationships between the number and type of intervention(s) used and statistically significant improvements in clinical practice behaviours. The two studies with eight interventions both reported statistically significant results. [35,39] In the five studies with single interventions, three reported statistically

**Table 1**  
Population, Concept and Context with inclusion and exclusion criteria.

Population	Inclusion	Exclusion
Emergency nurse	Nurses (as defined by jurisdictional regulatory authority) working in an emergency department. Includes but is not limited to nurse practitioners, registered nurses (including various classifications such as clinical nurse specialist, advanced practice nurse) and second level nurses (such as licenced practical nurses, practical nurses, enrolled nurses)	Studies of non-nurses including but not limited to health care assistants, patient care attendants, physician assistants, emergency medical technicians
Concepts	Inclusion	Exclusion
Education interventions	Organised educational activities including, but not limited, to lectures, seminars, in-service education, clinical support, clinical assessments, workshops, learning packages, simulation, feedback and debriefing	Undertaking or completing a postgraduate course or qualification was not in itself defined as an educational intervention, however studies detailing specific educational interventions delivered as part of postgraduate courses were considered.
Clinical practice behaviours	Observable objective measure(s) of emergency nurses' behaviours in clinical practice	Studies reporting subjective measures of nurses' clinical practice behaviours (such as self-reported performance)
Context	Inclusion	Exclusion
Emergency department	24-hour a day, 7-day per week nursing and medical staffing	Studies of short stay units and observation wards (even if co-located in the emergency department)

**Table 2**  
Definitions of Behaviour Change Wheel intervention functions and Bloom's Taxonomy cognitive domains.

<b>Behaviour Change Wheel Intervention Functions</b> [18,19]		
	<b>Definition</b>	<b>Example</b>
Education	Increasing knowledge or understanding.	Providing information about pain assessment and management.
Persuasion	Using communication to induce positive behaviour or negative feelings to stimulate action.	Using patient stories to motivate pain assessment and administration of analgesics.
Incentivisation	Creating an expectation of a reward.	Praise associated complete pain assessment documentation or timely analgesia administration.
Coercion	Creating expectation of punishment or cost.	Monitoring: if staff member doesn't follow protocol, will need to explain why to nurse manager.
Training	Imparting skills.	Training in preparation and administration of analgesics.
Restriction	Using rules to reduce opportunity for negative behaviour.	Nurses can only initiate specific types of analgesic agents.
Environmental restructuring	Changing physical or social context.	Ensuring pain assessment tools are easily accessible.
Modelling	Providing an example for people to aspire to or imitate.	Use of clinical champions.
Enablement	Increasing means or reducing barriers to capability.	Swipe card access to medication rooms.
<b>Cognitive domain (Bloom's Taxonomy)</b> [20]		
	<b>Definition</b>	<b>Example</b>
Knowledge	Recognising, remembering and recalling facts	Name the dose of a medication
Comprehension	Attaching meaning to knowledge. Incorporation of knowledge into practice.	Explain pain rating scale to a patient. Explain medication side effects to a colleague.
Application	Use of knowledge, skills, or techniques in new situations.	Perform and document patient assessment.
Analysis	Problem solving, application of knowledge into practice	Distinguish between analgesic agents suitable for a specific condition.
Synthesis	Critical thinking, distinguishing between facts. Analysis of situations, organisation of ideas	Develop a care plan. Anticipate need for pre-procedure pain relief.
Evaluation	Design, innovation and planning. Predicting and anticipating.	Anticipate side effects of specific medications.
	Critical appraisal of validity of information, judging relevance to specific patient or clinical situation. Evaluation of outcomes.	Evaluate patient's response to medications or therapy. Evaluate which cause of pain is most likely.

significant improvements [34,41,44], two reported clinically important improvements [24,27].

Of the twenty-four studies that used education sessions, fourteen reported statistically significant improvements, [23,26,28,32–35, 39–44,46] six had clinically important improvements, [22,24,25,27,37,45] three had mixed results [30,36,38] and in one study the effect was unable to be determined. [31] In the six studies where education was tailored to needs analyses or barriers assessment, four reported statistically significant improvements [35,39–41], one reported clinically important improvements [22] and one reported mixed findings [38].

Five studies used behaviour change frameworks: the two that used the Behaviour Change Wheel reported statistically significant improvements, [35,39] the two that used Theoretical Domains Framework had statistically significant but mixed results, [36,38] and the one study that used a transtheoretical model of five stages of behaviour change did not test statistical significance [45]. Of the four studies that used observations of clinical practice to collect the study data, two reported statistically significant improvement using education only [44] or education combined with simulation, [32] one reported non-significant improvements using posters and guideline distribution [29] and one reported improvements but did not test statistical significance using education and small group discussions [45].

In Table 4, a summary of educational interventions mapped against core components of the Behaviour Change Wheel (COM-B, Behaviour Change Intervention Functions, & Behaviour Change Techniques) [18,19] and cognitive domains of Bloom's Taxonomy of educational objectives [20,49] is presented in Table 4: detailed mapping is presented in Supplementary Table 2. When mapped against COM-B, [18,19] seven of the ten interventions addressed capability (education sessions, posters, reference cards, champions, clinical support, online materials and training manuals). Motivation was addressed in four interventions (champions, discussions, reminders and online materials), and only one intervention (policy or

guideline dissemination) focused on opportunity. When mapped against Behaviour Change Intervention Functions [18] four interventions were related to environmental restructuring (posters, reference cards, policy or guideline distribution, reminders), and three were each related to education or training (education sessions, discussions, online materials, training manuals), persuasion (clinical champions, discussions, clinical support) or enablement (discussions, policy or guideline distribution, clinical support). Modelling (clinical champions) and incentivisation (clinical champions) were each addressed by one intervention.

\*\* Table 4. Summary of educational interventions against core components of the Behaviour Change wheel and Cognitive Domains of Bloom's Taxonomy.

When mapping against Bloom's Taxonomy of educational objectives (Table 4 and Supplementary Table 2) [20,49] all 25 studies addressed knowledge, comprehension and application. Thirteen studies addressed analysis, [23,31,32,34,37–45] eleven studies addressed synthesis, [23,31,32,34,35,37,38,40,42,43,45] and two studies addressed evaluation [23,45].

## Discussion

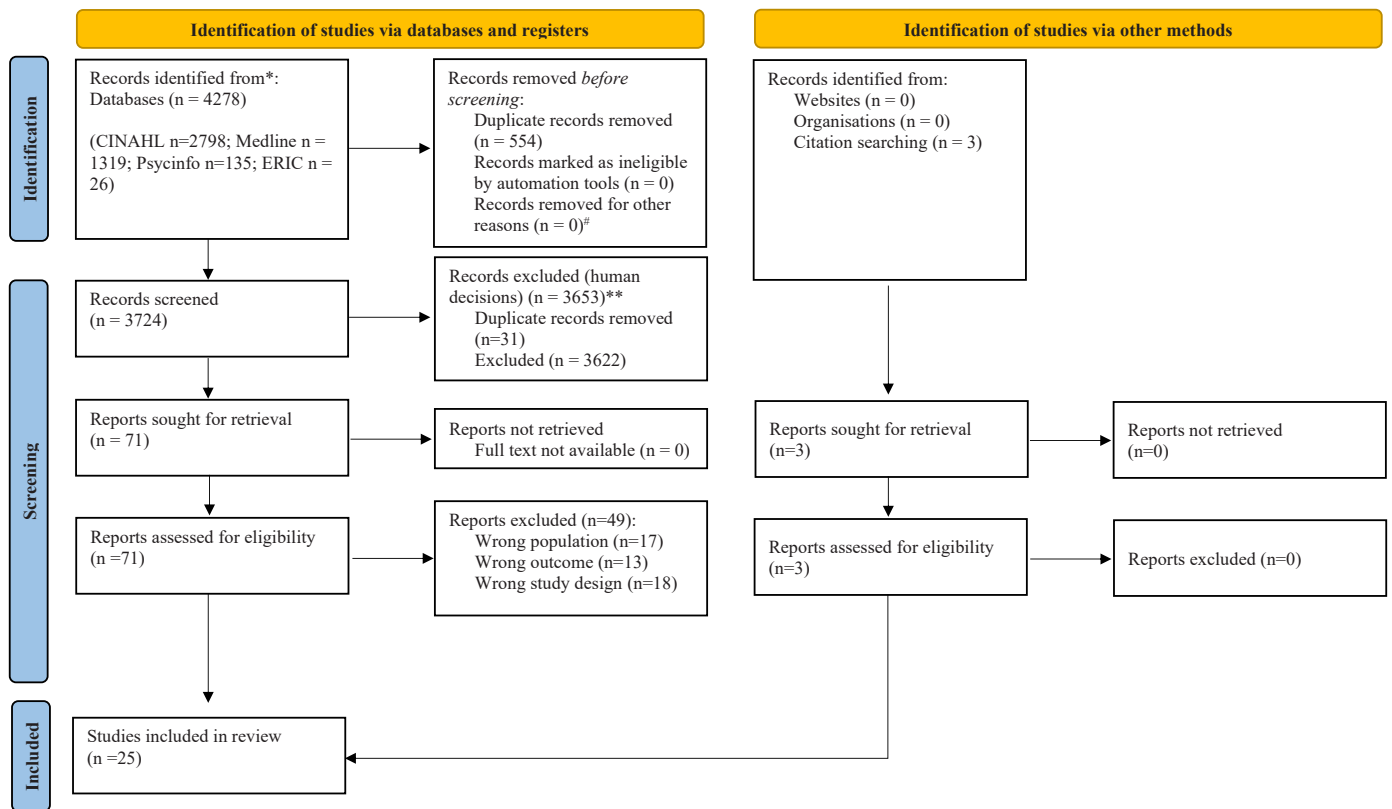
### Summary of evidence

This scoping review had four major findings: i) most studies used pre-post designs and collected data by record audit; ii) the purpose, number, and types of education interventions was variable; iii) the majority of studies reported improvements in clinical practice; and iv) there was variability in addressing the essential elements of behaviour change and targeted cognitive domains, which will be discussed in the following sections.

### Study design

Most studies (n = 23) used pre-post designs and relied on data derived from documentation (n = 20). Whilst randomised controlled





**Fig. 1.** PRISMA Flow Diagram \*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers)\*\*If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>.

trials are often cited as the most robust way to test an intervention, orchestrating a well-designed randomised controlled trial in an ED at the nurse level presents significant methodological, ethical, and logistical challenges. It would be difficult to prevent contamination given the close proximity in which emergency nurses work and the team-based models of care in EDs. Further, once there is evidence of harm it is unethical to continue that practice behaviour in the interests of a trial. A cluster randomised controlled trial is possible with the ED as the unit of randomisation but these trials are difficult to conduct, expensive and based on an assumption that emergency care practice is homogenous. Pre-post test studies rely on EDs being their own control which is a practical approach, however it is challenging to adjust for confounders that may occur over time and that may (e.g. seasonal variation) or may not (e.g. COVID-19 pandemic) be predictable.

**Education interventions**

There was variability in the number, types and purpose of education interventions. The purpose of the included educational interventions spanned various elements of assessment (patients in general, pain, triage, risk screening for substance use, falls, pressure injuries), management of specific clinical issues (stroke, pain, sepsis), patient safety (early recognition of deterioration, medication safety, improved documentation). This variability reflects the reality of emergency nursing practice whereby emergency nurses care for undiagnosed and undifferentiated patients of all ages, with differing degrees of illness or injury severity. [5] In our review, positive effects were seen with as few as one and as many as eight interventions, and no or mixed effects were seen in studies using one to six

interventions. This finding resembles that of other studies. A 2014 overview of 25 systematic reviews found no strong evidence that multifaceted interventions were more effective than single-component interventions in changing health-care professionals' behaviour in clinical settings [50]. Further, there was no statistically significant relationship between the number of intervention components and the effect size [50]. The use of behaviour change or educational frameworks were uncommon despite practice change being core to addressing the aim in most studies included in our review. This finding is similar to that of Grimshaw et al. [51] who showed few studies report explicit rationale or theoretical basis as the choice for intervention. In this scoping review, it was difficult to ascertain whether behaviour change or educational frameworks were not used, or were used but not reported.

**Clinical practice outcomes**

Statistically or clinically significant improvements in clinical practice were reported in most studies (n = 20). However, there were no obvious relationships between effect and number and type of intervention(s) used. It has been hypothesised that multifaceted interventions based on assessment of barriers and enablers, and a sound theoretical base may be more effective than single interventions, [51] however our scoping review showed multifaceted interventions with positive or mixed effects on clinical practice behaviours. In six studies, the education sessions were tailored to the findings of needs analyses and, or site-specific barriers with variable results ranging from statistically significant improvements [35,39–41] or clinically important improvements [22] in practice or mixed findings [38]. A systematic review of 32 studies indicated that

**Table 3**  
Characteristics of included studies.

Author, Year, Country	Aim Study Design	Population	Education intervention	COM-B classification [18,19] Cognitive domains from Bloom's Taxonomy[20]	Main findings	Effect on practice
<b>Pain assessment and management including procedural pain relief (n=8)</b>						
Sepahvand et al. 2019 Iran	Effect of a nurse-initiated pain management protocol on triage performance, waiting time, and pain management Pre-test, post-test study	Triage nurses from a trauma centre (n = 40)	3 × 90-minute face-to-face sessions over three weeks with case-based learning in small groups of 4–5 people	Capability Knowledge, comprehension, application, analysis	Statistically significant improvements in analgesic administration, nonpharmacological pain interventions, and documentation of assessments.	+ve
Boyd et al. 2018 Australia	Evaluate effect of simulation on quality of documentation of patient assessment Single site, prospective, single group pre-test, post-test study	Emergency nurses (RNs) from Level 1 trauma centre (n = 42)	Single high-fidelity simulation	Capability Knowledge, comprehension, application, analysis, synthesis	Statistically significant increase in documentation scores for clinical handover and indicators of urgent illness. No change in documentation of primary assessment, patient care delivered, plan of care.	Mixed
Solomon & Jurica, 2017 United States of America	Evaluate the effectiveness of education & an evidence-based electronic order set for nasogastric tube insertion Pre-test, post-test study	Emergency nurses from level 1 adult trauma centre (n not reported)	Education provided in staff meetings, pre-shift huddles, and on an individual basis as needed Posters in strategic areas of the ED	Knowledge, comprehension, application	Education and electronic order set increased oxymetazoline (p values not reported)	+ve
Scott et al. 2013 Australia	Effect of a paediatric pain bundle on pain assessment pain score documentation, analgesia administration, and time to analgesia Pre-test, post-test study	Emergency nurses from a regional teaching ED (n not reported)	30 min education sessions supported by a PowerPoint presentation; posters detailing analgesia guidelines displayed in key locations throughout ED; lanyard cards with pain assessment tool and analgesia guidelines	Capability, opportunity Knowledge, comprehension, application, analysis, synthesis, evaluation	Non-significant increases in documentation of initial pain score (improved) and pain score post analgesia; analgesia administration and median time to analgesia.	+ve
Corwin et al. 2012 United States of America	Measure the impact of an intervention on pain management Pre-test, post-test study	Nurses from paediatric ED (n not reported)	Policy distributed to nursing staff via education programs (duration and format not reported)	Capability Knowledge, comprehension, application, analysis	Significant increase in patients who received analgesia and pain reassessment and non-significant decrease in median time to analgesia.	+ve
Le May et al. 2009 Canada	Evaluate effect of an interventions on emergency nurses' pain management practices Pre-test, post-test study	Emergency nurses from paediatric university teaching hospital (n = 50)	Tailored educational interventions: 3 × 20–30 min capsules tailored to nurses' survey results from: i) pain management experience evaluation and ii) paediatric nurses' knowledge and attitudes survey	Capability, opportunity, motivation Knowledge, comprehension, application	Significant increases in nurses' documentation of pain, analgesia administration and nonpharmacological interventions.	+ve
Decosterd et al. 2007 Switzerland	Evaluate effect of a pain management education program and guideline Pre-test, post-test study	Emergency nurses from tertiary-care teaching hospital (n not reported)	Didactic education sessions (duration not reported); distribution of guideline; discussions at ED rounds & change of shift handovers; pocket size guideline; posters in ED	Capability Knowledge, comprehension, application	Significant increase in nurses' documentation of pain, pain location, pain type and pain reassessment. Non-significant increase in nurses' documentation of pain intensity.	+ve
Campbell et al. 2004 United States of America	Evaluate a protocol for pain management at triage Pre-test, post-test study	ED nurse interns (newly graduated nurses) from Level 1 trauma centre (n not reported)	Lecture and PowerPoint presentation (duration not reported)	Capability Knowledge, comprehension, application	Increased nursing documentation of initial pain level, pain level in nursing notes and pain level on disposition (p values not reported).	+ve
<b>Infection prevention and control, sepsis and antibiotic administration (n = 6)</b>						
Jizba et al. 2021 United States of America	Evaluate an emergency nurse-led implanted port access algorithm for ED patients Pre-test, post-test study	Emergency nurses (n = 32)	Training (duration and format not reported) supplemented by nurse champions in the ED	Capability, motivation Knowledge, comprehension, application	Decrease in port access and increased documentation of CLABSI education for patients (p values not reported). Port access algorithm was used correctly in all patients, with appropriate nursing documentation to support deviations from the algorithm	+ve
Reynolds et al. 2020 United States of America	Effect of triage standing orders on time to antibiotics in neonates Pre-test, post-test study	Emergency nurses from a paediatric level 1 trauma centre (n not reported)	Regular education on a rolling basis (duration and format not reported)	Capability Knowledge, comprehension, application	Increased proportion of neonates receiving antibiotics within 120 min (p value not reported)	+ve

(continued on next page)

Table 3 (continued)

Author, Year, Country	Aim Study Design	Population	Education intervention	COM-B classification [18,19] Cognitive domains from Bloom's Taxonomy[20]	Main findings	Effect on practice
Moore et al. 2019 United States of America	Evaluate the effect of nurse-driven sepsis protocol Pre-test, post-test study	Emergency nurses from a Level I trauma centre (n not reported)	Education meetings with didactic presentations and opportunity to discuss concepts (duration not reported); online reference material	Capability, motivation Knowledge, comprehension, application	Statistically significant increases in lactate assessment, blood cultures, antibiotic administration, and intake & output monitoring. Non-significant increase in IV fluid administration.	
McLaughlin et al. 2017 United States of America	Evaluate the effect of an intravenous push cephalosporin antibiotic protocol Pre-test, post-test study	Emergency nurses from Level II trauma centre (n not reported)	Staff meetings; team meeting topics; distribution of a tip sheet	Capability, opportunity Knowledge, comprehension, application	Statistically significantly decrease in median time from prescription to administration of ceftriaxone, cefepime and cefazolin. There was a non-significant decrease in time from order to administration for ceftazidime.	+ve
Keshmiri et al. 2017 Iran	Assess the effectiveness of an interprofessional education model (IPE) on collaborative practice Controlled pre-test, post-test study	Emergency nurses from two teaching hospitals (n = 49; pre 18 and 31 post)	Participant workshop consisting of interactive lectures, interprofessional small group discussions followed by videos, and case-based learning in buzz groups (duration not reported)	Capability, motivation Knowledge, comprehension, analysis, synthesis, evaluation	Increased nurses' mean Interprofessional Collaborator Assessment Rubric scores (nurse specific p value not reported)	No change
Dorsey et al. 1996 United States of America	Evaluate the effect of an intervention on compliance with handwashing recommendations Pre-test, post-test study	Emergency nurses from an urban, university-affiliated medical center (n = 85 RNs and 95 NPs)	Brightly coloured signs listing CDC recommendations for handwashing posted at all handwashing stations; distribution a handwashing compliance publication to all staff	Capability, opportunity Knowledge, comprehension, application	Non-significant increase in overall compliance. Non-significant increases in registered nurse handwashing after touching contaminated sources and between contacts with different patients and no difference in registered nurse handwashing after microbial contamination of hands. Non-significant increase in nurse practitioner handwashing before wound care, after wound care, after microbial contamination of hands and between contacts with different patients.	+ve
<b>Patient assessment and documentation (n = 4)</b>						
Curtis et al. 2021 A Australia	Evaluate effect of an emergency nursing framework on patient safety Pre-test, post-test study	Nurses from two rural EDs from one health service (n not reported)	Structured electronic documentation template (prompt); education workshops (1/2 day, format not reported); online learning module; audit and feedback of documentation; posters; reference cards; video demonstrating key-stakeholder engagement; clinical champions	Capability, motivation Knowledge, comprehension, application, analysis, synthesis	Statistically significant decrease delay or failure to escalate care when abnormal vital signs were identified in ED. Non-significant decreases ED nursing documentation and nurses' monitoring of observations as causal factors of clinical deterioration. Non-significant increase in ED nursing management errors as causal factors of clinical deterioration.	+ve
Munroe et al. 2021 Australia	Determine if use of an emergency nursing framework improves accuracy of emergency nurses' documentation Pre-test, post-test study	Nurses from four EDs from one rural health service (n not reported)	Structured electronic documentation template (prompt); education workshops (duration and format not reported); online learning module; audit and feedback of documentation; posters; reference cards; video demonstrating key-stakeholder engagement; clinical champions	Capability, motivation Knowledge, comprehension, application, analysis	Significant increase in the accuracy of documentation, defined as documenting all core elements (history, assessment findings, nursing interventions, diagnostics and outcomes). Significant increases in documentation scores for history and assessment.	+ve
Middleton et al. 2019 Australia	Evaluate the effectiveness of the T3 intervention to improve triage, treatment, and transfer for ED patients with acute stroke Cluster randomised controlled trial	Emergency nurses from 26 Australian EDs with stroke units and tPA capability (n not reported)	Interactive and didactic education sessions based on site specific barriers to implementation; site clinical champions; reminders (ED posters, lanyard cards); sustained engagement strategies (visits, telephone, email) to discuss progress against site-specific action plans	Capability, motivation Knowledge, comprehension, analysis, synthesis	Non-significant increases in 4 hourly temperature measurements in ED, 6 hourly blood glucose measurements in ED, oral food or fluids before swallow screening and oral medications before swallow screening. Non-significant decreases in temperature measurement on ED arrival and nil orally status.	Mixed

No change in triage to category 2 or blood status.  
(continued on next page)

Table 3 (continued)

Author, Year, Country	Aim Study Design	Population	Education intervention	COM-B classification [18,19] Cognitive domains from Bloom's Taxonomy[20]	Main findings	Effect on practice
Macrina et al. 1996 United States of America	Evaluate the effect of an educational intervention on documentation of GCS Pre-test, post-test study	Emergency nurses from six EDs (characteristics not reported)	4-hour didactic continuing education session; pocket reference cards; 22-minute training video	Capability, motivation Knowledge, comprehension, application	glucose (finger prick) measurement on ED arrival. Overall, GCS documentation increased (no p value reported).	Mixed
<b>Triage (n = 4)</b> Rankin et al. 2013 Canada	Evaluate the effect of web learning on the accuracy of triage Randomised experimental study	Triage nurses from six EDs (characteristics not reported) (n = 132; control n = 67, intervention n = 65)	Intervention group: mandatory tutorial (duration not reported), online discussion = 25% of grade, and triage workplace project. Control group: tutorial was recommended but not mandatory, no marks for online discussion, and no workplace project. 4-hours didactic instruction; 3 x 3–5 min simulation scenarios with debriefing	Capability, motivation Knowledge, comprehension, application, analysis, synthesis	Non-significant increase in triage accuracy. The control had significantly higher under-triage and intervention group had significantly higher over-triage.	+ve
Wolf et al. 2008 United States of America	Evaluate use of simulation in triage training Pre-test, post-test study	Emergency nurses from a community hospital (n = 6)	3-hour formal education session Educator available in ED for informal discussions including practical skills training regarding mental illness, clinical support available	Capability Knowledge, comprehension, synthesis	At baseline, average 40% rate of under-triage for all nurses and no patients were over-triaged. Post-test:70–100% of patients were triaged accurately (no p values reported)	Unsure
Clarke et al. 2006 Canada	Evaluate intervention to improve ED assessment and care of patients with mental illness Pre-test, post-test study	Triage nurses from tertiary university-affiliated teaching hospital (n = 10)	3 x 4-hour study sessions (format not reported) informed by learning needs analysis; training manual on use and documentation of triage scale	Capability Knowledge, comprehension, application, analysis, synthesis	Statistically significant increase in triage to category 2. No change in triage to categories 3, 4 or 5.	+ve
Broadbent & Berk, 2002 Australia	Evaluate effect of a mental health triage scale on triage category allocation Single site, prospective, single group pre-test, post-test study	ED triage nurses (n not reported) from major rural ED	Education meetings (duration and format not reported); clinical support; training manual	Capability Knowledge, comprehension, application, analysis, synthesis	Statistically significant increase in triage to categories 1, 2, 3 and 5 and significant decrease in triage to category 4.	+ve
<b>Risk screening (n = 2)</b> Campbell et al. 2021 United States of America	Evaluate the effect of the Emergent Documentation Aggression Rating Tool (EDART) on drug and alcohol screening Pre-test, post-test study	Emergency nurses (n not reported)	Education meetings (duration and format not reported); clinical support; training manual	Capability Knowledge, comprehension, application	Statistically significant increase in nursing documentation using the EDART. Increase in number of escalations and discharge de-escalations (p values not reported). Non-significant decrease in restraint use. Statistically significant decrease in falls risk screening overall. Statistically increase in pressure injury screening, substance use screening, completion of ≥ 1 of the three screens and all three screens completed. In patients > 65 years there was a statistically significant decrease in falls risk screening and statistically significant increase in pressure injury screening.	+ve
Curtis et al. 2021B Australia	Evaluate implementation of a consolidated electronic checklist on screening completions for falls, pressure injury and substance use Pre-test, post-test study	Nurses from four EDs from one rural health service (n not reported)	Face to face education (bedside and classroom) (duration and format not reported); clinical champions; reminder icon on ED tracking screen; posters, restructuring of electronic forms, monitoring/feedback	Capability, motivation Knowledge, comprehension, application	Statistically significant increase in nursing documentation using the EDART. Increase in number of escalations and discharge de-escalations (p values not reported). Non-significant decrease in restraint use. Statistically significant decrease in falls risk screening overall. Statistically increase in pressure injury screening, substance use screening, completion of ≥ 1 of the three screens and all three screens completed. In patients > 65 years there was a statistically significant decrease in falls risk screening and statistically significant increase in pressure injury screening.	Mixed

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Table 3 (continued)

Author, Year, Country	Aim Study Design	Population	Education intervention	COM-B classification [18,19] Cognitive domains from Bloom's Taxonomy[20]	Main findings	Effect on practice
<b>Medication safety (n = 1)</b> Feleke et al. 2009 United States of America	Evaluate the effect of color-coded medication safety (CCMS) system on paediatric medication management Pre-test, post-test study	Emergency nurses from 3 area community EDs (n = 16)	Interactive training session (duration and format not reported), "talk out loud" simulated pediatric emergency scenarios	Capability Knowledge, comprehension, application, analysis, synthesis	Statistically significant decreases in incorrect medication conversion and incorrect dilution, incorrect administration time. Statistically significant increases in recognition of prescribing error and median time to median time to medication, median time to infusion and median time to medication plus infusion (p values not reported).	+ve

ED = emergency department; +ve = positive effect on practice; mixed = combination of positive and some negative effects on practice

tailored interventions (compared to no or non-tailored interventions) can effect practice change professional, although the effect tends to be small to moderate [48]. Only four studies in that review focused on nurses as part of mixed professional groups in acute care hospitals [48].

The most common education intervention in this scoping review was education sessions (n = 24 studies). Healthcare professionals are probably more likely to follow recommended practices when educational meetings are used alone or as the main part of a multi-faceted intervention (compared with no meetings) or compared with other strategies to change healthcare professionals' behaviour [52]. The very low certainty of evidence related to interactive educational meetings compared with lecture-based educational sessions means it is difficult to make recommendations about the format of educational meetings [52]. Clinical champions were used in five of the included studies. There is moderate certainty evidence that intervention involving opinion leaders probably improve healthcare professionals' compliance with evidence based practice, however the effect of opinion leaders on clinical practice behaviours varies within and across studies [53]. Further, the evidence to date does not clearly report the role and actions of opinion leaders, how opinion leaders are selected, or whether single opinion leaders, multiple opinion leaders or by multidisciplinary opinion leader teams are most effective [53]. The use of printed materials identified in this scoping review included posters (n = 8 studies), reference cards (n = 6 studies) and policy or guideline distribution (n = 4 studies). A 2020 systematic review of 82 studies comparing the use of printed materials versus no intervention, showed that printed educational material may slightly improve health professionals' practice behaviour compared to no intervention [54]. Further, computerised versions (compared to printed versions of same materials) made little or no difference to healthcare professionals' practice [54].

*Theoretical foundations*

Finally, there was variability in addressing the essential elements of behaviour change and targeted cognitive domains. When the included studies were mapped against the Behaviour Change Wheel, and specifically the COM-B model, [18,19] most interventions targeted capability with few addressing opportunity or motivation. The widespread use of education sessions in the included studies suggests that physiological capability (knowledge and understanding) was a priority area however, as mentioned previously, few included studies undertook detailed behaviour diagnostics, or barriers and enablers assessments. There is a risk that mismatch between the conditions for behaviour change and the selected intervention functions and behaviour change techniques [18] may result in lack of effect on clinical practice behaviours. For example, education is unlikely to be an effective driver of practice change if there are issues of opportunity or motivation [18].

When the included studies were mapped against the cognitive domains of Bloom's Taxonomy of educational objectives, [20,49] few studies targeted higher order thinking (synthesis and evaluation). A possible explanation for this finding may be the challenge in measuring higher order thinking such as synthesis and evaluation, which requires assessment of decision making, evaluative thinking and concept acquisition, in relation to the intended practice change. For example, application was the highest cognitive domain in eleven studies that mostly related to application of protocols or rules [22,24–30,33,36,46] which reflects mid-range order thinking and low to moderate levels of complexity, uncertainty and clinical risk. Contrasted are the two studies addressing evaluation, which were related to assessment and management of pain [23] and infection prevention and control, sepsis & antibiotic administration: [45] these studies reflect higher order thinking and moderate to high levels of complexity, uncertainty and clinical risk [20,49].

**Table 4** Educational interventions mapped against core components of the Behaviour Change Wheel [18,19] and cognitive domains of Bloom's Taxonomy of Educational Interventions [20].

Author, Year, Country	Education sessions (n = 24)	Posters (n = 8)	Reference cards (n = 6)	Champions (n = 5)	Discussions (n = 3)	Policy / guideline distribution (n = 4)	Reminders (n = 3)	Clinical support (n = 2)	Online material (n = 4)	Training manual (n = 2)	Other (n = 2)	Number of interventions	Highest Bloom's taxonomy cognitive domain[20]	Effect on practice
COM-B[18,19]	Capability	Capability	Capability	Capability Motivation	Motivation	Opportunity	Motivation	Capability	Capability Motivation	Capability	Motivation			
Behaviour Change Wheel Intervention Functions[18,19]	Education Training	Environmental restructure	Environmental restructure	Modelling Persuasion Incentivisation	Education Persuasion Enablement	Enablement Environmental restructure	Environmental restructure	Enablement Persuasion Training	Education Training	Education Training	Monitoring			
Behaviour Change Technique Taxonomy[18,19] <sup>o</sup>	4.1 Instruction 4.3 Re-attribution	7.1 Prompts / cues	7.1 Prompts / cues	4.1 Instruction 6.1 Demonstration	4.1 Instruction 8.7 Graded tasks	4.1 Instruction	7.1 Prompts / cues	6.1 Demonstration 3.2 Social support	4.1 Instruction 6.1 Demonstration 6.3 Other's approval	4.1 Instruction	2.2 Feedback			
Curtis et al. 2021 A Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8	Synthesis	+ve
Munroe et al. 2021 Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8	Analysis	+ve
Middleton et al. 2019 Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	6	Synthesis	Mixed
Decosterd et al. 2007 Switzerland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5	Application	+ve
Curtis et al. 2021B Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	4	Application	Mixed
Campbell et al. 2021 United States of America	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3	Application	+ve
Macrina et al. 1996 United States of America	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3	Application	Mixed
Scott et al. 2013 Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3	Synthesis	+ve
Broadbent & Berik. 2002 Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	Synthesis	+ve
Clarke et al. 2006 Canada	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	Synthesis	+ve
Corwin et al. 2012 United States of America	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	2	Evaluation	+ve
Dorsey et al. 1996 United States of America	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	3	Application	+ve

(continued on next page)

Table 4 (continued)

Author, Year, Country	Education sessions (n = 24)	Posters (n = 8)	Reference cards (n = 6)	Champions (n = 5)	Discussions (n = 3)	Policy / guideline distribution (n = 4)	Reminders (n = 3)	Clinical support (n = 2)	Online material (n = 4)	Training manual (n = 2)	Other (n = 2)	Number of interventions	Highest Bloom's taxonomy cognitive domain[20]	Effect on practice
COM-B[18,19]	Capability	Capability	Capability	Capability Motivation	Motivation	Opportunity	Motivation	Capability	Capability Motivation	Capability	Motivation			
Behaviour Change Wheel Intervention Functions[18,19]	Education Training	Environmental restructure	Environmental restructure	Modelling Persuasion Incentivisation	Education Persuasion Enablement	Enablement Environmental restructure	Environmental restructure	Enablement Persuasion	Education Training	Education Training	Monitoring			
Technique Taxonomy[18,19]*	4.1 Instruction 4.3 Re-attribution	7.1 Prompts / cues	7.1 Prompts / cues	4.1 Instruction 6.1 Demonstration	4.1 Instruction 8.7 Graded tasks	4.1 Instruction	7.1 Prompts / cues	6.1 Demonstration 3.2 Social support	4.1 Instruction 6.1 Demonstration 6.3 Other's approval	4.1 Instruction	2.2 Feedback			
Jizba et al. 2021 United States of America	✓			✓								2	Application	+ve
Keshmiri et al. 2017 Iran	✓				✓							2	Evaluation	Nil
McLaughlin et al. 2017 United States of America	✓					✓						2	Application	+ve
Moore et al. 2019 United States of America	✓								✓			2	Application	+ve
Rankin et al. 2013 Canada	✓				✓						✓	2	Synthesis	+ve
Solomon & Jurica, 2017 United States of America	✓	✓										2	Application	+ve
Wolf et al. 2008 United States of America	✓✓											2	Synthesis	?
Feleke et al. 2009 United States of America	✓✓											2	Synthesis	+ve
Boyde et al. 2018 Australia	✓											1	Synthesis	Mixed
Campbell et al. 2004 United States of America	✓											1	Application	+ve
Le May et al. 2009 Canada	✓											1	Analysis	+ve
Reynolds et al. 2020 United States of America	✓											1	Application	+ve

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Table 4 (continued)

Author, Year, Country	Education sessions (n = 24)	Posters (n = 8)	Reference cards (n = 6)	Champions (n = 5)	Discussions (n = 3)	Policy / guideline distribution (n = 4)	Reminders (n = 3)	Clinical support (n = 2)	Online material (n = 4)	Training manual (n = 2)	Other (n = 2)	Number of interventions	Highest Bloom's taxonomy cognitive domain[20]	Effect on practice
COM-B[18,19]	Capability	Capability	Capability	Capability Motivation	Motivation	Opportunity	Motivation	Capability	Capability Motivation	Capability	Motivation			
Behaviour Change Wheel Intervention Functions[18,19]	Education Training	Environmental restructure	Environmental restructure	Modelling Persuasion Incentivisation	Education Persuasion Enablement	Enablement Environmental restructure	Environmental restructure	Enablement Persuasion	Education Training	Education Training	Monitoring			
Behaviour Change Technique Taxonomy[18,19] <sup>∞</sup>	4.1 Instruction 4.3 Re-attribution	7.1 Prompts / cues	7.1 Prompts / cues	4.1 Instruction 6.1 Demonstration	4.1 Instruction 8.7 Graded tasks	4.1 Instruction	7.1 Prompts / cues	6.1 Demonstration 3.2 Social support	4.1 Instruction 6.1 Demonstration 6.3 Other's approval	4.1 Instruction	2.2 Feedback	1	Analysis	+ve
Sepahvand et al. 2019 Iran	✓													

<sup>∞</sup> the numbers reflect the numbers attributed to the behaviour change techniques from the Behaviour Change Wheel

COM-B = capability, opportunity, motivation – behaviour; ? = unable to determine, +ve = positive effect on practice; mixed = combination of positive and some negative effects on practice

Limitations

The strengths of this review are the thorough and systematic search technique, clear inclusion and exclusion criteria, and comprehensive data extraction. The limitations of this review are that studies were limited to publications in English, methodologically, only two of the included studies were randomised [38,42] and the remaining 23 studies used pre-post test methods. The significant heterogeneity across studies in area of focus, number and types of educational interventions used, data collection methods, and approach to statistical analysis, precluded meta-analysis.

Conclusions

In the main, education interventions had a positive effect on emergency nurses' clinical practice behaviours. To optimise clinician behaviour change, consideration of frameworks such as the Behaviour Change Wheel provide an opportunity to rethink the role of education in implementation and target interventions to context and known behavioural gaps (capability, opportunity, motivation). Evaluating the impact of education interventions on emergency nurses' clinical practice behaviours is logistically and methodologically challenging. However, future studies should focus on robust controlled designs testing different educational intervention(s), more rigorous reporting of the specific nature of the education intervention(s) tested, and the rationale or theoretical underpinning the intervention(s) selected.

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Ethical statement

No ethics approval was required for this scoping review.

CRediT authorship contribution statement

**Julie Considine:** Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft. **Ramon Z Shaban:** Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing. **Margaret Fry:** Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing. **Kate Curtis:** Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing.

Declaration of Competing Interest

Author Professor Ramon Z. Shaban is the Editor in Chief of the Australian Emergency Care but had no role or part in the peer review or editorial decision-making of this paper whatsoever, and was blinded to the manuscript in the Elsevier Editorial System. Authors Professors Julie Considine and Margaret Fry are the Senior Editors of the Australian Emergency Care but had no role or part in the peer review or editorial decision-making of this paper whatsoever, and were blinded to the manuscript in the Elsevier Editorial System. Author Professor Kate Curtis is Associate Editor (Trauma) of the Australian Emergency Care but had no role or part in the peer review or editorial decision-making of this paper whatsoever, and was blinded to the manuscript in the Elsevier Editorial System.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.auec.2023.10.004](https://doi.org/10.1016/j.auec.2023.10.004).

## Appendix 1: Search Strategy

Date:30/08/2022 Database: CINAHL Complete via EBSCOhost Time: unlimited Limiters: published in English		
<b>S34</b>	<b>S8 AND S14 AND S28 AND S33 (Limited to published in English)</b>	<b>2675</b>
<b>S33</b>	<b>S29 OR S30 OR S31 OR S32</b>	1134,064
S32	(MH "Behavior+")	1114,793
S31	(MH "Behavioral Changes")	12,052
S30	TI "behavio*r change" OR AB "behavio*r change"	2371
S29	TI behavio*r OR AB behavio*r	49,344
<b>S28</b>	<b>S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27</b>	<b>1333,124</b>
S27	TI ((educat* and nurs*)) OR AB ((educat* and nurs*))	99,281
S26	(MH "Education, Clinical+")	19,269
S25	(MH "Nursing, Knowledge+")	1623
S24	(MH "Teaching Methods, Clinical+")	6975
S23	(MH "Learning Methods+")	25,906
S22	(MH "Education+")	1006,695
S21	TI "clinical educ*" OR AB "clinical educ*"	3526
S20	TI inservice OR AB inservice	888
S19	TI "professional development" OR AB "professional development"	13,329
S18	TI pedagog* OR AB pedagog*	6954
S17	TI learn* OR AB learn*	199,018
S16	TI teach* OR AB teach*	113,892
S15	TI educat* OR AB educat*	418,219
<b>S14</b>	<b>S9 OR S10 OR S11 OR S12 OR S13</b>	<b>709,898</b>
S13	(MH "Nurses+")	246,439
S12	(MH "Emergency Nursing+")	15,948
S11	TI "emergency nurs*" OR AB "emergency nurs*"	4267
S10	TI registered nurs* OR AB registered nurs*	21,174
S9	TI nurs* OR AB nurs*	618,378
<b>S8</b>	<b>S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7</b>	<b>189,184</b>
S7	MH ("Emergency Service+")	69,430
S6	TI "ER" OR AB "ER"	13,204
S5	TI "A&E" OR AB "A&E"	3437
S4	TI "accident and emergency" OR AB "accident and emergency"	2554
S3	TI "emergency room" OR AB "emergency room"	7137
S2	TI "emergency department" OR AB "emergency department"	59,399
S1	TI emergency OR AB emergency	151,051
Date:30/08/2022 Database: MEDLINE Complete via EBSCOhost Time: unlimited Limiters: published in English		
<b>S32</b>	<b>S8 AND S14 AND S27 AND S31 (Limited to published in English)</b>	<b>1271</b>
<b>S31</b>	<b>S28 OR S29 OR S30</b>	2684,108
S30	MH ("behavior+")	2004,432



S29	TI "behavio*r change" OR AB "behavio*r change"	3158
S28	TI behavio*r OR AB behavio*r	74,691
<b>S27</b>	<b>S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26</b>	<b>2076,176</b>
S26	TI ((educat* and nurs*)) OR AB ((educat* and nurs*))	86,821
S25	(MH ("Education, Nursing+"))	87,693
S24	(MH ("Teaching+"))	91,495
S23	(MH "Learning+")	421,285
S22	(MH "Education+")	874,911
S21	TI "clinical educ* " OR AB "clinical educ* "	3818
S20	TI inservice OR AB inservice	1186
S19	TI "professional development" OR AB "professional development"	11,720
S18	TI pedagog* OR AB pedagog*	10,463
S17	TI learn* OR AB learn*	516,774
S16	TI teach* OR AB teach*	218,639
S15	TI educat* OR AB educat*	691,827
<b>S14</b>	<b>S9 OR S10 OR S11 OR S12 OR S13</b>	<b>539,185</b>
S13	(MH "Nurses+")	95,483
S12	(MH "Emergency Nursing+")	7367
S11	TI "emergency nurs* " OR AB "emergency nurs* "	2701
S10	TI "registered nurs* " OR AB "registered nurs* "	13,761
S9	TI nurs* OR AB nurs*	500,897
<b>S8</b>	<b>S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7</b>	<b>458,001</b>
S7	(MH "Emergency Service, Hospital+")	93,747
S6	TI "ER" OR AB "ER"	100,070
S5	TI "A&E" OR AB "A&E"	8646
S4	TI "accident and emergency" OR AB "accident and emergency"	4579
S3	TI "emergency room" OR AB "emergency room"	20,977
S2	TI "emergency department" OR AB "emergency department"	103,630
S1	TI emergency OR AB emergency	326,992

**Date: 30/08/2022 Database: ERIC (Education Resources Information Center) via EBSCOhost Time: unlimited Limiters: published in English**

<b>S34</b>	<b>S7 AND S14 AND S27 AND S33 (Limited to published in English)</b>	<b>26</b>
<b>S33</b>	<b>S29 OR S30 OR S31 OR 32</b>	<b>106,174</b>
S32	DE "Behavior"	4439
S31	DE "Behavior Change"	12,507
S30	TI "behavio*r change" OR AB "behavio*r change"	1807
S29	TI behavio*r OR AB behavio*r	98,409
<b>S28</b>	<b>S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27</b>	<b>1194,060</b>
S27	DE "Clinical Teaching (Health Professions)"	750
S26	DE "Learning Strategies"	19,976
S25	DE "Teaching Methods"	200,195

S24	DE "Nursing Education"	5466
S22	DE "Education"	4401
S22	TI ((educat* and nurs*)) OR AB ((educat* and nurs*))	7932
S21	TI "clinical educ*" OR AB "clinical educ*"	480
S20	TI inservice OR AB inservice	15,810
S19	TI "professional development" OR AB "professional development"	37,156
S18	TI pedagog* OR AB pedagog*	63,006
S17	TI learn* OR AB learn*	458,045
S16	TI teach* OR AB teach*	572,108
S15	TI educat* OR AB educat*	743,062
<b>S14</b>	<b>S8 OR S9 OR S10 OR S11 OR S12 OR S13</b>	<b>17,435</b>
S13	DE "Nursing education"	5469
S12	DE "Nursing"	2196
S11	DE "Nurses"	3322
S10	TI "emergency nurs*" OR AB "emergency nurs*"	17
S9	TI " registered nurs*" OR AB "registered nurs*"	920
S8	TI nurs* OR AB nurs*	16,623
<b>S7</b>	<b>S1 OR S2 OR S3 OR S4 OR S5 OR S6</b>	<b>35,315</b>
S6	TI "ER" OR AB "ER"	502
S5	TI "A&E" OR AB "A&E"	29,477
S4	TI "accident and emergency" OR AB "accident and emergency"	24
S3	TI "emergency room" OR AB "emergency room"	175
S2	TI "emergency department" OR AB "emergency department"	232
S1	TI emergency OR AB emergency	5536

**Date:30/08/2022Database: Psycinfo via EBSCOhostTime: unlimitedLimiters: published in English**

<b>S33</b>	<b>S7 AND S13 AND S27 AND S32</b>	<b>133</b>
S32	S28 OR S29 OR S30 OR S31	645,653
S31	DE "Behavior"	35,441
S30	DE "Behavior Change"	13,037
S29	TI "behavio*r change" OR AB "behavio*r change"	12,699
S28	TI behavio*r OR AB behavio*r	627,851
<b>S27</b>	<b>S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26</b>	<b>7993</b>
S26	TI ((educat* and nurs*)) OR AB ((educat* and nurs*))	24,705
S25	DE "Nursing Education"	6819
S24	DE "Learning"	93,736
S23	DE "Teaching Methods"	43,607
S22	DE "Teaching"	54,616
S21	DE "Education"	43,673
S20	TI "clinical educ*" OR AB "clinical educ*"	1318
S19	TI inservice OR AB inservice	1851

S18	TI "professional development" OR AB "professional development"	22,544
S17	T1 pedagog* OR AB pedagog*	36,277
S16	TI learn* OR AB learn*	501,074
S15	TI teach* OR AB teach*	299,729
S14	TI educat* OR AB educat*	528,944
<b>S13</b>	<b>S8 OR S9 OR S10 OR S11 OR S12</b>	<b>111,480</b>
S12	DE "Nursing"	25,496
S11	DE "Nurses"	31,321
S10	TI "emergency nurs*" OR AB "emergency nurs*"	252
S9	TI registered nurs* OR AB "registered nurs*"	5745
S8	TI nurs* OR AB nurs*	108,660
<b>S7</b>	<b>S1 OR S2 OR S3 OR S4 OR S5 OR S6</b>	<b>163,671</b>
S6	TI "ER" OR AB "ER"	6118
S5	TI "A&E" OR AB "A&E"	127,808
S4	TI "accident and emergency" OR AB "accident and emergency"	470
S3	TI "emergency room" OR AB "emergency room"	3533
S2	TI "emergency department" OR AB "emergency department"	8746
S1	TI emergency OR AB emergency	31,446

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