THE CAMPBELL COLLABORATION

Protocol for a Systematic Review:
E-learning of Evidence-Based Health Care to Increase EBHC Competencies in Healthcare Professionals

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Submitted to the Coordinating Group of:

☐	Crime and Justice
☒	Education
	☐ Disability
☐	International Development
	☐ Nutrition
☐	Social Welfare
☐	Other:

Plans to co-register:

☒	No		
☐	Yes	☐ Cochrane	☐ Other
☐	Maybe		

BACKGROUND

The need for evidence-based health care competencies

Evidence-based medicine (EBM), introduced in 1991, has its roots in the field of clinical epidemiology and was listed as "one of the 15 greatest medical milestones since 1840" in the *British Medical Journal* (Montori & Guyatt, 2008). The most commonly used definition of evidence-based medicine (EBM) describes it as "the conscientious, explicit and judicious use of the current best evidence in making decisions about the care of individual patients" (Sackett, Rosenberg, Muir Gray, Haynes, & Richardson, 1996). It thus requires practitioners to bring together external evidence about the effects of new tests, treatments and interventions, clinical judgement and expertise, and the patient's clinical state, values, preferences, needs and predicament.

EBM is now more commonly referred to as evidence-based practice (EBP) or evidence-based health care (EBHC), as EBM is not limited to medical doctors, but should be adopted by all healthcare practitioners. Practicing EBHC typically involves five steps: (i) formulating an answerable question from a healthcare problem; (ii) finding the best available evidence applicable to the question; (iii) critically appraising the evidence for validity, clinical relevance, and applicability; (iv) applying the results of the evidence in the healthcare setting; and (v) evaluating the performance (Dawes et al., 2005). An important aim of EBHC is that beneficial, effective health care practices are adopted, and that harmful and ineffective ones are abandoned. Consequently, this requires healthcare professionals to recognise their deficiencies in knowledge and to adopt a philosophy of life-long learning, which is the backbone of practicing EBHC (Greenhalgh & Macfarlane, 1997).

The importance of the knowledge, skills, and attitude learnt through the principles of EBHC is also highlighted in the *Lancet* report on the health professional for the 21st century (Frenk et al., 2010), which proposes that healthcare professional training become transformative. One of the fundamental shifts of transformative learning aligns almost perfectly with the steps of EBHC: the shift from memorization of facts to "critical reasoning that can guide the capacity to search, analyse, assess and synthesise information for decision-making" (Frenk et al., 2010).

In addition, Glasziou and colleagues (2011) have urged educational institutions to teach medical students skills that enable them to become life-long learners so that they are able to combine external evidence from research with their own expertise and their patients' values and preferences. They emphasize that teaching EBHC skills should form an integral part of the medical curriculum and be re-iterated and practiced throughout undergraduate and postgraduate training (Glasziou, Burls, & Gilbert, 2008; Glasziou, Sawicki, Prasad, & Montori, 2011).

In a recent evaluation of an online module of EBM, we have proposed a set of EBHC competencies that all healthcare professionals should ideally possess once they graduate (Rohwer, Young, & van Schalkwyk, 2013). These competencies comprise five key competencies that mirror the five steps of EBHC, as well as enabling competencies that include basic knowledge of epidemiology and biostatistics. Figure 1 is a graphic representation of the EBHC competencies.

Figure 1: EBHC key and enabling competencies

A number of systematic reviews have explored the effects of teaching EBHC to healthcare professionals, both at the undergraduate and postgraduate stages. From these reviews, it is evident that teaching EBHC to students and health care professionals leads to increased EBHC knowledge and skills (Coomarasamy & Khan, 2004; Flores-Mateo & Argimon, 2007; Ilic, 2009; Norman & Shannon, 1998). The question is therefore no longer *whether* we should be teaching EBHC, but rather *how* we should be teaching it. Khan and Coomarasamy (2006) have proposed a hierarchy of teaching EBHC, where integrated and interactive teaching is seen as the most effective way of teaching EBHC (Khan & Coomarasamy, 2006). This, however, only refers to traditional lecture-based or face-to-face teaching of EBHC and does not include the increasingly popular method of electronic learning.

Electronic Learning (e-learning)

Electronic learning or e-learning (as the term is widely used) strategies have been widely adopted by educators around the world, and it is not surprising that it has also become a buzzword amongst medical educators. E-learning—also called web-based learning, online learning, distributed learning, computer-assisted instruction, and internet-based learning— can be defined as the delivery of training material via information and communication

technology (ICT), including the Internet, CD-ROMs, DVDs, smartphones, and other media, both inside and outside of the classroom (Frehywot et al., 2013; Ruggeri, Farrington, & Brayne, 2013; Ruiz, Mintzer, & Leipzig, 2006).

Pure e-learning refers to the use of e-learning materials only, without any face-to-face classroom methods. Although it seems to be synonymous to completely online learning, the difference between pure e-learning and fully-online learning refers to the delivery platform. While online learning relies on a web-based delivery platform and requires Internet access, pure e-learning can take place without internet access, e.g., using CD-ROMs to deliver the educational content. Blended learning combines e-learning components with other traditional face-to-face, lecture-based learning in and outside of the classroom (Frehywot et al., 2013).

Potential advantages of e-learning include improved accessibility of educational materials at a time convenient to the learner; individualised or personalised learning, where the learner decides on the amount, pace and place, which allows personal tailoring of the learning experience and meeting of individual learner objectives; lower training costs; collaborative learning environments; the ability to track learner activity; and provision of consistent and standardized training to a larger number of learners all over the world (Clark, 2002; Ruggeri et al., 2013; Ruiz et al., 2006; Welsh, Wanberg, Brown, & Simmering, 2003).

Potential disadvantages of e-learning include costs related to the technologies as well as the staff needed, although most costs seem to occur at the development stage of e-learning courses, and social isolation or the lack of interaction among the participants in the e-learning activity or course. The lack of face-to-face networking and peer interaction can be seen as a huge drawback, possibly making e-learning less attractive and less useful. Poor instructional design, technical problems, and de-individualised instruction can also be regarded as disadvantages of e-learning (Cook, 2007; Welsh et al., 2003).

E-learning is a complex intervention with multiple components and dimensions that may interact differently in different contexts (Wong, Greenhalgh, & Pawson, 2010). In the literature, different components, levels, dimensions, and categories of e-learning have been described.

Ruiz et al. (2006) describe the components of e-learning as being (i) the development of content, (ii) management of the content, and (iii) delivery of the content. Regarding development of content, digital learning objects, i.e., "any grouping of digital materials structured in a meaningful way and tied to an educational objective," are the fundamental components of lessons, modules, and curricula, created with the help of instructional design and pedagogical principles. Examples of digital learning objects include tutorials, case-based learning scenarios, hypermedia, simulations, and game-based learning modules (Ruiz et al., 2006).

Management of content encompasses the administrative functions (storing, indexing, cataloguing) needed to make content available to learners through portals, repositories, digital libraries, learning management systems (e.g., Blackboard WebCT), search engines, and e-Portfolios (Ruiz et al., 2006).

Content can be delivered in a synchronous or asynchronous way. Synchronous delivery of content refers to real time, instructor-led learning, where all learners receive information simultaneously, and communicate and interact directly with other learners by logging onto platforms like virtual classrooms (e.g. teleconferencing, Internet chat forums, instant messaging). Asynchronous delivery of content occurs when the transmission and receipt of information occurs at different time points. It can include pre-recorded presentations or podcasts, PowerPoint slides, or even more sophisticated applications like simulations. While asynchronous communication is done by means of email, online bulletin boards, listservs, newsgroups, wikis, or weblogs, it enables learners to participate in the learning activity at any time of day, from any desired location (Ruiz et al., 2006; Welsh et al., 2003).
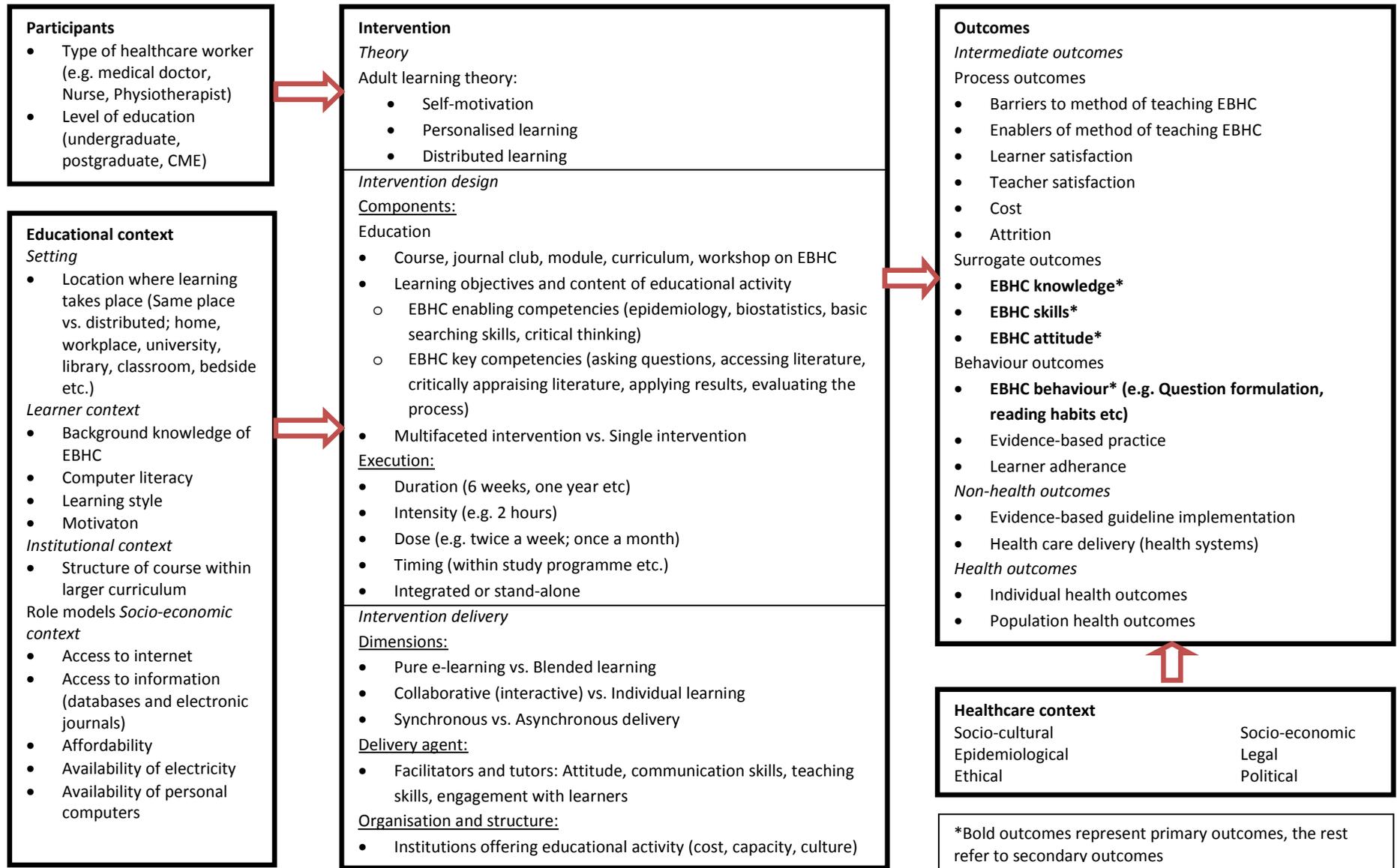
Ruggeri et al. (2013) describe the different dimensions and attributes of e-learning programmes under four headings: synchronicity (asynchronous vs. synchronous), location (same place vs. distributed), independence (individual vs. collaborative), and mode (electronic-only vs. blended) (Ruggeri et al., 2013).

Cook (2005) describes four levels of instructional design in computer-based learning: medium, which refers to the mode of delivery of instruction (e.g., textbook, face to face, computer-based, television); configuration, referring to the "big picture" differences within a given media format (e.g., computer: web-based discussion board, web-based, or CD-ROM-based tutorial, vs. face to face: small-group discussion, lecture); instructional method, referring to teaching techniques that support learning processes (e.g., learning activities, self-assessment questions, clinical cases, simulations, group discussions); and presentation, referring to elements of the given medium that enhance the intervention, but do not qualify as instructional methods (e.g., hyperlinks, multimedia, font simulation fidelity) (Cook, 2005).

Our understanding of the complexity of e-learning of EBHC and the different components, contextual factors, and interactions that are needed to achieve the desired outcomes are graphically depicted in Figure 2 (Rohwer & Rehfuess, 2013).

In an effort to tease out the characteristics and dimensions of e-learning interventions in order to be combined meaningfully, we have only listed the broad categories that we thought of as being most important.

Figure 2: Systems-based logic model on e-learning of EBHC

Participants
- Type of healthcare worker (e.g. medical doctor, Nurse, Physiotherapist)
- Level of education (undergraduate, postgraduate, CME)

Educational context
Setting
- Location where learning takes place (Same place vs. distributed; home, workplace, university, library, classroom, bedside etc.)

Learner context
- Background knowledge of EBHC
- Computer literacy
- Learning style
- Motivaton

Institutional context
- Structure of course within larger curriculum

Role models *Socio-economic context*
- Access to internet
- Access to information (databases and electronic journals)
- Affordability
- Availability of electricity
- Availability of personal computers

Intervention
Theory
Adult learning theory:
- Self-motivation
- Personalised learning
- Distributed learning

Intervention design
Components:
Education
- Course, journal club, module, curriculum, workshop on EBHC
- Learning objectives and content of educational activity
  - EBHC enabling competencies (epidemiology, biostatistics, basic searching skills, critical thinking)
  - EBHC key competencies (asking questions, accessing literature, critically appraising literature, applying results, evaluating the process)
- Multifaceted intervention vs. Single intervention
Execution:
- Duration (6 weeks, one year etc)
- Intensity (e.g. 2 hours)
- Dose (e.g. twice a week; once a month)
- Timing (within study programme etc.)
- Integrated or stand-alone

Intervention delivery
Dimensions:
- Pure e-learning vs. Blended learning
- Collaborative (interactive) vs. Individual learning
- Synchronous vs. Asynchronous delivery
Delivery agent:
- Facilitators and tutors: Attitude, communication skills, teaching skills, engagement with learners
Organisation and structure:
- Institutions offering educational activity (cost, capacity, culture)

Outcomes
Intermediate outcomes
Process outcomes
- Barriers to method of teaching EBHC
- Enablers of method of teaching EBHC
- Learner satisfaction
- Teacher satisfaction
- Cost
- Attrition
Surrogate outcomes
- **EBHC knowledge***
- **EBHC skills***
- **EBHC attitude***
Behaviour outcomes
- **EBHC behaviour* (e.g. Question formulation, reading habits etc)**
- Evidence-based practice
- Learner adherance
Non-health outcomes
- Evidence-based guideline implementation
- Health care delivery (health systems)
Health outcomes
- Individual health outcomes
- Population health outcomes

Healthcare context

Socio-cultural	Socio-economic
Epidemiological	Legal
Ethical	Political

*Bold outcomes represent primary outcomes, the rest refer to secondary outcomes

How e-learning May Work

A number of studies, including a few systematic reviews, have been done in various fields of medical and health science education, examining whether different types of e-learning have an effect on knowledge and skills.

A systematic review on Internet-based learning amongst healthcare professionals (Cook, Levinson, Garside, Dupras, Erwin, & Montori, 2008) found large, statistically significant effects for knowledge, skill, and behaviour outcomes when comparing Internet-based educational interventions to no educational interventions. When comparing Internet-based educational interventions with non-Internet-based interventions, there was a very small statistically significant effect for knowledge outcomes but no statistically significant effect for skill and behaviour outcomes. Internet-based learning in the healthcare professions can thus be beneficial and neither superior nor inferior to traditional educational models.

Other studies have examined *how* e-learning works, focusing more on the essential components for successful learning, as well as certain contextual factors that influence learning.

A realist review by Wong et al. (2010), looking at "what works, for whom and in what circumstances" when considering Internet-based medical education, concluded that online courses need to engage the learners to use the technology, which is more likely to happen when the technology is perceived as being useful and easy to use; and that interactivity should be a key characteristic of an online course, since learners want to be able to enter a dialogue with tutors and peers (Wong et al., 2010).

A systematic review by Cook and colleagues (2010) looking at ways to improve Internet-based learning had similar conclusions. They found an association between interactivity, practice exercises, repetition, and feedback, as well as improved learning outcomes, although they also found significant heterogeneity which needs to be taken into consideration when interpreting the results (Cook et al., 2010)

E-learning technologies afford a new learner paradigm based on adult learning theory, explaining that adults learn by relating new information to past experiences; tailoring learning to their unique needs (open learning); and applying learning in practice, resulting in more effective and efficient learning experiences. The attributes of accessibility and convenience (distributed learning) personalise the learning, because students decide when and where they are receptive to learning. Learning becomes an individual experience where adults learn because they want to learn–not because they are told to learn. This shift from "expert-led *teaching* to user-lead *learning*" results from intrinsic motivation and offers a much stronger learning stimulus. Some evidence suggests that learning by means of e-learning is more efficient and that learners gain knowledge faster, which in turn translates back to improved motivation and enhanced learning (Clark, 2002; Dabbagh, 2005; Ruggeri et al., 2013; Ruiz et al., 2006).

When considering these attributes and pedagogical underpinnings of e-learning, one can argue that these fit perfectly within the EBHC paradigm. Enhanced learning occurs through internal motivation rather than external drivers, and requires acknowledgement of shortcomings (knowledge gaps) and adoption of a reflective approach towards one's own practice. This alignment between attributes of e-learning and EBHC foci suggests that making use of e-learning in this context could be of value.

The pathway from EBHC e-learning activities to the desired outcomes, i.e. increased knowledge, skill, attitude and behaviour, as well as health outcomes is depicted in Figure 3 (Rohwer & Rehfuess, 2013).

Figure 3: Process-orientated logic model showing the pathway from EBHC learning to desired outcomes
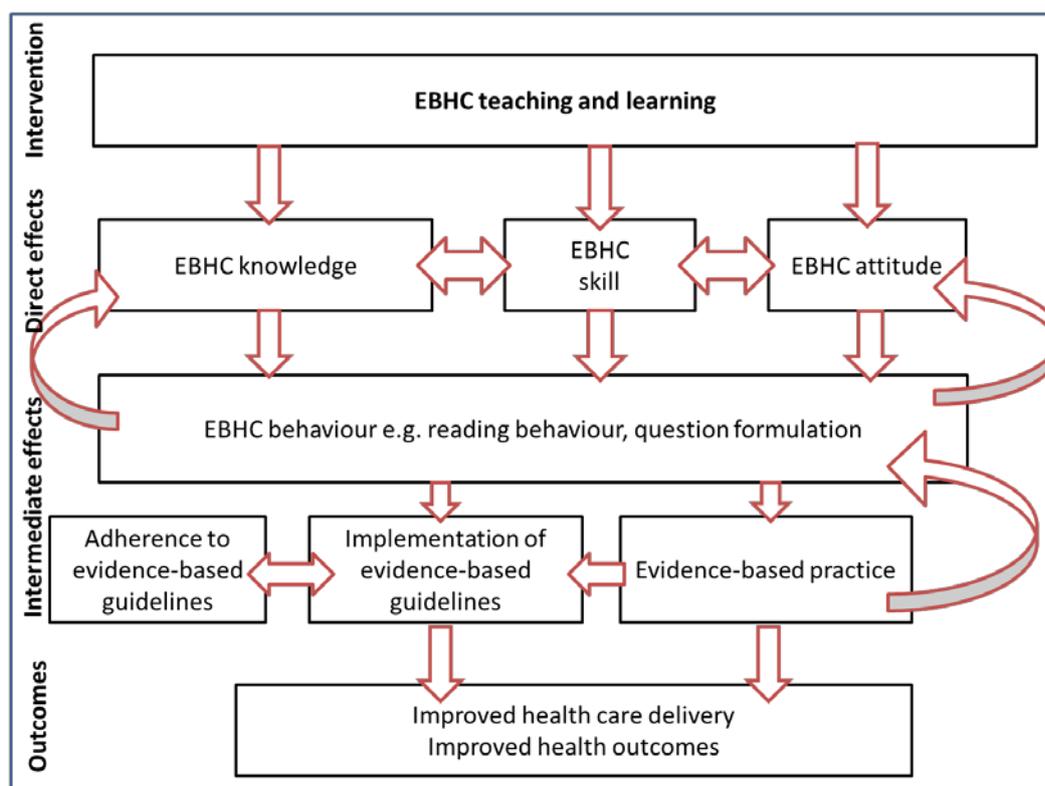
It is important to note that this pathway does not take place in a vacuum, but that ultimately, improved health care delivery and improved health outcomes do not only rely on evidence-based practice, but are influenced by a variety of other factors within the healthcare context, such as socio-cultural, socio-economic, epidemiological, legal, ethical, and political factors on a national and international level (See Figure 2).

Why it is Important to do this Review

A recent overview of systematic reviews (Young, Rohwer, Volmink, & Clarke, 2013) that included 16 systematic reviews examining the effects of educational activities on EBHC

found that when comparing single interventions (a workshop, journal club, lecture, or e-learning) with multifaceted interventions (a combination of different strategies, such as lectures, tutorials, e-learning, and journal clubs), multifaceted clinically integrated educational activities were more likely to increase EBHC knowledge, skills, attitude, and behaviour. Although some of the studies included in the systematic reviews related to e-learning activities, it is still unclear whether e-learning of EBHC leads to increased knowledge, skills, attitude, and behaviour. In addition, it is still unknown whether some e-learning strategies are more useful and effective than others.

This review considers e-learning of EBHC to be a complex intervention and focuses on the effectiveness of the interventions, as well as the implementation and contextual factors in delivering the intervention. In teasing out these issues, we hope to be able to formulate evidence-based recommendations for EBHC teachers and program developers.

OBJECTIVES

Primary objective:

- To assess the effectiveness of e-learning of EBHC on increasing EBHC competencies in healthcare professionals.

Secondary objectives:

- To assess the effectiveness of specific dimensions of e-learning in increasing EBHC competencies.

- To assess how educational context influences the effectiveness of EBHC e-learning.

- To assess how implementation approaches influence the effectiveness of EBHC e-learning.

METHODOLOGY

Study inclusion criteria

Types of studies.

We will consider the following study designs for inclusion in the review, as defined by the Effective Practice and Organisation of Care (EPOC) group of The Cochrane Collaboration (http://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/EPOC%20Study%20Designs%20About.pdf):

- Randomized controlled trials (RCTs)

- o An experimental study in which people are allocated to different interventions using methods that are random.

- Cluster randomized controlled trials

  - o An experimental study in which groups of people (clusters) are allocated to different interventions using random methods. EPOC recommends that only studies with at least two intervention sites and two control sites are included, in order to minimise confounding due to study site.

- Non-randomised controlled trials (NRCTs)

  - o An experimental study in which people are allocated to different interventions using methods that are non-random

- Controlled before-after studies (CBAs)

  - o A study in which observations are made before and after the implementation of an intervention, both in a group that receives the intervention and in a control group that does not. In this case, decisions about allocation to different groups are not made by the investigators. EPOC recommend that only studies with at least two intervention and two control sites are included, in order to minimise confounding due to study site.

- Interrupted time series (ITS)

  - o A study that uses observations at multiple time points before and after an intervention. Studies should have a clearly defined point in time when the intervention occurred with at least three data points before and three data points after the intervention.

In addition, we will include studies supporting the included intervention studies that yield information on the process of implementation. These studies may be quantitative (e.g., process evaluations, quantitative interview studies) or qualitative in nature (e.g., focus groups, qualitative interview studies). The information gathered may be reported within the above included intervention studies, or cited within these and published separately. We will not include these supporting studies in the data synthesis, but rather report their results separately, in a tabular or narrative form.

Types of participants

We will include all healthcare professionals, including doctors, dentists, nurses, occupational therapists, physiotherapists, dieticians, audiologists, mental health professionals, psychologists, counsellors, and social workers; at undergraduate, postgraduate, or

continuing medical education (CME) level; working in primary, secondary, or tertiary environments.

Types of interventions

We will include any educational intervention (a co-ordinated educational activity) that includes any or all of the 5 steps of EBHC (asking questions, searching the literature, critically appraising the literature, applying the results, evaluating the process) and is delivered via an electronic platform (e-learning only), or makes use of e-learning in a supplementary way (blended learning). E-learning (web-based learning, online learning, distributed learning, computer-assisted instruction) will be regarded as: delivery of training material via any electronic media (Internet, CD-ROMs, DVDs, smartphones, and other media), independent of the delivery platform.

Types of comparison

We will include the following comparisons:

- No educational intervention.

- Any educational intervention that includes any or all of the 5 steps of EBHC (asking questions, searching the literature, critically appraising the literature, applying the results, evaluating the process) that is delivered via an electronic platform, but with different components than the intervention (e.g. interactivity vs. no interactivity; synchronicity vs. asynchronicity).

- Any educational intervention that includes any or all of the 5 steps of EBHC (asking questions, searching the literature, critically appraising the literature, applying the results, evaluating the process) and is delivered via face-to-face learning, with no e-learning components. These control interventions will be categorized into the same broad categories as the e-learning interventions.

Types of outcome measures

Primary outcomes in this review are:

- EBHC knowledge, measured by evaluating knowledge scores with a validated pre-and post-training questionnaire, such as the Fresno test (Ramos, Schafer, & Tracz, 2003) or Berlin test (Fritsche, Greenhalgh, Falck-Ytter, Neumayer, & Kunz, 2002).

- EBHC skills, measured by evaluating skill scores with a validated pre-and post-training questionnaire, such as the Fresno test (Ramos et al., 2003) or Berlin test (Fritsche et al., 2002).

- EBHC attitude, measured with Likert-scale questions pre- and post-training (e.g., Baum, 2003; or by self-report).

- EBHC behaviour, measured by self-reported behaviour changes (e.g., amount of questions formulated, amount of searches done) or more objective measurements (e.g., proportion of clinical cases where evidence was consulted).

Secondary outcomes in this review are:

- Process outcomes

  o Satisfaction of students with method of learning, measured with Likert-scale questions post-training, or open-ended questions yielding qualitative data.

  o Satisfaction of educators with method of learning, measured with Likert-scale questions post-training, or open-ended questions yielding qualitative data.

  o Enablers of the method of learning EBHC, measured with Likert-scale questions post-training, or open-ended questions yielding qualitative data.

  o Barriers to the method of learning EBHC, measured with Likert-scale questions post-training, or open-ended questions yielding qualitative data.

  o Cost (e.g., a sum of all the monetary cost involved in the training).

  o Attrition of learners, measured quantitatively by looking at the proportion of learners that complete the training.

- Behaviour outcomes

  o Learner adherence, measured either quantitatively by looking at the proportion of learners that adhere to the prescribed learning, or qualitatively by asking learners whether about their learning experience.

  o Evidence-based practice, measured qualitatively through self-report of practitioners.

- Non-health outcomes

  o Evidence-based guideline implementation, measured quantitatively (e.g., by looking at practice audits).

  o Health care delivery, measured qualitatively through self-report of practitioners.

- Health outcomes

- Individual health outcomes; these refer to clinical patient-orientated outcomes, measured quantitatively.

- Population health outcomes; these refer to health outcomes of the community or the entire population measured quantitatively (e.g., disease incidence rates).

Information retrieval

Electronic searches

We will develop a comprehensive search strategy consisting of relevant terms (Appendix 1) and search electronic databases (MEDLINE, EMBASE, ERIC, CINAHL, CENTRAL, SCOPUS, Best Evidence Medical Education, Web of Knowledge, Google Scholar, PsycInfo) and dissertation databases (ProQuest) for relevant studies. We will not apply any language restrictions.

Searching other resources

We will complement our search with a thorough examination of reference lists of identified studies and will contact experts in the field to identify any on-going or unpublished studies. We will also search trial registries (ICTRP) for on-going studies.

Coding procedures and categories

Two authors (either AR and TY; or AR and ER) will independently screen the search outputs and abstracts for relevant studies. Full texts of studies with seemingly relevant abstracts will be retrieved and assessed for eligibility using the pre-specified inclusion criteria. Studies will be classified as either included, excluded, awaiting assessment, or on-going.

Two authors (either AR and TY; or AR and ER) will independently extract data from relevant studies by electronically completing pre-piloted data extraction forms made available via a link to Google forms (Appendix 2). In case of differences in extracted data, we will discuss these to reach consensus, and if unresolved, further discussion will involve the third author. In case of missing data, we will contact the original study author for clarification.

We will place all interventions (e-learning) and control interventions (e-learning and face-to-face interventions) into one of the following broad categories:

1. Single intervention: standalone EBHC learning
2. Single intervention: integrated EBHC learning
3. Multifaceted intervention: standalone EBHC learning
4. Multifaceted intervention: integrated learning

In addition, e-learning interventions and control interventions will be further broken down into the following subcategories:

1. Pure e-learning: individual learning
2. Pure e-learning: collaborative learning
3. Blended learning: individual learning
4. Blended learning: collaborative learning

An e-learning intervention will therefore be placed in 1 of 16 categories and a non-e-learning intervention in 1 of 4 categories.

Data on the following will be extracted from included studies (see Appendix 2 for detailed data extraction form):

- Study design
  - Type of study
  - Duration of study
  - Country where study was conducted
- Participants
  - Number of participants
  - Type of health care professionals
  - Level of education
- Interventions and control
  - Theory underlying intervention
  - Intervention design
    - Educational content (learning objectives; EBHC key and enabling competencies)
    - Duration, intensity, dose, timing of intervention
  - Intervention delivery
    - Synchronicity (synchronous vs. asynchronous learning)
    - Characteristics of facilitators and tutors (e.g. commnication skills, teaching skills, engagement with learners)
    - Institutional characteristics (e.g. cost, capacity, culture)
- Outcomes:
  - Primary and secondary outcomes
  - Measurement details (e.g. definition of outcome, tools used to measure outcome)
  - Timepoint at which outcomes were measured
- Results:
  - Measures of effect with 95% confidence intervals
  - Qualitative data
- Educational context:
  - Location

- o Learner context (background knowledge of EBHC, computer literacy, learning style)
- o Institutional context (structure of course within larger curriculum, role models)
- o Socio-economic context (Access to internet, access to information, affordability of educaton, availability of personal computer, availability of electricity)

Assessment of methodological quality

For each included study, two authors (either AR and TY; or AR and ER) will independently judge the risk of bias for different domains (selection bias, performance bias, detection bias, attrition bias, reporting bias, other bias) according to the Cochrane Effective Practice of Care's (EPOC) suggested risk of bias criteria (http://epoc.cochrane.org/sites/ [epoc.cochrane.org/files/uploads/Suggested%20risk%20of%20bias%20criteria%20for%20E](http://epoc.cochrane.org/files/uploads/Suggested%20risk%20of%20bias%20criteria%20for%20EPOC%20reviews.pdf) [POC%20reviews.pdf](http://epoc.cochrane.org/files/uploads/Suggested%20risk%20of%20bias%20criteria%20for%20EPOC%20reviews.pdf)) We will resolve discrepancies through discussion and consultation with the third author.

Risk of bias in cluster randomized controlled trials

In addition, we will look at the following risk of bias issues in case of cluster randomised controlled trials:

1. Recruitment bias:

    - o We will describe whether participants were recruited before or after randomization of clusters. We will regard studies as having low risk of recruitment bias if participants were recruited before randomization of clusters; high risk of bias if they were recruited after randomization; and unclear risk of bias if information about the timing of recruitment is unclear.

2. Baseline imbalance:

    - o We will describe any baseline imbalances between individuals and clusters.

3. Loss of clusters:

    - o We will describe number of clusters lost as well as reasons for attrition.

4. Incorrect analysis:

    - o We will describe whether analysis was adjusted for clustering.

Risk of bias in RCTs, NRCTs and CBAs

We will answer the following questions with "yes" (low risk of bias), "no" (high risk of bias) or "unclear" (unclear risk of bias) to make judgments of risk bias for RCTs, NRCTs and CBAs:

Domain	Yes	No	Unclear
Was the allocation sequence adequately generated?	Low risk of selection bias if the sequence generation was truly random (e.g. computer-generated table of random numbers, tossing a coin)	High risk of bias if sequence generation contained a non-random component (e.g. alternate randomisation, randomisation by birth date)	Unclear risk of bias if the randomisation process was not clearly described
Was the allocation adequately concealed?	Low risk of selection bias if allocation was truly concealed (e.g. central allocation of participants, use of sequentially numbered, opaque, sealed envelopes)	High risk of bias if the allocation process was not concealed (e.g. open randomisation, unsealed or non-opaque envelopes). We will score CBAs as "high risk"	Unclear risk of bias if the process of concealing allocation was not described sufficiently to make a judgement
Were baseline outcome measurements similar?	Low risk of bias if performance or patient outcomes were measured prior to the intervention, and no important differences were present across study groups. We will score RCTs as having low risk of bias if an imbalance is present, but authors appropriately adjusted the results (e.g. Analysis of covariance).	High risk of bias if important differences were present and not adjusted for in analysis.	If RCTs have no baseline measure of the outcome, we will score the study as having unclear risk of bias.
Were baseline characteristics similar?	Low risk of bias if baseline characteristics of the study and control providers are reported in the study and are similar.	High risk of bias if there is no report of participant characteristics in the text or tables; or if there are differences between the control and intervention providers.	Unclear risk of bias if characteristics were not clearly reported in the paper (e.g. characteristics are mentioned in the text but no data were presented).
Were incomplete outcome data adequately addressed?	Low risk of attrition bias if there was no missing data or if missing data was balanced across groups	High risk of bias if there was missing data or if missing data was more prevalent in one of the groups and likely to bias the results	Unclear risk of bias if it is not specified in the paper. We will not assume a 100% follow-up rate, unless it is explicitly stated.
Was knowledge of the allocated interventions adequately prevented during the study?	Low risk of detection bias if they were blind to knowledge about which intervention the participants received; or if	High risk of bias if blinding was absent	Unclear risk if blinding was not specified in the paper

	outcomes were objective		
Was the study adequately protected against contamination?	Low risk of bias if allocation was by community, institution or practice and it is unlikely that the control group received the intervention	High risk of bias if it is likely that the control group received the intervention	Unclear risk of bias if professionals were allocated within an institution or practice and it is possible that communication between intervention and control professionals could have occurred (e.g. physicians within practices were allocated to intervention or control)
Was the study free from selective outcome reporting?	Low risk of reporting bias if it is evident that all pre-specified outcomes have been reported on (e.g. all relevant outcomes in the methods section are reported in the results section).	High risk of bias if it is evident that some outcomes were omitted in the report;	Unclear risk of bias if it is unclear whether all outcomes have been reported on
Was the study free from other risks of bias?	Low risk of bias if there is no evidence of other risks of bias	High risk of bias if there is evidence of other risks of bias (e.g. conflict of interest	Unclear risk of bias if it is not clear from the paper whether other biases are present

Risk of bias for interrupted time series (ITS) studies

Domain	Yes	No	Unclear
Was the intervention independent of other changes?	Low risk of bias if there are compelling arguments that the intervention occurred independently of other changes over time and the outcome was not influenced by other confounding variables/historic events during the study period.	High risk of bias if authors reported that the intervention was not independent of other changes in time.	Unclear risk of bias if it is unclear whether the intervention was independent of other changes in time.
Was the shape of the intervention effect pre-specified?	Low risk of bias if point of analysis is the point of intervention OR a rational explanation for the shape of intervention effect was given by the author(s). Where appropriate, this will include an explanation if the point of analysis is NOT the point of intervention;	High risk of bias if it is clear that the condition above is not met.	Unclear risk of bias if it is unclear whether the condition above is met or not.
Was the intervention unlikely to affect data collection?	Low risk of bias if authors reported that the intervention itself was unlikely to affect data collection (for example, sources and methods of data collection were the same before and after the intervention).	High risk of bias if the intervention itself was likely to affect data collection (for example, any change in source or method of data collection reported).	Unclear risk of bias if it is unclear whether the intervention affected data collection
Was knowledge of the allocated interventions adequately prevented during the study?	Low risk of detection bias if they were blind to knowledge about which intervention the participants received; or if outcomes were objective	High risk of bias if blinding was absent	Unclear risk if blinding was not specified in the paper
Were incomplete outcome data adequately addressed?	Low risk of attrition bias if there was no missing data or if missing data was balanced across groups,	High risk of bias if there was missing data or if missing data was more prevalent in one of the groups and likely to bias the results.	Unclear risk of bias if it is not specified in the paper. We will not assume a 100% follow-up rate, unless it is explicitly stated.
Was the study free from	Low risk of reporting bias if it is	High risk of bias if it is evident that some	Unclear risk of bias if it is unclear

selective outcome reporting?	evident that all pre-specified outcomes have been reported on (e.g. all relevant outcomes in the methods section are reported in the results section).	outcomes were omitted in the report;	whether all outcomes have been reported on
Was the study free from other risks of bias?	Low risk of bias if there is no evidence of other risks of bias	High risk of bias if there is evidence of other risks of bias (e.g. conflict of interest)	Unclear risk of bias if it is not clear from the paper whether other biases are present

1. Compatibility with RCTs randomised by individuals:

   o We will describe whether the intervention effects may be systematically different from individually randomised controlled trials (i.e., whether it was likely that the effect size was over- or underestimated).

Measures of intervention effect

Dichotomous data

We will present dichotomous summary risk ratios with 95% confidence intervals. This includes data for the outcomes: attrition, learner adherence, evidence-based guideline implementation, individual health outcomes, and population health outcomes.

Continuous data

We will present continuous data as the mean difference with 95% confidence intervals if outcomes are measured in the same way, and standardized mean difference with 95% confidence intervals if outcomes are measured in different ways (i.e. with different tools between studies). Continuous outcomes will include EBHC knowledge and skill scores, EBHC attitude scores, and EBHC behaviour, as well as costs and satisfaction with module scores.

Other data

Outcomes not measured numerically will be reported in a qualitative manner. These outcomes include self-EBHC behaviour, barriers and enablers to the method of learning EBHC, reports of evidence-based practice, and health care delivery.

Unit of analysis issues

In cluster-randomized trials, the unit of allocation is a group, rather than an individual. Since individuals within clusters tend to behave in a similar way, the data cannot be seen as being independent and thus have to be adjusted. If clustering is ignored, estimates will be too precise and will hence receive more weight in the meta-analysis.

If the cluster randomized controlled trials that we will include have sufficiently accounted for the cluster design, we will include the effect estimates in the meta-analysis. If clustering has been ignored, we will adjust the data by inflating the standard errors by multiplying them by the square root of the design effect (Higgins & Green, 2008). We will then include the data in the meta-analysis.

Dealing with missing data

We will report levels of attrition for all included studies. We will do sensitivity analysis to explore the impact of studies with high levels of missing data.

We will carry out analyses on an intention-to-treat basis, so that all participants will be analysed in the group that they were allocated to, regardless of which intervention they received.

Assessment of heterogeneity

We will assess heterogeneity by describing variability among studies regarding participants, interventions, and outcomes (educational heterogeneity), as well as variability in study design and risk of bias (methodological heterogeneity).

Educational heterogeneity will be explored by clearly documenting the characteristics of participants; all components of the intervention relating to intervention design and delivery; and outcomes and measurement of outcomes in table format. In addition, the educational context (setting, learner context, institutional context, socio-economic context) in which the intervention was delivered will be explored and reported (see Figure 2).

Methodological heterogeneity will be explored by clearly documenting different study designs as well as risk of bias for each study.

We will assess statistical heterogeneity by looking at the I^2 statistic as well as the Chi^2 test statistic. We will consider an I^2 value of more than 30%, and a p-value of less than 0.10 for the Chi^2 test for heterogeneity to be an indicator of important heterogeneity. In case of considerable heterogeneity, we will perform random-effects meta-analysis instead of fixed-effect meta-analysis or consider only reporting outcomes in tabular or narrative format.

Assessment of reporting biases

We will assess reporting biases by using funnel plots if there are 10 or more studies in a meta-analysis. We will visually inspect the funnel plot for asymmetry. In the presence of asymmetry, we will perform statistical tests for funnel plot asymmetry. We will use the test proposed by Egger and colleagues (1997) for continuous outcomes and the one proposed by Harbord and colleagues (2006) for dichotomous outcomes.

Data synthesis

We will consider studies within the same intervention category as being sufficiently homogenous to be pooled and will synthesize results by performing random-effects meta-analysis of quantitative outcomes, using Review Manager (RevMan, 2011). We will convert

means and standard deviations to standardized mean differences (Hedges g effect size). We will report the effect estimate with 95% confidence intervals.

We will also consider other factors affecting heterogeneity, such as participants, outcome measurements, educational context, and study design. If we consider heterogeneity between studies to be high, we will not pool data, but rather report on results of individual studies in a tabular and narrative manner, clearly describing participants, interventions, comparisons, outcomes, results, and measurement tools.

Subgroup analysis

Should we identify considerable heterogeneity, we will perform subgroup analysis on the following primary outcomes:

1. EBHC knowledge
2. EBHC skills
3. EBHC attitude
4. EBHC behaviour

We will perform subgroup analysis on the following subgroups:

1. Type of healthcare professional (e.g. medical vs. allied healthcare professionals)
2. Level of education of healthcare professionals (undergraduate vs. postgraduate vs. continuing medical education)
3. Measurement tool used for outcomes (e.g. Fresno test vs. Berlin test)
4. Synchronicity (synchronous vs. asynchronous delivery)
5. Duration of the intervention

Sensitivity analysis

We will perform sensitivity analysis on primary outcomes to see what effects the quality of studies and the study design have on the effect estimate. In addition, we will explore the impact of studies with high levels of missing data.

Supporting studies

If we find studies supporting the included intervention studies that yield information on the process of implementation, we will not include them in the data synthesis, but rather report their results separately, in a tabular or narrative form.

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- Statistical analysis: Anke Rohwer (with consultation of biostatistician)

- Information retrieval: Anke Rohwer (with consultation of librarian)

SOURCES OF SUPPORT

REQUEST SUPPORT

Systematic Searches

Field expertise – Education reviews

DECLARATIONS OF INTEREST

None known.

PRELIMINARY TIMEFRAME

Approximate date for submission of review: July 2014

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APPENDICES

Appendix 1: Search strategy for Medline (terms to be adapted to other databases according to specific requirements)

1. Evidence-based Practice (MeSH)
2. Evidence based Practice/education (MeSH)
3. Evidence based practice
4. Evidence-based practice
5. Evidence-based Medicine (MeSH)
6. Evidence-based medicine
7. Evidence based medicine
8. Evidence based health care
9. Evidence based healthcare
10. Evidence-based health care
11. Evidence-based healthcare
12. Evidence-based Dentistry (MeSH)
13. Evidence-based dentistry
14. Evidence based dentistry
15. Evidence-based Nursing (MeSH)
16. Evidence-based nursing
17. Evidence based nursing
18. Critical appraisal
19. Journal club
20. Education, Medical (MeSH)
21. medical education
22. Education, Medical, Graduate (MeSH)
23. Graduate medical education
24. Education, Medical, Undergraduate (MeSH)
25. Undergraduate medical education
26. Education, Medical, continuing (MeSH)
27. Continuing medical education
28. Continuing professional development
29. Course
30. Training
31. Module
32. Workshop
33. Curriculum
34. Education

35. Instruction

36. computer-assisted

37. computer assisted

38. internet-based

39. internet based

40. internet

41. web 2.0

42. web-based

43. web based

44. online

45. electronic

46. e-learning

47. computer

48. computer-based

49. virtual

50. #1 OR #2 OR#3 OR#4 OR#5 OR#6 OR#7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR

51. #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35

52. #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR # 46 OR #47 OR #48 OR#49

53. #50 AND #51 AND#52

Appendix 2: Coding manual

Eligibility criteria for potentially relevant studies (full text) identified after abstract screening. Each potentially relevant study will be given a study identification code (study ID) consisting of the surname of the first author and the date of publication.

Study ID:
Name of data extractor:
Date:

Please tick the appropriate boxes

1. **Study design:**

    a. Randomized controlled trial (RCT) ☐
    b. Cluster randomized controlled trial (cRCT) ☐
    c. Non-randomized controlled trial (NRCT) ☐
    d. Interrupted time series (ITS) ☐
    e. Controlled before and after study (CBA) ☐
    f. Unclear ☐
    g. Other (EXCLUDE) ☐

2. **Intervention:**

    a. E-learning ☐
    b. Blended learning ☐
    c. Other ☐ Please specify:

3. **Comparison:**

    a. No learning ☐
    b. Face-to-face learning ☐
    c. Blended learning ☐
    d. E-learning ☐
    e. Other ☐ Please specify:

4. Participants:

    a. Healthcare professional (any type at any level of education) ☐

    b. Other ☐ Please specify: (EXCLUDE)

5. Eligible

    a. Yes ☐ (INCLUDED)

    b. Unsure ☐ (AWAITING CLASSIFICATION)

    c. No ☐ (EXCLUDE) Reason:

For each included study, the following data will be extracted:

Study ID:
Citation:
Name of data extractor:
Date:

Please tick the appropriate boxes

Study identified through:

      a. Electronic search of databases ☐
      b. Reference list of relevant study ☐
      c. Electronic search of trial registries ☐
      d. Electronic search of dissertation databases ☐
      e. Contacting experts in the field ☐
      f. Other ☐ Please specify:

1. Study design

      a. Randomized controlled trial (RCT) ☐
      b. Cluster randomized controlled trial (cRCT) ☐
          • Unit of randomization:_____
      c. Non-randomized controlled trial (NRCT) ☐
      d. Interrupted time series (ITS) ☐

      o Clearly defined point in time when the intervention occurred: Yes ☐ No ☐
      o At least 3 data points before and 3 after the intervention: Yes ☐ No ☐

      e. Controlled before and after study (CBA) ☐

          ▪ Contemporaneous data collection: Yes ☐ No ☐
          ▪ Appropriate choice of control site/activity: Yes ☐ No ☐
          ▪ Study contains a minimum of two intervention and two control groups: Yes ☐ No ☐

  2. Duration of study:_____

  3. Country where study was conducted: _____

4. Risk of bias

a. Risk of bias for RCTs, NRCTs and CBAs

    i.   Was the allocation sequence adequately generated?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

    ii.   Was the allocation adequately concealed?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

    iii.   Were baseline outcome measurements similar?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

    iv. Were baseline characteristics similar*?*

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

    v.   Were incomplete outcome data adequately addressed?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

vi. Was knowledge of the allocated interventions adequately prevented during the study?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

vii. Was the study adequately protected against contamination?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

viii. Was the study free from selective outcome reporting?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

ix. Was the study free from other risks of bias?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

b. Risk of bias for interrupted time series

i. Was the intervention independent of other changes?

        i. Yes ☐

        ii. No ☐

        iii. Unclear ☐

Reason:_____

ii. Was the shape of the intervention effect pre-specified?

       i. Yes ☐

       ii. No ☐

       iii. Unclear ☐

Reason:_____

iii. Was the intervention unlikely to affect data collection?

       i. Yes ☐

       ii. No ☐

       iii. Unclear ☐

Reason:_____

iv. Was knowledge of the allocated interventions adequately prevented during the study?

       i. Yes ☐

       ii. No ☐

       iii. Unclear ☐

Reason:_____

v. Were incomplete outcome data adequately addressed?

       i. Yes ☐

       ii. No ☐

       iii. Unclear ☐

Reason:_____

vi. Was the study free from selective outcome reporting?

       i. Yes ☐

       ii. No ☐

       iii. Unclear ☐

Reason:_____

vii. Was the study free from other risks of bias?

    i. Yes ☐
    ii. No ☐
    iii. Unclear ☐

Reason:_____

c. Risk of bias for cRCTs

    i. Recruitment bias

        i. Yes ☐
        ii. No ☐
        iii. Unclear ☐

Reason:_____

    ii. Baseline imbalance

        i. Yes ☐
        ii. No ☐
        iii. Unclear ☐

Reason:_____

    iii. Loss of clusters

        i. Yes ☐
        ii. No ☐
        iii. Unclear ☐

Reason:_____

    iv. Incorrect analysis

        i. Yes ☐
        ii. No ☐
        iii. Unclear ☐

Reason:_____

     v.   Compatibility with RCTs randomised by individuals:

        i.   Yes ☐
        ii. No ☐
        iii. Unclear ☐

Reason:_____

5. Participants:

a. Type of participants:
    i. Medical doctors ☐
    ii. Nurses ☐
    iii. Physiotherapists ☐
    iv. Occupational therapists ☐
    v. Psychologists ☐
    vi.   Dieticians ☐
    vii. Counselors ☐
    viii. Audiologists ☐
    ix.   Social workers ☐
    x.   Dentists ☐
    xi.   Other healthcare worker ☐ Please specify:_____

b. Level of education:
    i. Undergraduate ☐
    ii. Postgraduate ☐
    iii. Continuing medical education ☐

c. Institution where training took place:

_____

d. Inclusion criteria:

_____
_____
_____

e. Exclusion criteria:

_____
_____

6. Intervention: _____

a. Reference to learning theory: Yes ☐ No ☐
    i. If Yes, please describe:

_____

_____

_____

_____

b. Intervention categories:

    i.   Single intervention; standalone EBHC learning ☐
    ii. Single intervention; integrated EBHC learning ☐
    iii. Multifaceted intervention; standalone EBHC learning ☐
    iv. Multifaceted intervention; integrated learning ☐

c. E-learning intervention subcategories:
    i.   Pure e-learning; individual learning ☐
    ii. Pure e-learning; collaborative learning ☐
    iii. Blended learning; individual learning ☐
    iv. Blended learning; collaborative learning ☐

d. Intervention components: *(tick all that apply)*
- EBHC content
    - a. Enabling competencies ☐
        - i.   Epidemiology ☐
        - ii. Biostatistics ☐
        - iii. Basic searching skills ☐
        - iv. Critical thinking ☐

    - b. Key competencies
        - i.   Asking questions ☐
        - ii. Accessing the literature ☐
        - iii. Critical appraisal ☐
        - iv. Applying the results ☐
        - v. Evaluating the process of EBHC ☐

    - c. General EBHC ☐

- Type of educational intervention
  - i. Course ☐
  - ii.   Module ☐
  - iii.   Journal club ☐
  - iv.   Workshop ☐
  - v. Other ☐ Please specify: _____

e. Execution of the intervention:
  - i. Duration:_____
  - ii.   Intensity: _____
  - iii.   Dose:_____
  - iv.   Timing:_____

f. Intervention delivery:
  - i. Synchronous delivery ☐
  - ii. Asynchronous delivery ☐
  - iii. Other learning activities (list):

    _____
    _____
    _____

g. Delivery agent
  - i. Characteristics:

    _____
    _____

h. Organization and structure:
  - Characteristics:

    _____
    _____

7. Comparison:

a. Type of comparison:
  - i. No learning ☐
  - ii. Face-to-face learning ☐
  - iii. E-learning ☐

b. Control intervention categories (e-learning and face-to-face categories):

   i.   Single intervention; standalone EBHC learning ☐
   ii. Single intervention; integrated EBHC learning ☐
   iii. Multifaceted intervention; standalone EBHC learning ☐
   iv. Multifaceted intervention; integrated learning ☐

c. E-learning (only) control intervention subcategories:
   i.   Pure e-learning; individual learning ☐
   ii. Pure e-learning; collaborative learning ☐
   iii. Blended learning; individual learning ☐
   iv. Blended learning; collaborative learning ☐

d. Control intervention components: *(tick all that apply)*
   - EBHC content
       a. Enabling competencies ☐
          i.   Epidemiology ☐
          ii. Biostatistics ☐
          iii. Basic searching skills ☐
          iv. Critical thinking ☐

       b. Key competencies
          i.   Asking questions ☐
          ii. Accessing the literature ☐
          iii. Critical appraisal ☐
          iv. Applying the results ☐
          v.   Evaluating the process of EBHC ☐

       c. General EBHC ☐

   - Type of educational intervention
       i. Course ☐
       ii. Module ☐
       iii. Journal club ☐
       iv. Workshop ☐
       v. Other ☐ Please specify: _____

e. Execution of the control intervention:

    i. Duration:_____

    ii. Intensity: _____

    iii. Dose:_____

    iv. Timing:_____

f. Control intervention delivery:

    i. Synchronous delivery ☐

    ii. Asynchronous delivery ☐

    iii. Not applicable ☐

    iv. Other learning activities (list):

    _____

    _____

    _____

g. Delivery agent

    i. Characteristics:

    _____

    _____

h. Organization and structure:

    • Characteristics:

    _____

    _____

8. Outcomes (tick all that apply)

a. Primary outcomes:

    i. EBHC knowledge ☐

      o Measurement details (definition of outcome, tools used, etc.):

      _____

      _____

      o Time point at which outcome was measured:

      _____

      _____

      _____

    ii. EBHC skills ☐
- o Measurement details:

    _____
    _____

- o Time point at which outcome was measured:

    _____
    _____
    _____

    iii. EBHC attitude ☐
- o Measurement details:

    _____
    _____

- o Time point at which outcome was measured:

    _____
    _____
    _____

    iv. EBHC behaviour ☐
- o Measurement details:

    _____
    _____

- o Time point at which outcome was measured:

    _____
    _____
    _____

b. Secondary outcomes:

- o Process outcomes
  - i. Satisfaction of students with method of learning ☐
    - o Measurement details:

    _____
    _____

      - o Time point at which outcome was measured:

    _____
    _____
    _____
    _____

ii. Satisfaction of educators with method of learning ☐

    o Measurement details:

_____

_____

    o Time point at which outcome was measured:

_____

_____

_____

_____

iii. Enablers of the method of learning EBHC ☐

    o Measurement details:

_____

_____

    o Time point at which outcome was measured:

_____

_____

_____

_____

iv. Barriers to the method of learning EBHC ☐

    o Measurement details:

_____

_____

    o Time point at which outcome was measured:

_____

_____

_____

v. Cost ☐

    o Measurement details:

_____

_____

    o Time point at which outcome was measured:

_____

_____

_____

_____

> vi. Attrition of learners ☐
> > o Measurement details:
> >
> > _____
> > _____
> >
> > o Time point at which outcome was measured:
> >
> > _____
> > _____
> > _____
> > _____

o Behaviour outcomes
> i. Learner adherence ☐
> > o Measurement details:
> >
> > _____
> > _____
> >
> > o Time point at which outcome was measured:
> >
> > _____
> > _____
> > _____
> > _____

> ii. Evidence-based practice ☐
> > o Measurement details:
> >
> > _____
> > _____
> >
> > o Time point at which outcome was measured:
> >
> > _____
> > _____
> > _____
> > _____

o Non-health outcomes
> i. Evidence-based guideline implementation ☐
> > o Measurement details:
> >
> > _____
> > _____
> >
> > o Time point at which outcome was measured:
> >
> > _____
> > _____

ii. Health care delivery (health systems) ☐
- o Measurement details:

_____
_____

- o Time point at which outcome was measured:

_____
_____
_____
_____

o Health outcomes
- i. Individual health outcomes ☐
  - o Measurement details:

_____
_____

  - o Time point at which outcome was measured:

_____
_____
_____
_____

- ii. Population health outcomes ☐
  - o Measurement details:

_____
_____

  - o Time point at which outcome was measured:

_____
_____
_____
_____

9. Results
a. Total sample size: _____

   i. Number of participants allocated to intervention group:

   _____

   ii. Number of participants allocated to control group:

   _____

iii. For RCTs

- Number of participants randomized:_____

iv. For cRCTs

- Number of clusters randomized: _____
- Number of clusters allocated to intervention group:

  _____

- Number of clusters allocated to control group:

  _____

- Mean number of participants per cluster: _____
- Adjusted for clustering: Yes ☐ No ☐

v. For ITS

- Number of data points before intervention: _____
- Number of data points after intervention: _____

vi. For CBAs

- Number of intervention groups: _____
- Number of control groups: _____

b. Power and sample size calculation present: Yes ☐ No ☐

c. Intervention group results

   i. Continuous outcomes

Outcome	Total number of participants (n)	Mean	Standard deviation (SD)	Standard mean difference (Effect size)

   ii.   Dichotomous outcomes

Outcome	Total number of participants (n)	n with event	n without event

iii.   Qualitative outcomes

Outcome	Results

d. Comparison group results
   i. Continuous outcomes

Outcome	Total number of participants (n)	Mean	Standard deviation (SD)	Standard mean difference (Effect size)

   ii.   Dichotomous outcomes

Outcome	Total number of participants (n)	n with event	n without event

iii.   Qualitative outcomes

Outcome	Results

10. **Educational context** *(describe)*

    a. Setting (location of learning):

        _____

        _____

    b. Learner context:

        i. Background knowledge of EBHC:

            _____

            _____

        ii.   Computer literacy:

            _____

            _____

        iii.   Learning style:

            _____

            _____

        iv.   Motivation:

            _____

            _____

    c. Institutional context

i. Structure of course within larger curriculum

_____

_____

ii. Role models

_____

_____

d. Socio-economic context

i. Access to internet

_____

_____

ii. Access to information

_____

_____

iii. Affordability

_____

_____

iv. Availability of electricity

_____

_____

v. Availability of personal computers

_____

_____

11. Missing Information:

a. Yes ☐

b. No ☐

12. Ethics:

a. Approval obtained ☐

b. Not mentioned ☐

c. Not done ☐

13. Funding:

a. Research funded by: _____

b. Declaration of conflict of interest: _____

14. Other:

a. Author contact information: _____

b. Author contacted

    i. Yes ☐

    ii. No ☐

15. Comments:

_____
_____
_____
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