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The current educational interventions for teaching and learning evidence-based practice knowledge, skills, attitudes, and behaviours: a systematic review among undergraduate healthcare students in developing countries

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ABSTRACT

This study aims to evaluate the current educational interventions designed to teach evidence-based practice (EBP) knowledge, skills, attitudes, and behaviours among undergraduate healthcare students in developing countries. A systematic review of quantitative primary research studies was conducted. From an initial set of 942 studies, 848 were screened based on their titles and abstracts, and 11 full-text articles were assessed. After applying exclusion criteria, eight studies were included in the review. These studies were identified through a comprehensive search of electronic databases, including CINAHL, MEDLINE, EMBASE, PUBMED, and ERIC. Two independent reviewers screened, appraised, and extracted data, utilizing the McMaster appraisal tools to assess methodological quality. A best-evidence synthesis approach was applied to summarize the findings in accordance with PRISMA guidelines. The review identified eight studies, 87.5% of which were conducted in Asian countries. The majority (62.5%) of these studies employed survey designs, and 75% incorporated blended teaching methods to deliver EBP content. A notable finding was the absence of EBP-focused interventions for healthcare students in sub-Saharan Africa. There is a significant gap in research regarding educational interventions for teaching EBP to undergraduate healthcare students in developing countries. The findings suggest a need for more targeted research and interventions, particularly in regions like sub-Saharan Africa.

IMPLICATIONS FOR PRACTICE

Integrating EBP education into undergraduate healthcare curricula is essential for preparing future healthcare professionals. Further research is needed to evaluate the long-term effectiveness of these interventions on students' EBP competencies.

IMPACT STATEMENT

This systematic review evaluates the effectiveness of educational interventions for teaching evidence-based practice (EBP) among undergraduate healthcare students in developing countries. Findings suggest that EBP education enhances students' knowledge, skills, attitudes, and behaviours, but challenges persist, particularly in sub-Saharan Africa, where interventions are scarce. The review highlights the use of blended teaching methods, yet there is a lack of longitudinal studies to assess the long-term impact of these interventions on students' clinical practice. Many studies focused only on certain aspects of EBP (knowledge, skills, or attitudes), leaving a gap in understanding. To improve healthcare outcomes, the study advocates for integrating EBP into curricula with contextually relevant, sustainable methods, particularly in resource-limited

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settings. The review calls for further research into the long-term behavioural outcomes of EBP education and the development of region-specific programs, especially in areas like sub-Saharan Africa, to ensure that healthcare professionals are equipped to deliver evidence-based care.

Introduction

Evidence-Based Practice (EBP) refers to the integration of the best available research evidence with clinical expertise, personal experiences, and patient preferences to make informed decisions in healthcare (Woo et al., 2017). This approach improves patient satisfaction, reduces hospital stays, lowers healthcare costs, and leads to better clinical outcomes (Ramis et al., 2018). The World Health Organization (2021) recognises the importance of EBP education in enhancing healthcare professionals' competencies, emphasising its role in improving practice across various healthcare settings.

Evidence-based practice (EBP) leads to increased patient satisfaction, shorter stays in the hospital, and cheaper healthcare costs in addition to better clinical outcome (Woo et al., 2017). EBP is the integration of the current and best evidence with clinical knowledge, personal experiences, and patients' preferences in a given context (Majid et al., 2011; Li et al., 2019; Nalweyiso et al., 2019). The World Health Organisation acknowledged the value of education interventions on EBP in its technical reference on global strategic orientations for all healthcare professionals (World Health Organization, 2021).

Ramis et al. (2018) argue that EBP training is the main predictor to influence intention to practice EBP. According to Melnyk et al. (2010) the seven-step paradigm for teaching EBP includes developing an inquiry-based mindset, formulating clinical inquiry questions, searching for appropriate research, assessing, integrating, and evaluating the evidence, and disseminating EBP findings. Moreover, when undergraduate healthcare students' curricula incorporate EBP training, they acquire the required competencies needed for their future practice (Abu-Baker et al., 2021; Song et al., 2021).

Several primary studies regarding EBP educational interventions among undergraduate healthcare professionals have been conducted globally (Lehane et al., 2019; Cardoso et al., 2021; Kumah et al., 2022). The majority of the SRs on these EBP educational interventions have focused on studies done in developed countries (Taylor et al., 2000; Coomarasamy & Khan, 2004; Flores-Mateo & Argimon, 2007; Schoonees et al., 2017). For example, in a SR by Flores-Mateo and Argimon (2007), conducted in Spain, the authors assessed the effectiveness of EBP to improve knowledge, skills, attitudes, and behaviour of postgraduate healthcare workers and found a large improvement in skills and knowledge in EBP when all EBP domains are measured together in a total test score.

Another SR conducted by Schoonees et al. (2017) focused on assessing the effectiveness of e-learning evidence-based healthcare (EBPHC) on increasing EBPHC competencies in healthcare professionals. Twenty randomised controlled trials (RCTs) and four non-randomised controlled trials (non-RCTs) with a total of 3,825 participants, including doctors, nurses, physiotherapists, physician assistants, athletic trainers, and a mix of professionals with different levels of education, were included in the review.

After appraising the evidence, clinicians integrate it with their own clinical expertise and the preferences of the patient, tailoring decisions to individual needs. This personalized approach ensures that interventions are not only evidence-based but also aligned with patient values and circumstances. Once an evidence-based intervention is selected, it is implemented through coordinated care plans, patient education, and continuous monitoring. Feedback from patients and adjustments to the intervention are crucial for evaluating its success and making necessary modifications.

The final step involves assessing the outcomes of the intervention, disseminating findings, and fostering a culture of continuous improvement. While EBP has the potential to enhance care quality, challenges such as time constraints, limited access to resources, and resistance to change must be addressed through training, resource allocation, and organizational support to ensure successful implementation.

The review found that pure e-learning improved EBHC knowledge and skills but not attitudes and behaviour. Even though the SRs discussed above indicate that when EBP training is done among

individuals, at least one or all the EBP domains improve. Despite all the reviews that have been done globally, there is a paucity of systematic reviews on the EBP educational interventions for teaching undergraduate healthcare students in developing countries. This could imply that the type and quality of EBP educational interventions for undergraduate healthcare students in developing countries are not known.

Accordingly, this review sought to examine the current educational interventions for teaching EBP knowledge, skills, attitudes, and behaviour among undergraduate healthcare students in developing countries. The justification for this SR is that this review is focused on undergraduate healthcare students as opposed to the majority of the SRs, whose populations are qualified doctors, nurses, or allied health professionals. It also focused on studies conducted in developing countries. Thus, results from the current review could add to the limited knowledge regarding undergraduate students' EBP education interventions, specifically in developing countries. Additionally, EBP is ineffectively implemented in healthcare practice, especially in developing countries where its use is rated below 20%. Similarly, country-by-country healthcare discrepancies need local initiatives that foster a culture of research and build EBP capacity among health professionals and organisations.

Evidence-Based Practice (EBP) in Real-World Clinical Settings involves a systematic approach where healthcare professionals integrate the best available research evidence with clinical expertise and patient preferences to improve patient care, safety, and outcomes (Majid et al., 2011; Melnyk et al., 2010). The process begins by formulating clear clinical questions using the PICO(T) framework, which helps define the patient population, intervention, comparison, desired outcomes, and time frame (Li et al., 2019).

Once a clinical question is established, clinicians systematically search for high-quality evidence from sources such as systematic reviews, randomized controlled trials (RCTs), and clinical guidelines (Schoonees et al., 2017). The next critical step is appraising the quality and relevance of this evidence by evaluating its validity, applicability, and statistical significance to the specific clinical context. Tools like the Critical Appraisal Skills Programme (CASP) checklists can help guide this evaluation, ensuring that only the most robust evidence is integrated into practice.

After appraising the evidence, clinicians integrate it with their own clinical expertise and the preferences of the patient, tailoring decisions to individual needs (Majid et al., 2011). This personalised approach ensures that interventions are not only evidence-based but also aligned with patient values and circumstances (Li et al., 2019). Once an evidence-based intervention is selected, it is implemented through coordinated care plans, patient education, and continuous monitoring. Feedback from patients and adjustments to the intervention are crucial for evaluating its success and making necessary modifications (Majid et al., 2011).

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Methods

Inclusion and exclusion criteria

It is recommended that a good SR should consider a specified inclusion and exclusion criteria for all the PICOT elements (Torgerson, 2007) as demonstrated in Table 1.

Search strategy

A comprehensive search strategy was employed to identify relevant studies on educational interventions for teaching and learning evidence-based practice (EBP) knowledge, skills, attitudes, and behaviours among undergraduate healthcare students in developing countries. The following electronic databases were searched: CINAHL, MEDLINE, EMBASE, PubMed, and ERIC. The search was limited to primary research studies published in English.

Table 1. Inclusion and exclusion criteria for the current SR.

	Inclusion criteria	Exclusion criteria
P – Population	Undergraduate healthcare students in developing countries (e.g. physiotherapists, occupational therapists, nurses, doctors, radiographers etc.) Students had participated in any EBP educational intervention program or part of an EBP program including (formulating clinical questions, searching the literature, critical appraisal skills program etc).	Studies with undergraduate students on top-up degrees were excluded
I – Intervention	Studies investigating any approach to teaching EBP were included. These approaches may include - lectures only or lectures with actual demonstrations and practice), workshops, experiential learning etc.	Studies reporting EBP guidelines or interventions specific to health conditions rather than education interventions to develop the actual processes of the EBP domains were excluded.
O – Outcome	Studies that investigated the EBP domains of knowledge, skills, attitudes and behaviour as a result of participating in any EBP program or a component of it were included.	Studies without sufficient detail on the outcome measures were excluded.
T – Type of Study	Quantitative studies e.g. using the following designs – RCTs, Surveys (cross-sectional and longitudinal), quasi-experimental designs, case-control studies, cohort studies, before and after designs etc. Studies published in English	Non-empirical studies

The search terms used were specifically chosen to capture studies focused on EBP educational interventions in the context of undergraduate healthcare education in developing countries. The primary search terms included:

'Evidence-Based Practice' OR 'EBP'

'Educational interventions' OR 'Teaching' OR 'Training' OR 'Curriculum'

'Knowledge' OR 'Skills' OR 'Attitudes' OR 'Behaviours'

'Undergraduate healthcare students' OR 'Medical students' OR 'Nursing students' OR 'Allied health students'

'Developing countries' OR 'Low-income countries' OR 'Global South' OR 'Africa' OR 'Asia' OR 'Latin America'

These terms were combined using Boolean operators (AND, OR) to ensure the inclusion of studies related to both educational interventions and EBP in healthcare students. For example, the search string used for PubMed was:

('Evidence-Based Practice' OR EBP) AND ('Educational interventions' OR Teaching OR Training OR Curriculum) AND ('Knowledge' OR 'Skills' OR 'Attitudes' OR 'Behaviours') AND ('Undergraduate healthcare students' OR 'Medical students' OR 'Nursing students' OR 'Allied health students') AND ('Developing countries' OR 'Low-income countries' OR 'Global South')

In addition, the search was refined by excluding studies that focused on postgraduate healthcare professionals or those conducted in high-income countries, ensuring the results were relevant to the context of undergraduate students in developing nations. The search was conducted for studies published from 2012 to 2022.

To identify relevant articles, a comprehensive search of electronic databases was carried out on published English studies from the last 10 years on several databases; these include MEDLINE, CINAHL, EMBASE, PUBMED, and ERIC. The electronic database search process involved breaking the SR question into keywords using the PIO framework (Table 1), and then identifying synonyms for each of the keywords (Appendix 1). Using Boolean operators ('AND' and 'OR'), a filtered search of the identified databases was done (Appendix 1). A range of limits were applied to the databases, including the English language, empirical quantitative studies, and time frame (2012–2022). The flowchart of the search strategy is illustrated in Figure 1.

Selection criteria

The selection was done by two reviewers (NID and JM). The first selection was made based on the title and abstract. This was recorded as a 'yes' if all the above inclusion criteria were met, a 'maybe' if it was

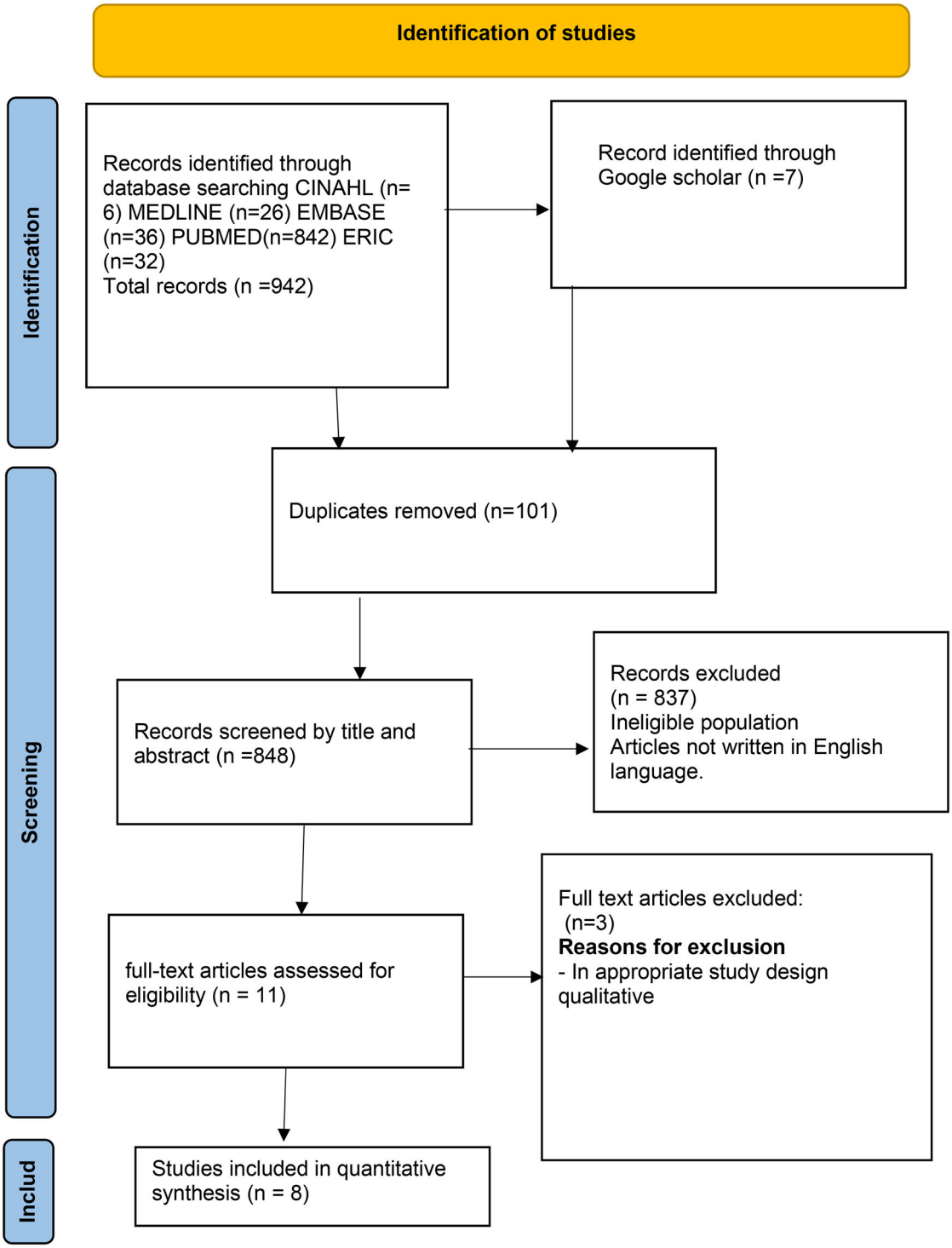

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

not clear if all criteria were met, and a 'no' if any of the criteria were not met. The second selection was made based on the body of the article. After the first selection, NID and JM discussed the outcomes of this procedure and arrived at a decision on the research to be conducted for the second selection.

The second selection included all the articles, irrespective of whether they were rated yes or maybe by any of the reviewers. This required both reviewers to separately read the whole texts and determine whether or not they met the inclusion criteria by determining whether or not they were eligible. After the second selection, NID and JM, who were reviewing the articles, discussed whether or not the final articles were appropriate.

After that, everyone came to an agreement on which final papers should be included. There were no disputes, but should there have been a disagreement, a third researcher (KS) would have been involved. There were no disputes, but should there have been a disagreement, a third researcher (KS) would have been involved. This is an effective strategy that has been used in the literature to overcome selection bias (Franklin & Graham, 2022; Mbabazi et al., 2023a). Figure 1 shows the studies selected for inclusion.

Methodological quality

Two reviewers independently assessed the methodological quality of individual studies using the McMaster appraisal tools (Mbabazi et al., 2022b; Mbabazi et al., 2023a). Scores were pre-determined by the researchers. A score of 1 was assigned to each question answered with 'yes, while a score of 0 was assigned to each question answered with 'no' or 'not addressed'. The possible range of scores was 0–15 studies that scored 0–5 was rated as low quality, 6–10 was rated as moderate, and 11–15 was rated as high. The scores were used to establish the quality of the studies but not for the inclusion or exclusion of studies (Table 2).

Data extraction

All relevant information that could answer the research question was identified and extracted using the data extraction form (Mbabazi et al., 2024c; Mbabazi et al., 2024d), which was piloted on two studies by two reviewers (NID and JM). Afterwards, the reviewers independently extracted data from the included studies and verified the extracted data with the third reviewer (KS) (Li et al., 2019; Piggott et al., 2023). Data extracted included the names of authors, year of publication, number of included studies, total number of participants, study design, study purpose, country where study was done, type of intervention, study findings, and conclusions of included articles related to the EBP educational interventions to enhance knowledge, skills, attitudes, and behaviour among undergraduate healthcare students in developing countries (Table 3).

Table 2. Showing scores from methodological assessment of included studies.

Article/framework question	Sánchez-Mendiola et al. (2012)	Kahouei et al. (2015)	Sabouni et al. (2017)	Atwa and Abdelaziz (2017)	Sukkarieh-Haraty, (2017)	Windyahening et al., (2019)	Al-Youzbaki et al. (2020)	Al Shahrani (2020)
Q1. Was the purpose stated clearly?	1	1	1	1	1	1	1	1
Q2. Was relevant background literature reviewed?	1	1	1	1	1	1	1	1
Q3. What was the study design?	1	1	1	1	0	1	1	1
Q4. Was the sample described in detail?	1	0	1	0	0	1	1	1
Q5. Was sample size justified?	0	0	1	0	0	0	0	0
Q6. Were the outcome measures reliable?	1	1	1	1	0	1	1	1
Q7. Were the outcome measures valid?	1	1	1	1	1	1	1	1
Q8. Was the Intervention described in detail?	1	0	1	1	0	1	0	1
Q9. Was contamination avoided?	0	0	0	0	0	0	0	0
Q10. Was Cointervention avoided?	0	0	0	0	0	0	0	0
Q11. Results were reported in terms of statistical significance?	1	1	1	0	0	1	1	1
Q12. Were the analysis method(s) appropriate?	1	1	1	1	0	1	1	1
Q13. Clinical importance was reported?	1	1	1	1	1	1	1	1
Q14. Drop-outs were reported?	1	1	1	0	0	0	0	0
Q15. Conclusions were appropriate given study methods and results	1	1	1	1	1	1	1	1
Total score obtained	12/15	10/15	13/15	9/15	5/15	11/15	10/15	11/15
Rating	**High**	**Moderate**	**High**	**Moderate**	**Low**	**High**	**Moderate**	**High**

Key: Table demonstrates strengths of the included studies.
0–5: **Low quality**, 6–10: **Moderate**, 11–15: **High**.

Table 3. Extracted data from the included studies.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
Sánchez-Mendiola et al., 2012	Teaching of evidence-based medicine to medical students in Mexico: a randomised controlled trial.	Mexico, 289 Medical students (Sixth, Fifth, Fourth year students) Not stated, Randomised, The Mexican army medical school.	Randomised Control trial (RCT)	EBM course 14, two-hour weekly sessions, One semester Strategy of content delivery is not stated Stand alone Berlin Questionnaire. Embedded in the curriculum	To assess the educational effectiveness (attitude, knowledge and skills) of an EBM course in undergraduate medical school students.	Attitude, knowledge, skills and Behaviour. In the intervention group, Cochrane Library and secondary journal use were higher (M5). Critical appraisal and attitude scores were higher in the intervention group, and the previous year's EBM instrument group (M6) M5 intervention group knowledge was greater than M5 non-EBM group knowledge ($P < 0.001$). Taylor's instrument had Cohen's $d = 0.88$ and the 100-item MCQ test 3.54. The previous year's intervention group scored better than the M4 and M5 non-EBM groups but lower than the M5 EBM group. EBM training improved medical students' attitude, knowledge, and self-reported critical evaluation abilities compared to a randomised control group. **Key Findings:** The intervention group showed improved use of the Cochrane Library and secondary journals. Significant improvement in critical appraisal and attitude scores. Intervention group knowledge was significantly better than non-EBM group ($p < 0.001$). **Conclusion:** EBM training improved attitude, knowledge, and critical evaluation abilities in medical students.
Kahouei et al., 2015	Strategy of health information seeking among physicians, medical residents, and students after introducing digital library and information technology in teaching hospitals of Iran	Iran, 315 Physician and medical students Convenient All physicians and medical students in the five affiliated hospitals at Semnan University of Medical Sciences Participated in the pilot study. Five affiliated hospitals at	survey	Connecting hospitals to the world-wide web and digital libraries.6monthsDigital library was introduced in the teaching hospitals. Single strategy. Stand alone. An anonymous, self-administered questionnaire was used to evaluate the intervention.	The purpose of this study was to investigate whether several educational interventions in the areas of information technology and data bases increased the use of evidence-based health information resources among physicians, medical residents and students.	Knowledge, 79.5% of medical residents always used patient data. 67.1% of students used own experiences. 16.9% of medical students always used PubMed and MEDLINE for patient care. The participants had little inclination to use the educators' knowledge in their clinical decisions. The educational interventions can increase students' inclinations to use information-seeking strategies for scientific conference materials in their

(*continued*)

Table 3. Continued.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
		Semnan University of Medical Sciences				clinical decisions. These results indicate that clinical librarians should not be neglected. Educational conferences, IT, and database searching courses were not enough to use research. Students frequently found and utilised information from sources that were not the greatest evidence.
	Development and evaluation of an evidence-based medicine module in the undergraduate medical curriculum	Saudi Arabia, 52 fourth-year medical students during their primary healthcare course at the College of Medicine, Princess Nourah bint Abdulrahman University. Using convenient sampling	Survey	A 5-week short EBM module including lectures, workshops, and online search sessions Embedded in the curriculum	The purpose of the study was to help medical colleges develop, implement and evaluate their EBM courses.	Skills and Knowledge. EBM is an important competence for undergraduates. This study supports that a short course in EBM that is incorporated into the undergraduate curriculum, especially in the clinical years, might be effective in improving medical students' knowledge and skills in EBM. Furthermore, this study adds to the body of evidence that suggests multiple teaching and learning strategies that can improve students' short-term EBM knowledge and skills. However, rigorous studies are necessary to assess the long-term impact of these interventions and their effectiveness for clinical decision-making. **Key Findings:** 79.5% of medical residents used patient data, but only 16.9% of students used PubMed and MEDLINE for patient care. Educational interventions increased students' inclination to seek evidence-based resources. However, participants frequently used low-quality evidence for clinical decisions. **Conclusion:** IT and database courses can increase the use of evidence-based resources but are insufficient without additional educational support.

(*continued*)

Table 3. Continued.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
Sabouni et al., 2017	Multiple strategy peer-taught evidence-based medicine course in a poor setting.	Syria and Egypt, 84 Graduate entry medical students and recently graduated final year medical students. Convenient Sampling Faculties of Medicine of Damascus University, Syria, Cairo University, Egypt, and Tanta University, Egypt	survey	EBM education intervention, 6 weeks. Multiple strategy (online peer taught lectures with 2–4 videos lasting 90 min in each session and two interactive practical workshops.) Journal club discussions. Stand alone. Quiz. -Berlin questionnaire and a self-reported confidence questionnaire were used to evaluate the course	The purpose of the study was to evaluate the effectiveness of a multiple strategy peer-taught online course in improving EBM awareness and skills among medical students in two developing countries, Syria and Egypt.	Skills, knowledge before and after the course. As a self-rating of EBM skills and knowledge, all the included participants (100%) thought they knew little or nothing at all about evidence-based medicine before the course. This percentage decreased by half (p-value <0.001) after completing the course. - The mean scores of students' pre- and post-course Berlin tests was 3.5 (95% CI: 2.94–4.06) and 5.5 (95% CI: 4.74–6.26) respectively, increasing significantly by 2 marks (95% CI: 1.112–2.888; p-value <0.001). To come up with reliable Evidence-Based Medicine practitioners in developing countries, multiple strategy peer-taught online courses are an effective approach and a comparable alternative to face-to-face expert-taught courses. **Key Findings:** Pre-course knowledge of EBM was minimal (100% of participants rated themselves low). Post-course, students showed significant improvement in EBM knowledge (mean score increased from 3.5 to 5.5, $p < 0.001$). **Conclusion:** Peer-taught online EBM courses are effective and a viable alternative to expert-taught face-to-face courses, especially in resource-limited settings.
Atwa & Abdelaziz, 2017	Evidence based medicine for undergraduate medical students: A six-step integrative approach.	Saudi Arabia, 247, Undergraduate Year 4 medical students in the education programs: Medicine, Dentistry, Clinical pharmacy, and Nursing. Exclusion is not stated. Convenient Sampling Sina National College for Medical Studies in Jeddah	survey	Atwa & Abdelaziz, 2017. The EBP pilot education intervention's curriculum followed a six-step method. No duration is given. The EBP course integrated into curriculum with many strategies (group discussion, hands-on training, interactive lectures). Using a marking	To design and pilot a basic course on EBM for undergraduate medical students to raise the awareness of the Saudi medical education community about EBM.	knowledge Skills Attitude It is important to integrate EBP principles into the curriculum. The students had a positive attitude towards incorporating EBP into the curriculum. 89% of the students passed the cause while 11% failed. Teaching EBM is recommended and

(*continued*)

Table 3. Continued.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
				scheme, instructors evaluated the intervention. A 20-question, multiple-choice test assessed knowledge. Using a questionnaire, the programme was assessed.		applicable. It is not resource-intensive and can be conducted through developing and integrating EBM courses in the undergraduate medical curriculum. **Key Findings:** 89% of students passed the course. Positive attitude towards integrating EBM into the curriculum. **Conclusion:** EBM principles should be integrated into the undergraduate medical curriculum, as the course was effective, resource-efficient, and positively received by students.
Sukkariek and Hoffat, 2017	Integrating evidence- based practice into a Lebanese nursing Baccalaureate program: Challenges & Success	Lebanon, 241 Fourth year medical Students completing a Clinical Epidemiology and Evidence-based Medicine module in the academic year 2014–2015. Random Sampling. Exclusion is not stated. Faculty of Medicine Universitas Indonesia.	.	Evidence-based practice education intervention integrated into two courses at two different levels of the BSN curriculum. Embedded in the curriculum. Multiple strategy. Evaluation was based on descriptive writing and proper use of English. Embedded in the curriculum. Students participated in an anonymous course evaluation at the end of each semester using an on-line process as per the university evaluation methods. A Likert scale was used.	To establish the challenges and successes of integrating an evidence-based practice course into a Lebanese nursing baccalaureate program.	Knowledge, skills and attitude. Course evaluation data shows that students who participated in the course evaluation process agreed (range2.5–3.5) that the course learning outcomes were met and agreed (range 2.57–3.33) that the graded assignments helped them meet the learning outcomes. Students agreed (range2.43–3.33) that the courses stimulated their interest in research and EBP. With the exception (the 012/2013 group), Integrating EBP into the undergraduate nursing curriculum remains indispensable to lessen the gap between academia and practice, hence reaching optimal health outcomes and healthcare of individuals and populations. **Key Findings:** Students agreed that the course met learning outcomes and stimulated interest in research. Students also agreed that graded assignments helped them meet course goals. **Conclusion:** Integrating EBP into the nursing curriculum is essential for bridging the gap between academia and clinical practice, leading to better health outcomes.

(*continued*)

Table 3. Continued.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
WindyaheNing et al., 2019	Evaluating of the role of near-peer teaching in critical appraisal skills learning: a randomised crossover trial.	Indonesia, 241Fourth year medical Students completing a Clinical Epidemiology and Evidence-based Medicine module in the academic year 2014–2015. Random Sampling. Exclusion is not stated. Faculty of Medicine Universitas Indonesia.	RCT	The intervention was adapted from the University Medical Center Utrecht. The module is completed 4 weeks. Standalone, Peer teaching, Multiple strategy -Evaluation of self-efficacy utilized a modified version of the Evidence-based Practice Confidence (EPIC) scale -Attitudes were measured using part of the Knowledge Attitudes and Behaviours questionnaire developed by Johnston and colleagues Student experience was evaluated by a questionnaire (Knobe & colleagues)	To evaluate near-peer tutors' teaching of critical appraisal skills to medical students as an aspect of Evidence-based Medicine.	Knowledge, -skills, attitude Experience with the intervention. The mean + SD age of participating students was 22.1 + 1.1 years (range 18.9–26.7 years), of whom 89 (36.9%) were male. The median age of near-peer tutors was 24 years (range 23–26 years). The median age of staff tutors was 41.5 years (range 37–55 years). Mid -evaluation following the first two discussion sessions found no statistically significant difference t (241) = −1 .520, p = 0.130) between mean + SD of written test scores for the near-peer tutored group (65.89 + 12.86) and the staff-tutored group (63.18 + 13.69). The present findings confirm that near-peer tutors can be as effective as and more readily accepted than staff tutors. **Key Findings:** No significant difference in post-test scores between near-peer and staff tutors (p = 0.130). However, students accepted peer tutoring more readily. **Conclusion:** Near-peer teaching can be as effective as staff tutoring and may be more accepted by students, making it a viable alternative.
Al-Youzbaki et al., 2020	Evidence based medicine: short course effects to a medical undergraduate.	Iraq, 25, 4th year medical undergraduates for the academic year 2017–2018. Randomised Sampling, AL Iraqia Medical College in Baghdad, Iraq.	RCT	EBP course based on the Berlin questionnaire. It was conducted for 14 weeks in the 2nd semester. Standalone Multiple strategy (didactic lectures, small group discussion, E-practice). Knowledge and skills were assessed using the Berlin questionnaire on EBP. Attitudes was assessed using a special	The purpose was to estimate the usefulness and value of teaching an interventional introductory EBM course to undergraduate medical students.	EBP knowledge Skills Attitude. There was a significant difference between the students' knowledge in pre- and post-tests, as the mean of computed knowledge scores was significantly higher in post-test than that in pre-test (76.8000 ± 11.80395 vs. 58.8000 ± 18.77942) respectively($P < 0.05$) There was a significant difference among study groups regarding

(*continued*)

Table 3. Continued.

Author(s) and year	Title	Location/participant characteristics(population)	Study design	Intervention	Study aims/purpose	Variables/key findings/conclusion
				questionnaire generated by the researchers and reviewed by special committee in the Family and Community Medicine Department.		gaining EBM skills between post- and pre-test, as the mean of skills scores in post-test was significantly. higher than that in pre-test (90.4000 ± 14.57166 vs. 25.6000 ± 11.21011) respectively ($P < 0.01$) The prompt short course in EBM training among undergraduate medical students is feasible and useful. Thus, it should be applied and included in the curriculum. **Key Findings:** Significant improvement in knowledge and skills scores from pre-test to post-test ($p < 0.05$ for knowledge, $p < 0.01$ for skills). **Conclusion:** The short EBM course was feasible, effective, and should be incorporated into medical curricula.

Key:
Population.
Sample size.
Participants.
Inclusion and exclusion criteria.
Sampling method.
Study settings.
Intervention.
Education intervention.
Duration of intervention.
Approach of EBP intervention.
Evaluation methods.

Data synthesis

The data was summarised descriptively using a best evidence synthesis approach (Piggott et al., 2023; Mbabazi et al., 2024c). This approach involved identifying the data that best answered the research question. The data was analysed and summarised using frequency tables, pie charts, and histograms.

Results

Nine hundred and forty-two studies were retrieved. Eight hundred and forty-eight studies were screened for title and abstract. Full text screening was done on eleven studies. Furthermore, of the 11 full-text studies screened, 837 articles excluded for ineligible population and articles that were not written in English language) three were excluded for in appropriate study design (qualitative studies). The results of the comprehensive search are reported in the PRISMA flow diagram in Figure 1.

Limitations of the PRISAM flow diagram (Figure 1)

A key limitation of this systematic review is its inclusion of only English-language studies, which may have excluded relevant research from non-English-speaking regions. This is particularly concerning in the context of a global review focused on developing countries, where many studies may be published in local languages or regional journals not indexed in English-language databases.

As a result, valuable data from regions like Asia, Africa, and Latin America could have been omitted, potentially introducing bias and limiting the comprehensiveness of the findings. To mitigate this issue, future reviews should consider including studies in multiple languages or collaborating with translators to incorporate non-English studies. Acknowledging this language exclusion is essential when interpreting the findings, as it may impact the generalizability and conclusions of the review.

Characteristics of included studies

This SR included eight papers (Table 3). One study was conducted in North Africa (Sabouni et al., 2017). The majority of the included studies (seven) were conducted in Asia (Sánchez-Mendiola et al., 2012; Kahouei et al., 2015; Atwa & Abdelaziz, 2017; Sukkarieh-Haraty & Hoffart, 2017; Widyahening et al., 2019; Al Shahrani, 2020; Al-Youzbaki et al., 2020).

The majority of studies had a university as the study setting. The sample sizes ranged from 25 to 315. Among the included studies, three (Sánchez-Mendiola et al., 2012; Widyahening et al., 2019; Al-Youzbaki et al., 2020) used randomisation sampling, while the other five (Sabouni et al., 2017; Kahouei et al., 2015; Atwa & Abdelaziz, 2017; Sukkarieh-Haraty & Hoffart, 2017; Al Shahrani, 2020; Al-Youzbaki et al., 2020) used convenience sampling. Five of the studies included 4th-year students as participants. The study duration in the majority of the studies was between 4 to 14 weeks.

Multiple strategies were used to deliver the EBP content in six of the studies (Sabouni et al., 2017; Atwa & Abdelaziz, 2017; Sukkarieh-Haraty & Hoffart, 2017; Widyahening et al., 2019; Al-Youzbaki et al., 2020; and Al Shahrani, 2020). Half of the interventions were standalone interventions while half were embedded in the curriculum. The majority of the interventions were taught by qualified staff, only two studies (Sabouni et al., 2017; Widyahening et al., 2019) were taught by peers. All the studies had at least one of the EBP domains (knowledge, skills, attitude, and behaviour) as one of the outcomes. Surprisingly only one study had all the EBP domains as measured outcomes (Sánchez-Mendiola et al., 2012).

Seven out of the eight included studies did not justify the sample size. All eight studies did not put measures in place to avoid contamination and cointervention. Although the purpose of all the included studies was clearly stated and all the studies were embedded in relevant literature. The outcomes measured in all the studies were valid and in line with the methods. The clinical importance was reported and the conclusions in all the included studies were in line with the methods and results. Table 3 below provides a clearer overview of the extracted data from the included studies, enhancing transparency regarding the study designs, interventions, evaluation methods, and key findings. It also incorporates more details on the population, study settings, and sampling methods.

Additional information

- Sampling Method: Most studies used convenience sampling, except for WindyaheNing et al., and Al-Youzbaki et al., 2020, which used randomized sampling.
- Evaluation Methods: Various evaluation methods were used, including questionnaires, self-reported confidence scales, multiple-choice tests, and Likert scales. The evaluation typically focused on knowledge, skills, and attitudes related to EBM.
- Limitations: A common limitation in these studies is the reliance on self-reported data, which may introduce bias. Several studies also did not mention inclusion or exclusion criteria clearly, and the generalizability of findings could be limited by small sample sizes and single-site settings. However, the absence of studies from certain regions and the lack of long-term follow-up suggest that further research is needed to fill these gaps.

Study characteristics

To determine the distribution of evidence from the current study by regions in the review study, data on the country where the study was conducted were retrieved. The SR revealed that EBP educational interventions that were used to teach undergraduate healthcare students in developing countries came mostly from Asian countries (87.5%) (Figure 2).

The research designs used to conduct the studies were synthesised. The majority of the studies used survey designs (62.5%), and a few studies used the RCT (37.5%) (Figure 3).

Mode of EBP educational interventions

To synthesise evidence on EBP interventions used to teach undergraduate healthcare students, educational interventions were divided into three modes: embedded in the curriculum, delivered as a standalone short course, and delivered as continuous medical education (e.g. as one-time conferences, webinars). Fifty percent of the interventions (Al-Youzbaki et al., 2020; Widyahening et al., 2019; Sabouni et al., 2017; Kahouei et al., 2015) was delivered as standalone short courses and 50% were embedded in the normal curriculum, (Al Shahrani, 2020; Atwa & Abdelaziz, 2017; Sukkariek and Hoffat, 2017 Sánchez-Mendiola et al., 2012) none of the intervention was given as a continuous medical education. Table 4 below summarises the findings on the mode of EBP intervention.

Content delivery strategies in EBP educational interventions

Various teaching strategies were used to deliver the EBP content related to the learning outcomes in the studies included in the review. Seventy-five percent of the studies used blended strategies to deliver

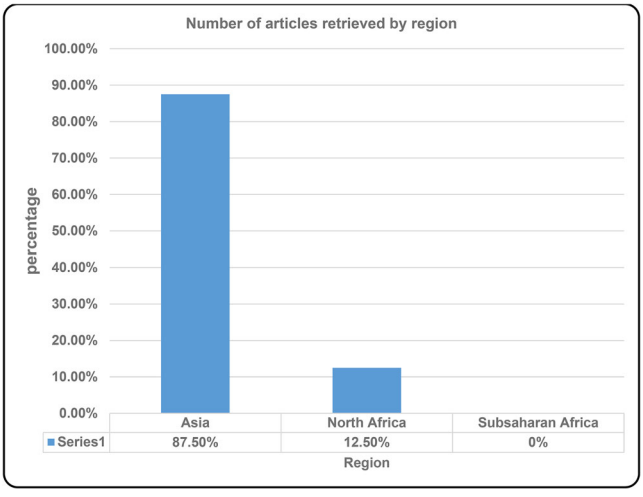

Figure 2. Articles retrieved by region.

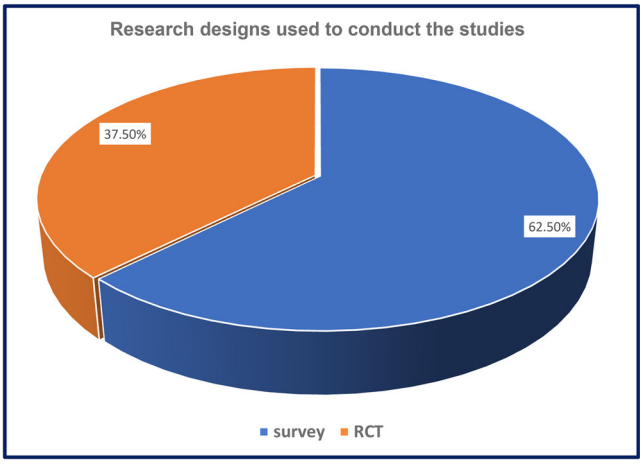

Figure 3. Pie chart demonstrates included studies survey vs RCT.

Table 4. Mode of EBP interventions.

Article included in the study	Intervention embedded in the curriculum	Standalone intervention	Continuous medical education e.g. conference
Sánchez-Mendiola et al. (2012)	+	-	-
Kahouei et al. (2015)	-	+	-
Sabouni et al. (2017)	-	+	-
Atwa and Abdelaziz (2017)	+	-	-
Sukkariek and Hoffat (2017)	+	-	-
Windyahening et al (2019)	-	+	-
Al-Youzbaki et al. (2020)	-	+	-
Al Shahrani, 2020	+	-	-
Total	50%	50%	0%

Key: + stands for yes, - stands for No.

Table 5. Effect of Intervention on EBP outcomes.

		Effect of intervention on EBP Outcomes											
		Knowledge			Attitude			Skills			Behaviour		
Number of Studies		I	ND	NA	I	ND	NA	I	ND	NA	I	ND	NA
1	Sánchez-Mendiola et al., 2012	✓			✓			✓			✓		
2	Kahouei et al., 2015	✓				✓				✓			✓
3	Sabouni et al., 2017	✓			✓			✓					✓
4	Atwa & Abdelaziz, 2017	✓			✓			✓					✓
5	Sukkariek and Hoffat, 2017			✓			✓	✓					✓
6	Widyahening et al., 2019	✓			✓			✓					✓
7	Al-Youzbaki et al., 2020	✓			✓			✓					✓
8	Al Shahrani, 2020	✓					✓	✓					✓
	Total	**7**	**0**	**1**	**5**	**1**	**2**	**7**	**0**	**1**	**1**	**0**	**7**

Key: I stand for Improved; ND stands for No difference; NA stands for not applicable.

the content. In most of the interventions a faculty member facilitated teamwork on group assignments, addressed questions, and checked articles that students selected for use.

Impact of EBP-related educational interventions on EBP outcomes among undergraduate healthcare students in developing countries

Table 5 shows the impact of an EBP educational intervention on EBP knowledge, skills, attitude, and behaviour. Knowledge was measured in all seven out of the eight studies. It is only in a study by Sukkariek and Hoffat, (2017) that EBP knowledge was not measured. Six studies assessed EBP attitudes, and five of them found that attitudes improved with the EBP interventions. In a study by Kahouei et al. (2015) there was no difference in attitude scores before and after the intervention. In addition, with regards to EBP skills, seven out of eight studies assessed EBP skills that improved with the EBP

educational intervention. Another EBP aspect is behaviour, this was assessed in only one study (Sánchez-Mendiola et al., 2012). This study scored the lowest on methodological quality, however it was included in the review because it is the only study that measured all the EBP domains.

The findings of this study showed that EBP behaviour improved among the participants after the intervention (Sánchez-Mendiola et al., 2012). From the findings, EBP educational packages led to increased knowledge and skills. All studies that measured knowledge and skills (Sánchez-Mendiola et al., 2012; Kahouei et al., 2015; Sabouni et al., 2017; Atwa & Abdelaziz, 2017; Widyahening et al., 2019; Al-Youzbaki et al., 2020; Al Shahrani, 2020) found that there was an increase in EBP knowledge and skills among the participants after the interventions. The majority of the studies ((Sánchez-Mendiola et al., 2012; Sabouni et al., 2017; Atwa & Abdelaziz, 2017; Widyahening et al., 2019; Al-Youzbaki et al., 2020) found improved attitudes. Nonetheless Kahouei et al. (2015) reported no difference in participants' attitudes before and after the EBP education intervention.

Discussion

The current review assessed educational interventions for teaching and learning EBP among undergraduate healthcare students in developing countries. It offers significant evidence concerning the characteristics of EBP interventions and their effect on the knowledge, attitude, skills, and behaviour among undergraduate healthcare students in developing countries. The SR was significant because it identified a paucity of quantitative primary studies on EBP educational interventions for undergraduate healthcare students in developing countries. The findings of the current study echoed findings in literature (Cardoso et al., 2021; Patelarou et al., 2020; Yi-Hao Weng et al., 2013; Barako et al., 2012). As demonstrated in Figure 2, there were seven empirical studies in Asia, one in North Africa, and none in Sub-Saharan Africa.

The review shows that most of the evidence about EBP interventions used to teach undergraduate healthcare students in developing countries comes from Asian countries (87.5%). No study was found from sub-Saharan African countries (Patelarou et al., 2020). This was a surprising result, since there have been efforts in sub-Saharan Africa to improve EBP in the health care systems. Institutions like the African Centre for SRs and knowledge translation have been set up to improve the use of research in health policy in Uganda and East Africa (Kinengyere et al., 2015).

However, it is possible that these institutions are not putting much effort into EBP training for healthcare undergraduate students. Ondari-Okemwa (2007), study at Moi University in Eldoret, Kenya, on the opportunities and challenges of scholarly publishing in sub-Saharan Africa found several challenges that might make scholarly publishing less visible. For example, lack of resources and lack of mentors. On the other hand, the current review highlights a paucity of EBP interventions in sub-Saharan Africa. It can be argued that interventions in the context of sub-Saharan Africa need to be developed, implemented, and disseminated in international journals to support the EBP movement in this region.

Furthermore, in the current SR, half of the EBP interventions were delivered as standalone short courses, while the other half were embedded within the curriculum. The two strategies can lead to improvements in the EBP domains among the students, as noted in the current SR. Nonetheless, Bala et al. (2021), argue that when standalone short EBP courses are used, the improvement in EBP domains may be 'short-lived'. Atwa and Abdelaziz (2017) and Al Shahrani (2020) suggest a need for EBP principles to be integrated throughout all elements of healthcare professional curricula. This enables educators, irrespective of the teaching setting, to draw out evidence-based components from any or all aspects of the curriculum content, including their incorporation into assessments and examinations.

According to Lehane et al. (2019), placing EBP as a core element within the existing professional curriculum and linking it to professional accreditation processes places further emphasis on the necessity of teaching EBP to students. In line with previous research from developed countries, this review suggests that studies that embed EBP interventions for teaching undergraduate healthcare students within the curriculum are more effective than standalone studies. This suggestion is supported by literature, where authors argue that incorporating the EBP educational package into the existing curriculum is effective in terms of cost, resources, and implementation (Atwa & Abdelaziz, 2017; Sukkarieh-Haraty & Hoffart, 2017; Al Shahrani, 2020). Therefore, this transferable evidence was used to guide the development of an EBP educational package for undergraduate healthcare students in Uganda, where EBP use is in its early stages.

The current study findings revealed that four (Sánchez-Mendiola et al., 2012; Widyahening et al., 2019; Al Shahrani, 2020) of the eight studies sored high on methodological quality, as determined by the McMaster quality assessment tool. Three studies (Kahouei et al., 2015; Atwa & Abdelaziz, 2017; Al-Youzbaki et al., 2020) were moderate. Although the four studies were of high methodological quality each used a single method of sampling as opposed to a combination of two methods of sampling, or triangulation. The quality of studies noted in the current SR is not confined to the teaching of EBP in developing countries (Panhale et al., 2017). Hatala and Guyatt (2002) argue that this is a global dilemma for the teaching of various sciences. As a result, the teaching of EBP to undergraduate medical students around the world, particularly in developing countries, should not be underestimated due to a lack of adequate and robust evidence.

Researchers have evaluated the short-term and long-term impact of EBP educational interventions on the students (Scurlock-Evans, Middleton et al., 2013; Scurlock-Evans et al., 2014; McEvoy et al., 2018; Santiago et al., 2018) and they have reported positive effects of EBP educational interventions on knowledge, attitudes, and behaviour. On the other hand, students' attitudes towards future use of EBP have been reported to be low in most of these studies (Abu-Baker et al., 2021). In addition, several challenges have been reported to hinder long-term behavioural change; these include, but are not limited to, time, resources, and organisational culture (Middleton et al., 2013; Scurlock-Evans et al., 2014).

None of the eight studies included in the current review assessed the long-term effects of the EBP educational interventions. The current review findings demonstrate that promoting and encouraging EBP educational interventions to teach EBP among undergraduate healthcare students is associated with improved EBP knowledge, attitudes, skills, and behaviour (Sánchez-Mendiola et al., 2012; Kahouei et al., 2015; Atwa & Abdelaziz, 2017; Sukkarieh-Haraty & Hoffart, 2017; Widyahening et al., 2019; Al Shahrani, 2020; Al-Youzbaki et al., 2020). However, from all eight studies, findings demonstrated that not all the EBP interventions assessed EBP knowledge, skills, attitude, and behaviour as outcomes. For example, Kahouei et al. (2015), only assessed knowledge, attitudes, and skills while Al Shahrani (2020) just assessed knowledge and skills.

Sabouni et al. (2017) assessed knowledge and skills. These findings corroborate with the findings of previous studies elsewhere in the world (Young et al., 2014; Ramos-Morcillo et al., 2015; Phillips et al., 2016; McEvoy et al., 2018; Santiago et al., 2018). This SR fills a research gap by capturing the need for the development of an EBP educational package for undergraduate healthcare students. The impact of the EBP educational package on participants will require assessing all the EBP domains (knowledge, skills, attitude, and behaviour) in a single study among undergraduate healthcare students.

The findings of the SR indicate a number of factors that have an impact on whether EBP training programmes are implemented among undergraduate healthcare students in developing countries. These can be broken down into two different categories: facilitators and barriers. For instance, Atwa and Abdelaziz (2017), propose that one of the barriers may be time constraints, such as compelling study demands, and the significant amount of time needed by the method used to gather evidence. On the other hand, Sukkarieh-Haraty and & Hoffart (2017) argues that having access to different resources, such as multiple teaching strategies, well-developed EBP teaching materials, access to the literature, and a curriculum design that links EBP to clinical experience, are the fundamental building blocks of effective EBP education (Hung et al., 2015).

Current review and implications for future research and practice

The lack of longitudinal data makes it difficult to determine the true impact of EBP education on long-term professional behaviour and practice, particularly in resource-limited settings.

Additionally, many of the studies in the review did not comprehensively assess all EBP domains (knowledge, skills, attitudes, and behaviour). For instance, while some studies focused solely on knowledge and attitudes, others assessed only knowledge and skills. This selective measurement limits the ability to draw conclusions about the full spectrum of outcomes that EBP education can produce. Future research should adopt a more holistic approach, assessing all four domains in a single study, to provide a clearer picture of the impact of EBP interventions.

Another limitation is the inconsistency in the methodologies employed across studies. While four of the studies were of high methodological quality, most used a single method of sampling, which may limit the generalizability of the findings. Triangulation, which combines multiple data collection methods, could improve the robustness and validity of results.

Furthermore, the lack of diverse geographical representation, particularly from sub-Saharan Africa, highlights a critical gap in the literature. Given the ongoing efforts to improve EBP in African healthcare systems, as indicated by institutions like the African Centre for SRs, more research is needed to evaluate the effectiveness of EBP educational interventions in this region. The absence of studies from sub-Saharan Africa may reflect a broader issue of underreporting or a lack of robust educational interventions, which requires urgent attention to develop and disseminate evidence-based practices.

Limitations

This review had a number of limitations. For example, the limitation of studies to English language could have induced publication bias as the studies in other languages were not excluded. Furthermore, there was no data on follow-up assessments and therefore, the long-term effects of education interventions remain inconclusive. All eight studies did not put measures in place to avoid contamination and cointervention.

The diverse teaching strategies used across the studies, including standalone short courses and embedded curriculum interventions, also raise questions about the feasibility and sustainability of these methods in resource-limited settings.

Implication for practice and policy

Findings from this review show that teaching EBP has the potential to improve EBP knowledge, attitude, skills, and behaviour among undergraduate medical students. There is still insufficient evidence to support the argument that EBP teaching in developing countries yields long-term mastery of the EBP domains. Moreover, the majority of the studies included within the current SR did not evaluate the long-term impact of the implemented EBP educational packages on the students. Thus, robust evidence is required, and future researchers may focus on conducting quality research with an emphasis on the long-term educational effects on students.

Implication for research

The studies that were included in this review did not assess the long-term retention of EBP knowledge, skills, attitudes, and behaviour. After the implementation of the EBP training interventions, the findings may have provided positive or negative indicators regarding the future application of EBP in practice. Hence, future research on teaching EBP to undergraduate healthcare students in developing countries need to concentrate on studying the impact of EBP education on long-term EBP knowledge, skills, attitudes, and behaviours utilising rigorous techniques and assessment tools.

Long-term behavioural outcomes and practical recommendations

A key area for future research is the examination of long-term behavioural outcomes following EBP interventions. Given that several studies in this review reported low levels of students' attitudes towards future use of EBP, it is essential to explore what factors contribute to sustained engagement with EBP after the educational intervention. Longitudinal studies should assess how well students are able to apply EBP in real-world clinical settings, and whether their improved knowledge and skills translate into changes in clinical decision-making and patient outcomes.

In terms of practical recommendations, educators and policymakers should prioritize the integration of EBP into healthcare curricula in a manner that is contextually appropriate and resource sensitive. This might include developing flexible, modular EBP training programs that can be adapted to different healthcare settings, whether through online courses or short, targeted workshops.

Additionally, fostering a culture of continuous learning within healthcare institutions by promoting mentorship programs and providing ongoing support for EBP integration in clinical practice can help bridge the gap between academic learning and professional application.

To maximise the impact of EBP education in developing countries, interventions must be designed with sustainability in mind. This involves not only addressing immediate educational needs but also creating systems and structures that support ongoing EBP use long after students graduate. Collaboration, innovation, and commitment to long-term evaluation will be essential in ensuring that the benefits of EBP education translate into meaningful improvements in healthcare delivery and patient outcomes.

Conclusion

The findings of this systematic review indicate that incorporating evidence-based practice (EBP) training into the undergraduate healthcare curriculum positively impacts students' knowledge, skills, attitudes, and behaviours. However, the adoption and implementation of EBP in undergraduate medical education are still nascent, particularly in developing countries, with sub-Saharan Africa facing significant challenges. The low level of research output in these regions, coupled with limited infrastructure and resources for EBP training, hinders the widespread adoption of evidence-based healthcare decision-making. To address these gaps, it is essential to prioritize the integration of EBP into healthcare curricula through tailored training programs, local partnerships, and the development of region-specific evidence that aligns with the contextual realities of sub-Saharan Africa. Despite these promising findings, there are practical challenges that must be acknowledged. These include limited access to quality research resources, the need for trained educators, and overcoming institutional resistance to curricular changes. Future studies should focus on addressing these limitations by exploring innovative, low-cost methods for EBP training and fostering regional collaborations to build local research capacity. Additionally, more robust and context-specific studies are needed to evaluate the long-term impact of EBP education on clinical practice in developing countries. By addressing these practical considerations, the study's recommendations can be more effectively implemented, supporting the broader adoption of EBP in healthcare systems in resource-constrained settings.

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