Teaching First-year Medical Students to Apply Evidence-based Practices to Patient Care

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Background and Objectives: *Our objective was to describe and evaluate an educational intervention for teaching preclinical medical students enrolled in a family medicine preceptorship to use evidence-based medicine (EBM) techniques.* Methods: *In a brief workshop, 94 preclinical students, enrolled in a 4-week family medicine preceptorship, learned an EBM approach to clinical decision making. Students were responsible for completing four patient case summaries to document that they had searched selected databases and obtained feedback from their preceptors. We then evaluated (1) the percent of students documenting EBM processes, (2) the students' perceived self-efficacy, (3) the level of the students' EBM learning, and (4) preceptors' attitudes toward using the EBM project as the focus of their feedback.* Results: *All students succeeded in identifying the factual knowledge that they had used to convert information from patient encounters into searchable clinical questions. The preceptors provided case-specific, written feedback to all students. Students gave lesser ratings of importance to EBM and self-efficacy in using EBM after the preceptorship as compared to after the brief introductory workshop. Preceptors acknowledged that the project helped them to focus their feedback and to reconsider patient management practices.* Conclusions: *Students learned to use an EBM process and became more familiar with and more realistic about their self-efficacy in using EBM. Preceptors and preclinical medical students can learn and hone EBM skills together.*

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Evidence-based medicine (EBM) is the integration of individual clinical expertise with the best available evidence from systematic research.[1-2] Most teaching of EBM for medical students currently takes place in classroom settings that feature teacher-centered didactic activities. When EBM is taught in this manner, the teaching appears not to influence patient care or to ensure that medical students are prepared to apply EBM at the point of care.[3-6]

For physicians, EBM is a lifelong, self-directed behavior that demands a habit of consistent learning by inquiry and the use of information technology. Practicing EBM means that the physician must accept the challenge of sifting through the massive amount of current information and must develop a coherent, practical, and effective approach to patient care.[7] It is not surprising, then, that there is a continuing need to introduce and sharpen EBM skills among faculty who teach medical students in ambulatory clinical settings while managing the care of patients.[8]

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Earlier studies of EBM suggest that even at the preclinical level of training, medical students can learn EBM principles, formulate clinical questions, and receive evidence-based feedback from their teachers.[9,10] In general, however, preclinical students have limited opportunities to apply EBM to patient care. We believe that the primary care preclinical preceptorship is an ideal but underused setting for beginning the active teaching and learning of EBM at the point of care. In this article, we describe a brief educational intervention that encourages first-year medical students and their family physician preceptors to engage in EBM together.

Methods

This EBM module is the third in a series of educational interventions that we implemented in the Texas Statewide Family Medicine Preceptorship Program (TSFMPP) between years one and two of medical training. Internal Review Board approval was obtained for the interventions used in this study.

During the first year of each intervention, the educational materials were tested, and the students' participation was voluntary. In the following two summers,

educational materials were upgraded, and all students enrolled in the preclinical preceptorship were required to participate.[11]

Ninety-four self-selected, first-year medical students from the medical school at the University of Texas Health Science Center at Houston (UTHSC) who enrolled in the elective family medicine preceptorship were matched with 94 volunteering family physician preceptors who belonged to the TSFMPP, a network of more than 800 physicians. We conducted the EBM intervention described below in the summers of 2005–2007.

Orientation Workshop

The intervention began with a mandatory 2-hour orientation workshop on applying EBM skills to patient care. Led by the authors and EBM database experts, the workshop's goal was to begin to engage the students in an EBM process for making informed clinical decisions about the care of ambulatory primary care patients. A sample case of a 94-year-old male farmer with elevated blood pressure was shown to students as part of an EBM PowerPoint presentation, which was based on the intervention model described by Straus et al.[12] Specifically, the students learned to ask a clinical question about this patient by using PICO format, which stands for Patient, Intervention, Comparison, and Outcome.[13-15] After instruction, the students formulated the following clinical question: "In elderly patients with systolic hypertension, does antihypertensive therapy compared to no treatment reduce the risk of stroke, mortality, or cardiovascular events?"

During the EBM discussion about the sample patient, the students learned to access databases for which the University of Texas Medical Center library holds a license or that are available for no cost on the Internet. One of these databases, DynaMed, was a commercial point-of-care database that contained preappraised medical literature for practicing family physicians.[16] Together, workshop leaders and participating students responded to their clinical questions by discussing helpful appraisals of relevant medical literature.

At the end of the discussion of the patient and the databases, students received a completed worksheet of a sample patient case that they could use as a model at their preceptors' offices. The worksheet, which we prepared with the assistance of a preclinical student who had participated in the TSFMPP, stated that a 45-year-old obese woman patient had recently been diagnosed with type 2 diabetes. The clinical question written by the TSFMPP student, keyed to the PICO mnemonic, read: "In obese women with newly diagnosed diabetes (P), does taking metformin (I) compared to diet alone (C) affect mortality (O)?"

The following exemplar learning statements of the student were provided in the handout: "I learned that patients who were intensively treated with metformin compared to making only changes to their diet had a risk reduction of 35% for any diabetes-related outcomes, diabetes-related mortality, and all-case mortality. I agree with my preceptor's treatment of metformin and I learned that it also is important to consider the patient's beliefs, values, and principles when making a clinical treatment decision. Because my preceptor had established a positive patient-physician relationship, and during history taking found that the patient had relatives who died from diabetic complications, the patient was willing to start this medication."

Work During the Preceptorship

The students were then told to complete EBM case summaries for four patients whom they would select with the agreement of their preceptor. Worksheets were used to summarize how the students had used the PICO format, the databases they had searched, and the learning they had achieved from each of four completed case summaries. All databases used during the workshop were available online to the students.

At the end of the preceptorship, all completed case summaries were returned to the TSFMPP office. Students had been told at the workshop and in writing how to contact TSFMPP faculty and staff during the preceptorship if they had any questions pertaining to the assignment.

The educational and workshop materials relating to the EBM project and a free trial subscription to the DynaMed database was sent to the preceptors. Preceptors also were able to access the UTHSC's electronic databases on the Internet. All preceptors were asked to sign that they agreed to have the students participate in the EBM intervention.

Program Evaluation

Evaluation of Student PICO Forms. Data for analyzing the outcomes of the students' participation in EBM came from the four PICO case summaries. Questionnaires administered at the close of the preceptorship provided preceptors' evaluation data.

We first measured the outcomes of the project in terms of the percentage of students who completed the project. Next, we measured the level of learning achieved by students as indicated in their statements of what they had learned. We read all of the students' statements and then adapted Bloom's taxonomies of the cognitive and affective domains as the framework for analysis of each statement.[17,18] Specifically, we identified factual recall during patient care (eg, the diagnostic identification of the problem) as a lower order of cognitive learning achievement. Statements that reflected the application, analysis, or evaluation of knowledge were identified as belonging to a higher order cognitive learning category (eg, stating that, for example, a Cochrane review revealed that one therapy was superior to another).

All learning statements that reflected a change in attitude, commitment to specific psychosocial behaviors,

or the motivation to improve communications were classified as valuing, a lower-order affective level. For example, in the sample case, the learning statement regarding the risk reduction of 35% was classified as lower-order factual recall. The statement recognizing that it is important to consider the patient's belief system was classified as lower-order affective. We then calculated the percentage of students documenting that they could apply the PICO format properly to ask searchable clinical questions based upon their encounters with patients.

Student Self-efficacy Questionnaire. We analyzed the students' perceptions of the importance of EBM and of their self-efficacy in applying the EBM approach to patient care. Responses were made to the following two questions on a 5-point Likert scale from strongly disagree to strongly agree: "How important do you think it is to use an evidence-based medicine approach to focus your interactions with your preceptor about specific patients?" "How confident are you that you can use an evidence-based approach to focus your interactions with your preceptor about specific patients?" The student self-efficacy questionnaire was administered before and after the orientation and after the end of the preceptorship.

Preceptor Questionnaire. We identified the preceptors' perceptions of various aspects of the project with a questionnaire consisting of 14 items. Three of these items assessed the preceptors' use of evidence-based databases before, during, and since the conclusion of the preceptorship. Preceptors rated frequency of use as less than once a month, about once a month, twice a month, weekly, or daily. Eleven items, which the preceptors rated as agree, neutral, or disagree, asked if the EBM project did the following: supplemented teaching activities, took away from more important teaching activities, helped to focus the preceptor's feedback, required the preceptor to devote additional time, helped the preceptor to keep up to date with the literature, and encouraged the preceptor to reconsider some usual management practices. Two of the 11 items were stated negatively: "My student's evidence-based medicine project:" 'took away from more important teaching activities' and 'showed me that students at this level of training were not ready for activities like this.'"

Data Analysis

We used the chi-square test to calculate differences in rates of return of PICO forms and use of cognitive and affective domain skills across the 3 years of students. We also used chi-square to assess differences in frequencies before and after the orientation workshop and from after the workshop to the end of the preceptorship for the individual survey items. The individual survey items were dichotomized as highly agree versus other responses on the 5-point Likert scale. Statistical significant difference was reported at $P<.05$. All statistical analyses were performed by using SAS 9.1.3 (SAS Institute Inc, Cary, NC).

Results

Student Reports

Of the 94 students participating in the TSFMPP during years 2005–2007, 74 (78.7%) returned 296 PICO forms. The number of returned forms was 64 in year 1, 100 in year 2, and 132 in year 3. Compared to 2005, when the project was elective, the percentage of students who submitted PICO forms increased from 47.1% to 92.6% and 100% in years 2006 and 2007, respectively (all $P<.05$). All responding students could use the PICO format accurately.

The categorization of students' learning statement according to Bloom's taxonomies of educational objectives is shown in Table 1.[17,18] Over 3 years, we found nearly all students wrote lower-order clinical facts that they had learned when they converted information from patients into answerable and searchable questions. In the second and third years of the project, the statements reflected that all the students learned to apply knowledge to patient care. Specifically, they wrote that they had learned to interpret the patient's problem in terms of a particular diagnosis. Students in the last 2 years of the intervention included specific evidence either from clinical guidelines or from databases when stating what they had learned.

In all years of the project, students most infrequently wrote what they had learned about communication skills and psychosocial aspects of patient care. The percent of students writing a learning statement about the doctor-patient communication and psychosocial aspects of patient care increased from 7.8% in year 2005 to 21.2% in year 2007 ($P<.05$). All of the students who submitted case summaries used the PICO format accurately.

The top frequency of use rankings of databases were: the DynaMed database, MEDLINE, Clinical Guidelines, and Up-to-Date. The database ranked first was searched by three times more students than the database ranked second (by 94 students as compared to by 34 students).

The proportion of students who responded along a 5-point Likert scale they "highly agree" to the importance of using EBM as the focus of their interactions with their preceptors increased significantly between before orientation (77.8%) and after orientation (88.7%) ($P<.05$). However, the proportion of students who responded "highly agree" to the importance of EBM as the focus of interactions with their preceptors decreased by the end of the preceptorship to 50.0% ($P<.05$).

The students' self-efficacy in their ability to provide EBM techniques to patients in their preceptorship also increased from 22.2% of before orientation to 80.4%

Table 1

Medical Students' Documentation of Cognitive and Affective Learning as a Result of EBM Activities

Items	*Percentage of Students Who Learned*		
	2005 (n=16)	2006 (n=25)	2007 (n=33)
Factual knowledge (c)	100.0	100.0	97.0
Comprehension (c): Identifies diagnostic categories to learn about the patient's problems from databases	37.5	72.0	75.8
Application (c): Provides specific evidence either from clinical guidelines or from databases	34.4	61.0	63.6
Valuing (a): Demonstrates importance of communication skills and psychosocial dimensions of care	7.8	10.0	21.2

(c)=cognitive learning, (a)=affective learning

of after orientation ($P<.05$). By the end of the preceptorship, the students' self-efficacy in using EBM with their patients had decreased to 57.1% ($P<.05$).

Preceptor Reports

Of the 73% of responding preceptors, 76.7% of them indicated that they now use EBM databases weekly or daily as compared to 66.0% before the preceptorship. Specifically, 76.4% agreed that "Being involved in activities like this is a good reason to serve as a preceptor" and disagreed that "Students at this level of training are not ready for activities like this. Eighty-three percent viewed the project as a "supplement" to the preceptorship's teaching activities. Sixty-six of the preceptors wrote that the intervention increased their comfort with evidence-based information.

Most responding preceptors used EBM databases identified by the preceptors as MEDLINE, Clinical Guidelines, Up-to-Date, and the Cochrane Library. Ninety-four percent found the EBM activity a help in focusing their feedback. Fifty-three percent of them found that the EBM project resulted in their need to devote extra time to their preempting activities.

Discussion

EBM has assumed a prominent place in planning for the future of family medicine.[19] Consistent with that planning, we were successful in teaching preclinical students who participated in a 4-week ambulatory preceptorship to engage with their preceptors in applying EBM to patient care. Moreover, the educational materials and measures that we implemented are now available to faculty and students of all eight schools that participated in the TSFMPP.

Program evaluations showed that over 3 years, students documented their use or EBM in asking clinical questions and researching the medical issues confronting 296 patients. The students used their case summaries to stimulate EBM discussions with their preceptors about their patients. The students did not make decisions about actual patient care. All students were able to apply the PICO format to generate and answer clinical questions; however, the predominant low cognitive level of the students' learning statements suggested that students had focused on gathering facts rather than learning to interpret those facts. These results were not surprising because preclinical students are accustomed to learning and being tested on their recall of factual information.

Results concerning the students' reduced perceptions of self-efficacy at the end of the preceptorship need further explanation. According to Bandura, students' perceptions that they can complete a set of behaviors successfully (ie, their self-efficacy) are influenced by a variety of factors that include their role models' and their own beliefs and motivations.[20] High post-workshop self-efficacy ratings of EBM likely reflected that the students achieved immediate success and boosted their perceptions of self-efficacy when performing their first EBM searches under expert EBM tutelage. During the preceptorship, the students' EBM activities were largely self-directed. Our informal discussions with the students after the preceptorship indicated that the EBM project gave students a greater awareness of what they did not know and the skills they lacked. According to learning experts, students who have such self-knowledge and who are self-directed have tended to perform better academically.[20,21]

Regarding the preceptors' reactions to the overall EBM project, responses to all 14 items reflected the preceptors' positive attitudes. All of the preceptors gave the students feedback on their EBM searches. Just under half of responding preceptors acknowledged using EBM databases daily prior to the preceptorship project. During the preceptorship, EBM use increased to 57%. The fact that preceptors learned from the EBM experience was reflected in the greater than 80% of them who responded that the EBM activity had assisted in the following ways: focusing their feedback, keeping up with the current literature, and rethinking some of their management practices. Nevertheless, 80% of the preceptors viewed the EBM project as a supplement to regular activities rather than as an integral part of the students' encounters with patients. The more traditional clinical activities of observing, working along side, and interacting with the preceptors as they saw patients took precedence over EBM in the preceptorship.

Our findings about the preceptors' reactions support earlier EBM educational literature that suggested the need to find mechanisms for enhancing the EBM training of busy primary care clinicians and for teaching EBM in a longitudinal fashion rather than as a single innovation.[22,23] While we realize that preceptorships offer students many worthwhile opportunities, we were pleased that the TSFMPP encouraged 94 preceptors to practice EBM with students and provide them with case-specific feedback during three preceptorship summers.

Limitations

One limitation of this project was that a relatively small number of students from a single medical school participated in the intervention, potentially limiting generalization of results. A second limitation was that we chose to simplify the implementation and assessment processes. Hence, we assessed the student's competency or lack of competency in writing clinical questions rather than measuring more qualitative variables such as the quality of the clinical questions asked. In addition, students submitted simultaneously all four of their patient cases, thus giving the students more flexibility in completing the assignment while eschewing the possibility of assessing the students' improvements over the 4 weeks. Finally, we did not follow the students' or the preceptors' EBM skills and activities beyond the preceptorship or in other parts of the second-year curriculum that include EBM skills. At UTHSC, over the next 3 years of their medical school training, the students will have ample curriculum opportunities and database resources to refine the EBM skills they first learned in the TSFMPP preceptorship.

Conclusions

The following summary points from this innovation should be helpful to those who seek to undertake similar interventions early in their training. First, preclinical medical students can begin to learn EBM skills at the point of care and can identify explicitly what they have learned. Second, students undertaking EBM activities early in their education will likely need continued supervision from experts who can model the EBM search process. Finally, preceptors increase their use of EBM when they participate with their students in an EBM intervention.

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References

1. Haynes RB, Sackett DL, Gray JM, Cook DJ, Guyatt GH. Transferring evidence from research into practice: 1. The role of clinical care research evidence in clinical decisions. ACP J Club 1996;125(3):A14-6.
2. Finkel ML, Brown HA, Gerber LM, Supino PG. Teaching evidence-based medicine to medical students. Med Teach 2003;25(2):202-4.
3. Evidence-based Medicine Working Group. Evidence-based medicine: a new approach to teaching the practice of medicine. JAMA 1992;268:2420-5.
4. El Ansari W. Appraisal skills as a public health competency for evidence-based care: students' satisfaction with their research education. J Public Health Manag Pract 2004;10(4):354-65.
5. 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.
6. Bennett KJ, Sackett DL, Haynes RB, Neufeld VR, Tugwell P, Roberts R. A controlled trial of teaching critical appraisal of the clinical literature to medical students. JAMA 1987;257:2451-54.
7. Slawson DC, Shaughnessy AF. Teaching evidence-based medicine: should we be teaching information management instead? Acad Med 2005;80(7):685-9.
8. Leipzig RM, Wallace EZ, Smith LG, Sullivant J, Dunn K, McGinn T. Teaching evidence-based medicine: a regional dissemination mode. Teach Learn Med 2003;5(3):204-9.
9. Srinivasan M, Weiner M, Breitfeld PP, Brahmi F, Dickerson KL, Weiner G. Early introduction of an evidence-based course to preclinical medical students. J Gen Intern Med 2002;17(1):58-65.
10. Dobbie A, Tysinger JW. Evidence-based strategies that help office-based teachers give effective feedback. Fam Med 2005;37(9):617-9.
11. Nieman LZ. A preclinical training model for chronic care education. Med Teach 2007;29(4):291-3.
12. Straus SE, Green ML, Bell DS, et al. Evaluating the teaching of evidence-based medicine: conceptual framework. BMJ 2004;329:1029-32.
13. Bigby M. Evidence-based medicine in a nutshell. A guide to finding and using the best evidence in caring for patients. Arch Dermatol 1998;134(12):1609-18.
14. Ismach RB. Teaching evidence-based medicine to medical students. Acad Emerg Med 2004;11(12):6-10.
15. Richardson WS, Wilson MC, Nishikawa J, Hayward RS. The well-built clinical question: a key to evidence-based decisions. ACP J Club 1995;123(3):A12-3.
16. Alper BS, White DS, Ge B. Physicians answer more clinical questions and change clinical decisions with synthesized evidence: a randomized trial in primary care. Ann Fam Med 2005;3(6):507-13.
17. Palmer EJ, Devitt PG. Assessment of higher order cognitive skills in undergraduate education: modified essay or multiple choice questions? BMC Med Educ 2007;28:49.
18. Krathwohl D, Bloom B, Masia B. Taxonomy of educational objectives. Handbook II: Affective domain. New York: David McKay, 1956.
19. Future of Family Medicine Project Leadership Committee. The future of family medicine: a collaborative project of the family medicine community. Ann Fam Med 2004;2:S3-S32.
20. Bandura A, ed. Self-efficacy: the exercise of control. New York: Freeman, 1997:212-58.
21. Payne SC, Youngcourt SS, Beaubien JM. A meta-analytic examination of the goal orientation nomilogical net. J Appl Psychol 2007;92(1):28-50.
22. Dagli A, Morse RM, Dalton C, Owen JA, Hayden GF. Formulating clinical questions during community preceptorships: a first step in utilizing evidence-based medicine. Fam Med 2003;35(9):619-21.
23. Suval K, Berkovits E, Netzer D, et al. Evaluating the impact of an evidence-based educational intervention on primary care doctors' attitudes, knowledge, and clinical behavior: a controlled trial and before and after study. J Eval Clin Pract 2007;13(4):581-8.