

Longitudinal Analysis of Integrating Evidence-based Medicine Into a Medical Student Curriculum

Tippawan Liabsuetrakul, MD, PhD; Thitima Suntharasaj, MD;
Boonsin Tangtrakulwanich, MD, PhD; Thida Uakritdathikarn, MD, MSc;
Panumad Pornsawat

Background and Objectives: Evidence-based medicine (EBM) is an important tool for lifelong learning by medical students. This study aimed to determine changes in self-reported attitudes and skills after integration of EBM into a medical school curriculum. **Methods:** A pre- and post-intervention study was conducted at the Faculty of Medicine, Prince of Songkla University in Thailand during 2005–2007. Fourth-year medical students were instructed in EBM by a team promoting EBM and then practiced EBM under supervision of faculty advisors. We then evaluated changes in attitude and skills before studying EBM (T0) and at two points (T1 and T2) after learning about EBM. Data were analyzed using Wilcoxon Sign Rank test and a generalized linear multilevel model. **Results:** After integration of EBM into the curriculum, the students' attitudes and skills at T1 and T2 were improved significantly compared to ratings at T0. **Conclusions:** Medical students developed a positive attitude toward EBM and improved their skills after integration of EBM into a medical school curriculum.

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Evidence-based medicine (EBM) is “the conscientious, explicit, and judicious use of the best current evidence in making decisions about the care of individual patients.”¹ EBM is an important tool for lifelong learning in medicine, and medical students can develop the skills necessary to understand and use EBM.² Indeed, medical students who learn EBM have significantly improved skills for searching for and critically appraising evidence in the medical literature when compared to controls who do not learn about EBM.³

There was a doubling in the number of publications upon the introduction of EBM into medical curriculum between 1999–2000 and 2006–2007.⁴ But, methods for teaching medical students about EBM varied considerably in requirements for training (compulsory versus voluntary), in approach (seminar versus problem-based learning), and in assessment techniques (self-assessment versus summative assessment).⁵⁻¹² There is no

universal approach to the incorporation of EBM into a medical curriculum.

In 2005, we integrated the five steps of EBM into the fourth- and fifth-year curriculum of the Faculty of Medicine at the Prince of Songkla University in Thailand. The curriculum was designed to be simple and practical, to reduce medical students' anxiety over their perception that EBM required them to learn an excessive quantity of information,¹³ and we included students' self-reported assessments of their progress in our evaluation of the new curriculum.^{14,15}

Our study aimed to assess the students' self-reported changes in attitudes toward EBM and skills for using EBM after integration of EBM into the curriculum. Our methods and results of the evaluation may be useful to other medical schools considering an EBM curriculum, especially schools in developing countries where resources are limited.

Methods

Study Setting

Our study was conducted at the Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, which is located in southern Thailand. The medical school was established in 1972 and initially used a conventional

From the Epidemiology Unit (Dr Liabsuetrakul), Department of Obstetrics and Gynecology (Dr Suntharasaj), Department of Orthopaedic Surgery and Physical Medicine (Dr Tangtrakulwanich), Department of Anesthesiology (Dr Uakritdathikarn), and Division of Medical Education (Mr Pornsawat), Faculty of Medicine, Prince of Songkla University.

curriculum. In 1999 the school adopted an integrated curriculum that used problem-based learning. The integrated curriculum is 6 years in duration and involves a 3-year preclinical medical curriculum and a 3-year clinical curriculum.

Study Design

The study was conducted between 2005 and 2007. We measured medical students' self-reported attitudes about EBM and their EBM skills before and after integration of an EBM course into the medical school curriculum. The study methods were approved by the Institute Ethics Committee of Faculty of Medicine, Prince of Songkla University.

General Course Content

The EBM course covered five steps. During the fourth year of the 6-year medical school curriculum, the course covered (1) how to formulate a clinical question, (2) how to search for evidence needed to answer the question, and (3) how to critically appraise the evidence found during the search. During the fifth year of the medical school curriculum, the course covered (4) how to integrate the evidence into practice, and (5) how to evaluate and monitor use of the evidence.

Course Faculty

A working group of faculty from the departments of obstetrics and gynecology, pediatrics, surgery, anesthesiology, medicine, and orthopedics served as primary teachers of the course. The working group invited all 235 faculty members of the medical school to participate in a seminar about introducing basic EBM into the medical school curriculum and the role of "advisors" who would work longitudinally with students on EBM projects. A total of 187 (80%) faculty members attended the seminar and enrolled as advisors.

Teaching Methods

The working group determined the content and the methods of teaching. The course materials included a book, handouts, and a practice module for advisors and students. The practice module included objectives, timelines, and recommended topics for discussion between students and advisors over the duration of the course.

The five steps outlined earlier were taught in small-group sessions under guidance of working group faculty. Subsequently, students practiced these steps at 2- to 3-month intervals under supervision of faculty advisors.

The course began during the fourth year of medical school with an introductory session in which students were introduced to the concepts of EBM and timelines for the course. Subsequently, the first step (formulating a clinical question) was taught in a 1-hour lecture, followed by 1.5 hour-long small-group sessions in

which students practiced and discussed formulating questions.

The second step (searching for evidence) was taught initially with a didactic presentation and then by having students perform PubMed searches to find answers to actual clinical questions they generated during their clinical work. The PubMed searches were performed in small groups (10–12 students) under the guidance of a facilitator. Then the students and advisors discussed the process of their searching and the evidence found.

For the third step, a 30-minute lecture was given to the students to summarize the concepts of critical appraisal using a worksheet for each type of clinical question (diagnosis, therapy, harm/etiology, systematic review, and prognosis).¹⁶ Students then divided into groups of 13–15 students to discuss the appraisal of the sample article. The duration of teaching from the first to third steps was 5 months.

The course continued in the fifth year of medical school, beginning with a lecture to review the methods of the first, second, and third steps and continuing with lectures on the fourth step (how to integrate evidence into clinical practice) and the fifth step (monitoring and evaluation). Because our fifth-year medical students are not directly involved in making clinical decisions, the aim of fourth step was for them to observe the clinical practices of resident trainees and faculty (staff) physicians and determine whether their decisions were in accordance with published evidence. For the fifth step, students evaluated their progress on the previous four steps, and repeat searching for evidence to answer their clinical questions. If any new articles were found, they would choose one or two articles for appraisal and consider whether the answer of the question had changed. Finally, the students reviewed what they learned from each specific step of the EBM process. The duration of these steps was 10 months. Total time devoted to all five EBM steps was approximately 15 months.

Course Evaluation

Two main outcome measures were students' attitude toward EBM and their EBM skills, measured on a self-administered questionnaire that was constructed based on the course's learning objectives of the curriculum. The questionnaire included five items about students' attitudes toward EBM and five items about their skills to use EBM (Table 1). Each statement was graded on a 5-point rating scale ranging from the least (1) to most (5).

Data Analysis

Data were recorded in Epidata 3.1 and analyzed by R software version 2.7.0 (the R Foundation for Statistical Computing, 2008, Austria). The internal consistency of attitude and skill items was assessed by computing Cronbach's alpha. All items of attitude and skills were tested for internal consistency before scores were summed,

Table 1

Self-evaluated Scores of Attitudes and Skills After Integration of EBM* (n=259)

	<i>Before Study (T0)</i>	<i>After the Third Step (T1) 5 Months After T0</i>	<i>After the Fifth Step (T2) 15 Months After T0</i>
	<i>Median (IQR)</i>	<i>Median (IQR)</i>	<i>Median (IQR)</i>
Overall attitudes	2.4 (1.7, 3.0)	3.6 (3.0, 4.0)	4.0 (3.4, 4.2)
Concern about quality of evidence	2 (1, 3)	3 (3, 4)	4 (3, 4)
Concern about searching evidence	2 (2, 3)	4 (3, 4)	4 (3, 4)
EBM needed in teaching	2 (1, 3)	4 (3, 4)	4 (3, 4)
EBM needed in practice	2 (2, 3)	4 (3, 4)	4 (3, 4)
EBM application in future	2 (2, 3)	4 (3, 4)	4 (4, 4)
Overall skills	2.2 (1.8, 2.8)	3.4 (3.0, 4.0)	3.8 (3.2, 4.0)
Knowledge for formulating question	2 (1, 3)	3 (3, 4)	4 (3, 4)
Ability for formulating question	2 (2, 3)	3 (3, 4)	4 (3, 4)
Ability for searching	3 (2, 3)	4 (3, 4)	4 (3, 4)
Identification search term for searching	3 (2, 3)	3 (3, 4)	4 (3, 4)
Ability for appraisal	2 (1, 3)	3 (3, 4)	4 (3, 4)

EBM—evidence-based medicine
IQR—interquartile range

* The scores of attitudes and skills at an individual time (T0, T1, and T2) were significantly different, with a *P* value of <.001 by Wilcoxon Sign Rank Test.

and the summed scores of attitude and skills before the course (T0) were compared to the scores after the third step (T1) and fifth step (T2), respectively, by paired *t* test or Wilcoxon Sign Rank test, as appropriate. The summed scores of attitude and skill at T0, T1, and T2 were then computed as longitudinal data and analyzed by a generalized linear multilevel model to assess the changes of attitude and skill over time.

Results

All 259 students enrolled in the medical school over the 2-year study participated in the study. There were 132 medical students who began the course in 2005. Their mean age was 21.6 (\pm 1.3) years, and there was a female-male ratio of 1.2:1. The 127 students, who began the course in 2006, had a mean age of 21.3 (\pm 0.8) years and a female-male ratio of 1.1:1.

Self-assessed scores of attitude and skills after integration of EBM at T0, T1, and T2 are shown in Table 1. The results showed significantly higher scores for attitude and skills over time (P <.001), and the trends were similar for students in both 2005 and 2006. The internal consistencies for attitude and skill items were good (Cronbach's α >0.85).

Table 2 shows the longitudinal analysis for the changes of attitudes and skills at three points in time (T0, T1, T2) using a linear multilevel model. At T0, the mean attitude and skills were 2.49 and 2.40, respectively. For each measurement, our model showed that students gained, on average, 0.76 points on the 5-point

scale for attitude and 0.73 for skills. The attitude and skill improvement between the interval of T0 and T1 was greater than the interval between T1 and T2.

Discussion

This pre- and post-intervention study confirmed that medical students' self-reported attitudes about EBM and skills for using EBM were improved significantly after integration of EBM into the curriculum of our medical school in Thailand. This improvement was achieved using teaching methods based on cognitive flexibility theory¹⁵ and self-directed, problem-based, and contextualized learning.¹³ It involved assigning each student an EBM advisor, whose role was to encourage the teaching and learning of EBM. To reduce the anxiety and resistance of the learners and teachers about a perceived excessive quantity of information and examinations,¹³ we integrated the students' practice experience into the teaching and did not implement summative examinations during the integration of EBM program. We only conducted an examination at the end of the course (ie, for sixth-year medical students).

Prior to learning about EBM, our students rated themselves as having poor EBM knowledge and skills, a finding similar to that in another developing country.⁶ In fact, baseline assessments of medical students' self-reported changes on attitude and skills in EBM are lower in studies conducted in the developing country⁶ than those in a developed country.⁸ There also is variation in how EBM is taught around the world.⁵⁻¹² Our

Table 2

Linear Multilevel Model of Attitude and Skill by Times

Factor	Attitude			Skill		
	Coefficient	SE	P Value	Coefficient	SE	P Value
Fixed intercept	2.49	0.05	<.001	2.40	0.04	<.001
Time	0.76	0.03	<.001	0.73	0.03	<.001
Standard deviation of random intercept	0.30			0.31		

SE: standard error

EBM course resulted in a significant improvement in those attitudes and skills—a finding similar to what has been found in other studies,^{5,6,8,14,17,19} but we used different teaching methods. We believe ours is the first course to use a flexible, multi-part, multi-year curriculum in which learning of EBM was accomplished by pairing faculty advisors with individual students.

Limitations

The main limitation of our study is that we relied on students' self-assessment of their attitudes and skills, rather than on direct measurement, and thus we do not know whether those self-reported changes translated into actual changes in behavior. We also have no data on whether any improvement in attitudes and skills were sustained over time. The 2-year interval between initial EBM exposure and subsequent evaluation in our study was, however, longer than what is reported in most other studies.⁴

Conclusions

Integration of EBM into a medical school curriculum results in an improvement of attitude about EBM and an improvement in self-reported skills for using EBM. Further study is needed to assess the long-term effects of teaching EBM on future medical practice.

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Corresponding Author: Address correspondence to Dr Liabsuetrakul, Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90112, Thailand. +66 74 429754. Fax: +66 74 212900 or 212903. ltippawa@yahoo.com.

REFERENCES

- Elnicki DM, Halperin AK, Shockcor WT, Aronoff SC. Multidisciplinary evidence-based medicine journal clubs: curriculum design and participants' reactions. *Am J Med Sci* 1999;317:243-6.
- Fritsche L, Greenhalgh T, Falck-Ytter Y, Neumayer HH, Kunz R. Do short courses in evidence-based medicine improve knowledge and skills? Validation of Berlin questionnaire and before and after study of courses in evidence-based medicine. *BMJ* 2002;325:1338-41.
- Ghali WA, Saitz R, Eskew AH, Gupta M, Quan H, Hershman WY. Successful teaching in evidence-based medicine. *Med Educ* 2000;34:18-22.
- Baernstein A, Liss HK, Carney PA, Elmore JG. Trends in study methods used in undergraduate medical education research, 1969-2007. *JAMA* 2007;298:1038-45.
- Wanvarie S, Sathapatayavongs B, Sirinavin S, Ingsathit A, Ungkanont A, Sirinan C. Evidence-based medicine in clinical curriculum. *Ann Acad Med Singapore* 2006;35:615-8.
- Okoromah CA, Adenuga AO, Lesi FE. Evidence-based medicine curriculum: impact on medical students. *Med Educ* 2006;40:465-6.
- Weberschock TB, Ginn TC, Reinhold J, et al. Change in knowledge and skills of year 3 undergraduates in evidence-based medicine seminars. *Med Educ* 2005;39:665-71.
- Dorsch JL, Aiyer MK, Meyer LE. Impact of an evidence-based medicine curriculum on medical students' attitudes and skills. *J Med Libr Assoc* 2004;92:397-406.
- Holloway R, Nesbit K, Bordley D, Noyes K. Teaching and evaluating first- and second-year medical students' practice of evidence-based medicine. *Med Educ* 2004;38:868-78.
- Srinivasan M, Weiner M, Breitfeld PP, Brahma F, Dickerson KL, Weiner G. Early introduction of an evidence-based medicine course to preclinical medical students. *J Gen Intern Med* 2002;17:58-65.
- Shaneyfelt T, Baum KD, Bell D, et al. Instruments for evaluating education in evidence-based practice: a systematic review. *JAMA* 2006;296:1116-27.
- Johnston JM, Leung GM, Fielding R, Tin KY, Ho LM. The development and validation of a knowledge, attitude, and behaviour questionnaire to assess undergraduate evidence-based practice teaching and learning. *Med Educ* 2003;37:992-1000.
- Mattick K, Knight L. High-quality learning: harder to achieve than we think? *Med Educ* 2007;41:638-44.
- Kulier R, Hadley J, Weinbrenner S, et al. Harmonising evidence-based medicine teaching: a study of the outcomes of e-learning in five European countries. *BMC Med Educ* 2008;8:27.
- Patel VL, Yoskowitz NA, Arocha JF. Towards effective evaluation and reform in medical education: a cognitive and learning sciences perspective. *Adv Health Sci Educ Theory Pract* 2008;Jan 24 [Epub ahead of print].
- Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. *Evidence-based medicine: how to practice and teach EBM*. Edinburgh: Churchill Livingstone, 2000.
- Taylor R, Reeves B, Ewings P, Binns S, Keast J, Mears R. A systematic review of the effectiveness of critical appraisal skills training for clinicians. *Med Educ* 2000;34:120-5.
- Boonluksiri P. Attitude towards evidence-based medicine of medical students at the Medical Education Center, Hatyai Regional Hospital. *Songkla Med J* 2005;23:321-5.
- Kljakovic M, Love T, Gilbert A. Attitudes of teachers to evidence-based medicine. *Aust Fam Physician* 2004;33:376-8.