Review Article

Teaching Evidence-based Practice: Perspectives from the Undergraduate and Post-graduate Viewpoint

Dragan Ilic,[1] *PhD, MSc*

Abstract

Introduction: Evidence-based practice (EBP) involves making clinical decisions informed by the most relevant and valid evidence available. It has been suggested that the outcomes of teaching EBP skills may differ between undergraduates and post-graduates due to different determinants in learning. This paper reviews the current literature and discusses the impact of the teaching environment (undergraduate or post-graduate) for teaching EBP and its impact on EBP competency. Methods: A search of the literature was performed across the MEDLINE, CINAHL, PsychInfo and ERIC databases. Randomised controlled trials (RCTs) and non-randomised trials were eligible for inclusion in the paper. Studies were included for review if they explored the impact of teaching on participants' EBP competency, consisting of critical appraisal skills, knowledge and/or behaviour. Results: Ten articles were eligible for inclusion for this review, of which 7 met all inclusion criteria. EBP competency was shown to increase regardless of whether EBP is delivered to medical students at an undergraduate or post-graduate level. EBP taught to a non-medical undergraduate audience did not modify participants' EBP competency. No study directly compared teaching EBP to an undergraduate and post-graduate audience. Conclusions: Given the limited amount of studies included in this review, further research incorporating high-level methodologies is required to establish a clear recommendation on the research question.

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Introduction

Evidence-based practice (EBP) involves making clinical decisions informed by the most relevant and valid evidence available.[1] EBP has been described as the integration of clinical expertise and patient values with the best available research evidence.[1] Clinical expertise draws on the health professional's clinical skills and past experience to identify and treat each patient's individual circumstance. Patient values encompass the personal concerns, expectations, cultural influences and characteristics of individuals during the clinical encounter. The best research evidence draws on the highest quality of clinically related research. The integration of these 3 elements increases the potential for positive health outcomes.

The practice of EBP involves 4 key steps including;

(i) Converting clinical scenarios into a structured answerable question,
(ii) Searching the literature to identify the best available evidence to answer the question,
(iii) Critically appraising the evidence for its validity and applicability, and
(iv) Applying the results of the appraisal into clinical practice.[1]

This practice of EBP requires competency across a variety of domains. In this context, EBP competency can be defined as a construct that incorporates knowledge, skills and behaviour.[2] Health professionals may demonstrate their EBP competency via a 4 step process including; (i) knowledge (e.g. formulating a structured answerable question); (ii) competence (e.g. searching medical databases); (iii) performance (e.g. critical appraisal); and (iv) behaviour (e.g. applying the outcomes in practice).[3] Each step of the EBP process requires a different level of competency. For example, step 2 requires practitioners to possess intermediate to advanced literature searching skills.

[1] Monash Institute of Health Services Research, Monash University, Clayton VIC 3168, Australia
Address for Correspondence: Dr Dragan Ilic, Monash Institute of Health Services Research, School of Public Health & Preventive Medicine, Locked Bag 29, Monash Medical Centre, Clayton, Victoria 3168, Australia.
Email: dragan.ilic@med.monash.edu.au

Similarly, step 3 requires a certain mastery of epidemiology and biostatistics.[4,5]

EBP attempts to improve the quality of healthcare through the identification and promotion of interventions and practices that are effective, whilst eliminating those that are ineffective or worse, harmful.[1] Therefore, EBP is not just acquisition of knowledge or a physical clinical skill that may be learned; rather, EBP is an integration of knowledge, cognitive skills and behaviour that promotes life long learning for health professionals. The primary aim of teaching EBP is to assist health professionals in guiding their decisions, thereby critically appraising the effectiveness of clinical interventions prior to their implementation.

It has been suggested that the outcomes of teaching EBP may differ between undergraduates and post-graduates due to different determinants in learning. For example, post-graduates may be driven by self motivation, whereas undergraduates driven by external factors including examinations.[6] Additional factors may also act as barriers preventing health professionals from acquiring EBP competency.[7] At the post-graduate environment, health professionals acknowledge time and awareness as major barriers preventing them from acquiring EBP competency.[5,7] Conversely, undergraduate students will commonly cite a perceived lack of clinical relevance as the major obstacle in acquiring EBP competency.[5,7] Therefore, the challenge is to identify the most effective timeframe at which EBP should be taught.

A decade old Cochrane systematic review identified 1 trial exploring the effectiveness of teaching EBP to graduate health professionals. The relevant randomised controlled trial (RCT) explored the impact of teaching EBP to medical interns. It identified that teaching EBP skills in that post-graduate environment increased participants' EBP knowledge and skills.[4]

This paper aims to review the current literature and discusses the impact of the teaching environment (undergraduate or post-graduate) for teaching EBP and its impact on EBP competency. It also explores whether there is any difference between teaching EBP to a medical audience and a non-medical audience (i.e. nursing, allied health) across undergraduate and post-graduate settings, and its affect on EBP competency.

Methods

A search of the literature was performed across the MEDLINE, CINAHL, PsychInfo and ERIC databases by the author. All databases were searched for articles from 1996 to 2008 (current contents September). The search strategy used for searching the MEDLINE, CINHAL and PsychINFO databases is listed in Table 1. Due to the configuration of the ERIC database, a modified version of this search strategy was used (Table 2). Database searches were limited to publications that were a RCT or non-randomised trial in design. Apart from a systematic review, RCTs offer the best level of evidence to review the literature since both study types control for methodological biases that may manipulate the results from the truth.[1,7] All studies also needed to explore the impact of teaching EBP competency to be eligible for inclusion (e.g. formulating an answerable question, searching medical databases, critical appraisal skills, knowledge or behaviour). Additionally, study participants either had to be undergraduate/post-graduate medical students or undergraduate/post-graduate allied health professional students to be included in this review. Whilst detailed appraisal of included studies was not performed, each included study was examined for selection, performance, attrition and detection bias using an RCT critical appraisal document.[8] Data extracted from

Table 1. Search Strategy Used for the MEDLINE, CINHAL and PsychINFO Databases

1.	Teaching/ or teach$.mp
2.	Education/ or educa$.mp
3.	Education, Graduate/ or graduate education.mp
4.	Education, Undergraduate/ or undergraduate education.mp
5.	Evidence Based Practice/ or evidence based pract$.mp
6.	Evidence Based Health Care.mp
7.	Evidence Based Medicine.mp
8.	EBM.mp
9.	Critical Appraisal/ or critical appraise$.mp
10.	Journal Club/ or journal club$.mp
11.	1 or 2 or 3 or 4
12.	5 or 6 or 7 or 8 or 9 or 10
13.	11 and 12
14.	Limit (English and (clinical trial or controlled study or randomized controlled trial))

Table 2. Search Strategy Adapted for use in the ERIC Database

1.	Teaching OR Education
2.	Evidence based practice OR Evidence based health care OR Evidence based medicine
3.	Critical appraisal
4.	Journal club
5.	2 OR 3 OR 4
6.	1 AND 5
7.	Limit (journal articles)

Table 3. List and Reason of Studies Included/Excluded

Study	Included/Excluded	Reason for inclusion/exclusion
Akl[9]	Excluded	Survey of medical interns
Bradley[10]	Included	Trial of EBP teaching to medical undergraduates
Carlock[11]	Included	Trial of EBCP teaching to nursing undergraduates
Ghali[12]	Included	Trial of EBP teaching to medical undergraduates
Green[13]	Excluded	Survey of medical residents
MacRae[14]	Included	Trial of EBP teaching to medical graduates
Mills[15]	Included	Trial of EBP teaching to naturopathic undergraduates
Smith[16]	Included	Trial of EBP teaching to medical graduates
Taylor[17]	Included	Trial of EBP teaching to medical graduates
Turner[18]	Excluded	Survey of physiotherapists

the included studies was performed by the author using a standard data extraction form, which examined the number of participants, interventions/comparisons and baseline/follow-up measures of EBP competency.

Results

A total of 10 articles were eligible for inclusion for this review, of which 7 were included (no studies were excluded on the basis of quality). A list of articles identified through the search, and reasons for inclusion/exclusion in this review are documented in Table 3. Three articles investigated the impact of teaching EBP competency to medical graduates, whilst 2 studies explored teaching EBP competency to medical undergraduate students. Two studies investigated the impact of teaching EBP competency to non-medical undergraduate students. No studies were identified during the literature search that explored teaching EBP competency to non-medical graduates. No studies directly compared teaching EBP competency to undergraduate versus post-graduates, regardless of discipline.

Description of the Studies

Teaching EBP Competency to Medical Graduates

The RCT by Taylor et al[17] randomised 175 general practitioners (GPs) to a half-day EBP workshop. Outcomes measured included knowledge, skills and attitudes. There were no significant differences between the intervention and control group across any of the reported outcomes. The trial was methodologically sound, therefore indicating that the lack of effect may be solely attributed to the intervention.

The comparative study by Smith et al[16] examined the impact of a 7 week-two hour workshop on the EBP competency of 55 medical residents. Participants attending the workshop were significantly better than control participants with respect to formulating clinical questions and searching databases. However, there was no difference between the 2 groups with respect to critical appraisal skills. The RCT by MacRae et al[14] randomised 55 general surgeons to receive a multimedia package, teaching EBP competency. Participants were followed up 6 weeks post intervention and examined on their EBP competency. Participants in the intervention group were assessed to have significantly better EBP critical appraisal skills than those in the control group.

Teaching EBP Competency to Medical Undergraduates

The RCT by Bradley et al[10] compared the effectiveness of self-directed versus directed EBP activities to supplement the EBP program taught to 175 final year medical undergraduates. Participants were similar in terms of their EBP competency and outcome measures at baseline. EBP knowledge, skills and behaviour all increased however, there was no significant difference across these outcomes between the 2 interventions (self-directed versus directed activities). This lack of difference between the two interventions may be attributed to the attributes of medical students. For example, medical students may learn any skill adequately, regardless of mode of teaching, due to their high level of motivation. The trial by Ghali et al[12] compared delivery of an EBP course to 60 third year medical undergraduate students. The intervention group received 4 tutorials in which EBP competency was taught, whilst the control group received tutorials on alternative clinical topics. Not surprisingly, students in the intervention group demonstrated significantly better EBP knowledge, skills and behaviour compared to the control group.

Teaching EBP Competency to Non-medical Undergraduates

The 'before and after' study by Carlock and Anderson[11] investigated the impact of two 4-hour EBP workshops to 90 third year undergraduate nursing students. The authors noted a limited increase in student acquisition of EBP competency. The cross-over trial by Mills et al[15] investigated the impact of a half-day workshop teaching EBP skills to 83 final year naturopathic undergraduates. Participants in the intervention group attended the workshop, whilst those allocated to control attended a workshop on another clinical area. There was no significant difference in participants' critical appraisal skills between the intervention and control groups.

Discussion

This review identified that EBP competency may increase regardless of whether they are taught to medical students at an undergraduate or post-graduate level. Whilst no study directly compared teaching EBP competency to an undergraduate and post-graduate audience, the trend of the identified studies suggests no difference for the uptake of EBP competency between medical undergraduates and post-graduates. Further evidence is required to validate whether teaching EBP to a non-medical undergraduate audience does not increase EBP competency.

Teaching EBP Competency to Medical Graduates

The study by Taylor et al[17] identified no difference in participants' EBP competency between those GPs receiving the intervention and those not. Behaviour change, be it patient or health professional, is an extremely difficult outcome to achieve, with many complex interventions often failing to do so.[19] Given that the intervention was short (i.e. a half-day workshop) it may be unrealistic to assume that such a brief intervention may change practitioner behaviour. Additionally, the authors do not report the duration of the follow-up. For example, a one-week follow up may achieve a different outcome compared to a six-month follow-up. Similarly, the study by Smith et al[16] established no difference in EBP competency in their graduate teaching. However, this 'absence of effect' may be attributed to the established knowledge of participants in the subject area. No assessment was performed at baseline to establish participants' competency prior to the study. This lack of assessing potential confounding factors may contribute to the 'absence of effect'. Whilst MacRae et al[14] reported an increase in EBP competency, it is not clear whether this change may be solely attributed to the intervention. Due to the nature of the intervention (i.e. distance learning), there was no method of identifying whether the difference in skill acquisition can be directly attributed to the multimedia package. For example, surgeons in the intervention group may have been motivated to seek further resources to supplement their learning, which may have affected their performance on the assessment tasks.

Teaching EBP Competency to Medical Undergraduates

The study by Ghali et al[12] demonstrated an increase in EBP skills and knowledge in medical undergraduate students, but did not evaluate changes in behaviour or attitude to EBP across the 2 groups. The duration of follow-up was only 4 weeks, therefore impact on long-term learning outcomes is unclear. Similarly, the study by Bradley et al[10] demonstrated an increase in undergraduate students' EBP skills and knowledge. A limitation of the study was that over one-third of participants withdrew from the study. Additionally, students were only followed-up for period of 3 months, therefore the long-term affects of the teaching on outcomes may be questionable.

Teaching EBP Competency Skills to Non-medical Undergraduates

The study by Mills et al[15] identified no improvements in naturopathic students EBP competency. Although the authors reasoned that study participants may have had a reasonably high competency level in EBP, it was acknowledged that a 'one-off' EBP training workshop is not sufficient at increasing and maintaining long term learning objectives. Despite this suggestion, no analysis was performed to establish participants' EBP competency at baseline. The study by Carlock and Anderson[11] identified a negligible increase in EBP competency with nursing undergraduate students. However, no formal statistical analysis was performed to further investigate the results or the impact of potential confounding factors. The lack of EBP knowledge and skill acquisition may be attributed to the limited duration of the teaching activity.

What Factors may Contribute to EBP Competency?

Increase in EBP competency is dependant on a variety of factors including prior training and exposure to epidemiology, research design and biostatistics. None of the studies identified in this review adjusted for these potential confounding factors. Therefore, it is difficult to estimate what effect, if any, these factors contribute to participants' EBP competency across undergraduate and post-graduate settings. The differences in EBP outcomes for post-graduate participants may be attributed to this prior learning (or lack there of). Whilst most medical undergraduates may not have extensive prior learning in EBP, the impact of environmental and attitudinal factors should be explored. Both studies exploring medical undergraduates' EBP competency saw a demonstrable increase. However, it is unclear what the impact, if any, of these confounding factors was. For example, role modelling within the medical teaching environment is important. If students see EBP use in practice by their supervisors/mentors, then they are more likely to value it as clinically important and be motivated acquire the relevant skills/knowledge.[5] EBP relies on a body of evidence, which may be appraised and applied to the clinical context. The lack of EBP competency in the non-medical undergraduate setting may be attributed to a lack of opportunity to practice, due to limited evidence available – particularly in the naturopathic case study.

Whilst this review identifies that EBP competency may increase regardless of whether they are taught for medical undergraduates or post-graduates, limited data exists as to whether such a trend exists within non-medical students. Further high quality studies across all 4 areas (undergraduate/

post-graduate – medical/non-medical) are required to further explore the research question. Additionally, such studies should also explore what impact prior EBP learning, attitudinal and environmental factors have upon further skill acquisition. Further studies may also investigate the effectiveness of standalone versus clinically integrated EBP courses. For example, clinically integrated interventions, such as journal clubs, have been identified as potential surrogates for EBP skill acquisition and learning.[18]

This review only reviewed studies that were RCTs or non-randomised trials. Only these types of studies were eligible for inclusion in this review since both account for inherent methodological biases that may influence the true results of the study.[1,7] However, other studies designs, including qualitative and observational studies, may offer a greater scope for analysis for the research question. Such research designs may also offer novel findings that may subsequently be further investigated using more robust methodology. Future updates of this review may incorporate formal appraisal of the quality of included studies by more than one reviewer. This would also provide a formal mechanism of determining inter-observer reliability for the appraisal of the included studies, and further validate the conclusions.

Conclusions

This review identified that EBP competency may increase regardless of whether they are taught to medical students at an undergraduate or post-graduate level. Whilst no study directly compared teaching EBP competency to an undergraduate and post-graduate audience, the trend of the identified studies suggests no difference for the uptake of EBP competency for either undergraduates or post-graduate medical students. Further studies are required to explore the effect of teaching EBP to a non-medical audience. However, the conclusions of this review should be interpreted with caution given the limitations of the included studies (e.g. limited follow-up period, small sample sizes). Whilst further research is needed to establish a clear recommendation on the research question, it may be that there is no clear answer for this topic. Such research may indicate that EBP competency is best acquired when teaching is initiated in an undergraduate setting, and then followed up in post-graduate training. Such an approach would appear to harness the EBP philosophy, which states that acquisition of EBP competency and practice are 'life long skills'.

REFERENCES

1. Sackett D, Straus S, Richardson W, Rosenberg WRH. Evidence-based medicine. Edinburgh: Churchill Livingstone, 2000.
2. Holmboe E, Hawkins R. Methods for evaluating the clinical competence of residents in internal medicine: a review. Ann Intern Med 1998;129:42-8.
3. Miller G. The assessment of clinical skills/competence/performance. Acad Med 1990;65:S63-7.
4. Parkes J, Hyde C, Deeks J, Milne R. Teaching critical appraisal skills in health care setting. Cochrane Database of Systematic Reviews. 2001(Issue 3).
5. Del Mar C, Glasziou P, Mayer D. Teaching evidence based medicine - should be integrated into current clinical scenarios. BMJ 2004;329:989-90.
6. Coomarasamy A, Khan KS. What is the evidence that postgraduate teaching in evidence based medicine changes anything? A systematic review. BMJ 2004;329:1017.
7. Jadad A. Randomised Controlled Trials. London: BMJ Publishing, 1998.
8. Medicine CfEB. RCT Critical Appraisal Sheet. Available at: http://www.cebm.net. Accessed 20 October 2008.
9. Akl EA, Maroun N, Neagoe G, Guyatt G, Schunemann HJ. EBM user and practitioner models for graduate medical education: what do residents prefer? Med Teach 2006;28:192-4.
10. Bradley P, Oterholt C, Herrin J, Nordheim L, Bjorndal A. Comparison of directed and self-directed learning in evidence-based medicine: a randomised controlled trial. Med Educ 2005;39:1027-35.
11. Carlock D, Anderson J. Teaching and assessing the database searching skills of student nurses. Nurse Educ 2007;32:251-5.
12. Ghali WA, Saitz R, Eskew AH, Gupta M, Quan H, Hershman WY. Successful teaching in evidence-based medicine. Med Educ 2000;34:18-22.
13. Green ML. Evidence-based medicine training in internal medicine residency programs a national survey. J Gen Intern Med 2000;15:129-33.
14. MacRae HM, Regehr G, McKenzie M, Henteleff H, Taylor M, Barkun J, et al. Teaching practicing surgeons critical appraisal skills with an Internet-based journal club: A randomized, controlled trial. Surgery 2004;136:641-6.
15. Mills E, Hollyer T, Saranchuk R, Wilson K. Teaching Evidence-Based Complementary and Alternative Medicine (EBCAM); changing behaviours in the face of reticence: a cross-over trial. BMC Med Educ 2002;2:2.
16. Smith CA, Ganschow PS, Reilly BM, Evans AT, McNutt RA, Osei A, et al. Teaching residents evidence-based medicine skills: a controlled trial of effectiveness and assessment of durability. J Gen Intern Med 2000;15:710-5.
17. Taylor R, Reeves B, Ewings P, Taylor R. Critical appraisal skills training for health care professionals: a randomized controlled trial. BMC Med Educ 2004;4:30.
18. Turner P, Mjolne I. Journal provision and the prevalence of journal clubs: a survey of physiotherapy departments in England and Australia. Physiother Res Int 2001;6:157-69.
19. Eccles M, Grimshaw J, Campbell M, Ramsay C. Research designs for studies evaluating the effectiveness of change and improvement strategies. Qual Saf Health Care 2003;12:47-52.