JAOA MEDICAL EDUCATION

Inclusion of Evidence-based Medicine in Colleges of Osteopathic Medicine and Suggestions for Implementing Evidence-based Medicine Into Osteopathic Medical School Curricula

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The authors investigated the extent to which colleges of osteopathic medicine include evidence-based medicine education in their curricula. Information was obtained through a questionnaire survey, including a Likert scale. The survey was sent to 19 colleges of osteopathic medicine for completion. Twelve responses were received within the time limits of this cross-sectional study, yielding a 63% response rate.

Four colleges of osteopathic medicine report that they currently teach evidence-based medicine within their education programs. Variations among the programs included the type of faculty delivering the evidence-based medicine course, the years in which instruction occurs, the number of hours of instruction, and assessment methods used. Seven additional schools have plans to implement evidence-based medicine into their educational programs.

Suggestions for the design of an evidence-based medicine course and an evidence-based medicine–based curriculum are discussed in relation to the survey results.

Evidence-based medicine is a relatively new paradigm in the practice of medicine that emphasizes application of medical literature to patient care.[1-5] Although the concept seems new, with *evidence-based medicine* being coined as a term in 1992,[1] its origins can be traced back to 1910 with the publication of the Flexner Report.[6] The Flexner Report discussed the quality of medical school education during the early part of the twentieth century and made recommendations for the reformation of medical education. The Flexner Report suggested basing medical education on scientific research to ensure that scientific factual information would be the foundation for clinical reasoning by the physician in practice.[6,7] Before that time, medical decision-making tools were based on knowledge of pathophysiology, clinical judgment, and clinical experience. However, there were no computers, Internet, or the funding for medical research[5] and the translation of scientific research to bedside care as it exists today.

While evidence-based medicine is not a replacement for a sound knowledge of pathophysiology, clinical judgment, or clinical experience, it incorporates these tools within the context of current medical research literature, allowing each physician to find the best possible evidence for a variety of clinical problems. The assumption of those practicing evidence-based medicine is that it will improve patient outcomes through decreased morbidity and mortality, reduction in the number of diagnostic tests, and improvement in health care delivery.[1,5] Long-term assessment measures are still necessary to provide proof of whether the evidence-based medicine approach reaches these assumed goals.

Evidence-based medicine is a theory of clinical decision-making and clinical practice with principles that allow clinicians latitude in treating individual patients. Evidence-based medicine is defined as the integration of the best research evidence with clinical expertise and patient values.[5] Under the evidence-based medicine paradigm, best research evidence implies that the clinician will use many different information tools for making decisions under the evidence-based medicine paradigm. These tools include the medical literature, academic reviews, continuing medical education courses, clinical guidelines and expert opinions (eg, US Preventive Services Task Force's Guide to Clinical Preventive Services),[8] and Internet resources.[9-11]

From an educational perspective, evidence-based medicine provides medical literature appraisal skills to students. Evidence-based medicine critical appraisal skills are grounded in epidemiology and biostatistics.[11] Both subjects serve as a foundation for the ability to analyze information sources to determine their validity and usefulness in a given clinical situation. Based on a recent survey study, skills of critical appraisal of the literature seem to increase for medical students in evidence-based medicine programs.[12] Student confidence in literature appraisal and application improves with an evidence-based medicine curriculum.[12] Recent sur-

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1. Do you currently have an evidence-based medicine course or curriculum established?
Yes ___
No ___

If your answer was no, do you plan to introduce an evidence-based medicine course within the next 2 years?

If your answer was yes, how long has the course been in place as a requirement for graduation?

2. List five major objectives of the evidence-based medicine course or curriculum (if in place).

_____

_____

_____

3. How many curriculum hours are devoted to evidence-based medicine? _____

4. Is the evidence-based medicine course a stand-alone course or an integrated course?

5. In what year(s) is the evidence-based medicine course taught? (Check all that apply)
___ Year 1
___ Year 2
___ Year 3
___ Year 4

6. Which prerequisites are required from students before the evidence-based medicine course is delivered?
___ Biostatistics
___ Public health
___ Epidemiology
___ Internet training and computer technology
___ Library media
___ Critical thinking
___ Medical literature evaluation
___ Decision making (medical decision making course)
___ Other
___ None

7. Which location(s) is (are) used in teaching an evidence-based medicine course?
___ Internet
___ Campus
___ Rotation sites
___ Combination of the above
___ Other (please explain: _____)

8. Which departments assist in the delivery of the evidence-based medicine course?

_____

_____

(continued)

Figure. *Survey used to determine inclusion of evidence-based medicine at colleges of osteopathic medicine.*

9. Have the evidence-based medicine course measurements (assignments, reports, tests taken by students, etc.) shown that students are able to apply the principles of evidence-based medicine?

___ Yes
___ No
___ Do not know

10. On a scale of 1-5 (1, strongly disagree; 2, disagree; 3, neutral/do not know; 4, agree; 5, strongly agree), please rate the following:

___ Evidence-based medicine is an important part of medical school curriculum.
___ Evidence-based medicine will be included in our curriculum in the future.
___ Evidence-based medicine strengthens clinical performance for medical school students in the third and fourth years.
___ Evidenced-based medicine improves clinical decision-making processes for students.
___ Evidence-based medicine has been difficult to include in the curriculum.
___ Basic science faculty members have resisted the implementation of an evidence-based medicine curriculum.
___ Clinical faculty members have resisted the implementation of an evidence-based medicine curriculum.
___ Technology support and computer support are barriers to implementation of an evidence-based medicine course in the curriculum.
___ Financial considerations have directed the inclusion/exclusion of an evidence-based medicine course.
___ Assessment of students is important to evidence-based medicine curriculum delivery in the future.

11. What types of assessment are you using in the evidence-based medicine course?

___ Written tests (essay format)
___ Multiple choice
___ Critical thinking surveys
___ Case study analysis or problem-based learning formats
___ Oral
___ Other (please explain: _____)

If you have an evidence-based medicine course in place, please attach a syllabus or syllabi for the course(s) offered. (No school will be specifically identified with regard to syllabus contents unless desired. Please indicate whether you want your school identified in relation to your evidence-based medicine syllabus.)

veys of students in various evidence-based medicine curricula attest to the fact that a 4-year program is best for maintenance of new skills and application in the clinical years.[12-14] Residents do not experience the same gains in comfort for literature evaluation and application as medical students in evidence-based curricula, suggesting that the most opportunistic time to teach evidence-based medicine to physicians is during medical school.[12]

In addition to increasing medical students' abilities to evaluate and apply evidence from medical research, evidence-based medicine is also useful in the conceptualization of research design.[15] As students begin to understand evidence-based medicine, they can use the principles of the paradigm to both practice medicine based on the best evidence available and design randomized clinical trials exploring the efficacy of medical interventions (eg, osteopathic manipulative techniques)[15] in an evidence-based model.

Although data exist for evidence-based medicine in residency programs,[16] no data for the inclusion of evidence-based medicine courses or curriculum exist for colleges of osteopathic medicine. Only four letters or articles discussing osteopathic medicine and evidence-based medicine were discovered in a MEDLINE search using the terms *osteopathic* and *evidence-based medicine* in January 2001.[15,17-19] None of

Table 1
Characteristics of Evidence-based Medicine Course or Curriculum in Osteopathic Medical Schools

School	Hours Devoted	Year Delivered	Degrees or Departments Involved in Delivery	Sites of Instruction	Assessment Methods
1	2 (plus independent study assignment)	Fourth	DO, PhD	Rotation/clerkship, Internet	Written tests (essay formats); case study analysis or problem-based learning
2	5	First, second	Primary care	Campus	Multiple choice, oral
3	15	First, second, third	Obstetrics and gynecology, family medicine, internal medicine	Internet, campus, rotation sites	Multiple choice, case study or problem-based learning, oral
4	Less than 4 during two seminars	First, second	Family medicine, osteopathic principles and practice	Campus	Case study or problem-based learning, oral

these articles discusses evidence-based medicine education in colleges of osteopathic medicine.

The following research question was posed: Are colleges of osteopathic medicine including some form of evidence-based medicine course or curriculum, and what are the characteristics of such education at each institutional setting? We hypothesized that evidence-based medicine curricula are in place at colleges of osteopathic medicine and that the following characteristics would vary: (1) number of years each institution instructs its students in evidence-based medicine, (2) faculty delivering an evidence-based medicine curriculum, and (3) osteopathic medical schools' ratings on the importance of evidence-based medicine. To answer the question, we designed a survey to obtain qualitative and quantitative information regarding evidence-based medicine from each college of osteopathic medicine.

Methods

A questionnaire was developed to survey each osteopathic medical school's academic administration about the current status of evidence-based medicine education in their curricula (*Figure*). Open-ended questions were used to learn about the characteristics of any evidence-based medicine course or curriculum components. Forced-choice questions, including a Likert scale, were also used to ascertain information about evidence-based medicine education in each college of osteopathic medicine. Each school was also asked to submit a syllabus for any evidence-based medicine course or curriculum. Schools were informed that their identities would remain anonymous in any data analysis and publication.

The survey was mailed to each college of osteopathic medicine to the attention of those in charge of the medical school curriculum, basic science curriculum, or other related positions (associate deans, deans of academic affairs, deans of academic programs). The American Osteopathic Association provided a list of the osteopathic medical schools with contact information for each of the positions listed previously. Each school was contacted by phone before the survey was mailed to confirm the person in the position (associate dean, dean of academic affairs, dean of academic programs) was also in charge of any type of evidence-based curriculum or course, or curriculum in general. In some cases, schools identified a person other than a dean in charge of evidence-based medicine delivery or curriculum in general. The survey was intended to be an institutional survey, not a personal survey, of the inclusion of evidence-based medicine in colleges of osteopathic medicine. The survey was mailed in early April 2001, with a requested return date of May 20, 2001. Once surveys were collected, they were reviewed for qualitative and quantitative information. All schools were assigned a numeric code for purposes of discussion and maintaining anonymity.

Results

Twelve of 19 colleges of osteopathic medicine responded within the requested time frame of the study, for a return rate of 63%. Of the twelve schools, four stated they currently have an evidence-based medicine course or curriculum. *Table 1* includes the characteristics of each of these school's evidence-based medicine educational programs. Three of the four schools teach evidence-based medicine content in the first 2 years, and primarily on campus. Only those schools that teach evidence-based medicine in years 3 or 4 (schools 1 and 3) have an Internet component or clerkship component to their evidence-based medicine education. Three schools (schools 2, 3, and 4) reported that they use oral examinations in the assessment of students in evidence-based medicine courses. Three schools (schools 1, 3, and 4) also reported that they use case study or problem-based learning to assess their evidence-based medicine

Table 2
Schools' Responses to Survey Question 10

Statement	School 1	2	3	4	5	6	7	8	9	10	11	12	Average	Mode
Evidence-based medicine is an important part of medical school curriculum.	5	4	5	5	5	4	4	4	4	4	4	3	4	4
Evidence-based medicine will be included in our curriculum in the future.	5	5	5	5	5		4	4	4	4		3	4	5
Evidence-based medicine strengthens clinical performance for medical school students in the third and fourth years.	3	5	5	5	5	3	3	4		5	3	2	4	5
Evidenced-based medicine improves clinical decision-making processes for students.	3	5	5	5	5	4	3	4		4	3	2	4	5
Evidence-based medicine has been difficult to include in the curriculum.	4	3	5	1	2		2	5		3	3	4	3	3
Basic science faculty members have resisted the implementation of an evidence-based medicine curriculum.	1	1	3	3	1	2	3	1		3	2	3	2	3
Clinical faculty members have resisted the implementation of an evidence-based medicine curriculum.	2	1	4	1	2	2	3	2		3	2	3	2	2
Technology support and computer support are barriers to implementation of an evidence-based medicine course in the curriculum.	1	1	2	1	1		1	2		3	3	4	2	1
Financial considerations have directed the inclusion/exclusion of an evidence-based medicine course.	3	1	2	1	2	2	3	2		3	2	4	2	2
Assessment of students is important to evidence-based medicine curriculum delivery in the future.	4	4	4	5	5	4		4		5	4	2	4	4

students. Schools 3 and 4 use both case study or problem-based learning and oral examinations to assess students' performance in evidence-based medicine courses.

Although eight schools responded that they did not have evidence-based medicine in their curricula, several schools responded to other questions in the survey. *Table 2* summarizes the Likert scale responses from the twelve colleges of osteopathic medicine that responded to the survey. Most schools responding did not believe that financial considerations, technology support, or clinical faculty member resistance were barriers to the implementation of an evidence-based medicine curriculum. Schools were unsure whether basic science faculty members resisted the implementation of an evidence-based medicine curriculum.

Perhaps the most significant result from question 10 of the survey is that of the eight schools (schools 5 through 12) without evidence-based medicine in their curriculum, only school 12 is undecided about how important evidence-based medicine is to osteopathic medical education and whether it will be incorporated in the future. The remaining schools agree that evidence-based medicine is an important part of a medical school curriculum. Five of the eight schools without evidence-based medicine in their curriculum agree or strongly agree that evidence-based medicine will be included in their curriculum in the future. This brings the number of schools that have, or plan to have, an evidence-based medicine educational component to 9 (75%) of 12 schools.

Two schools without evidence-based medicine courses or curriculum included comments and syllabi about courses they do have in their efforts to implement evidence-based medicine education in the future. Their comments can be viewed in *Table 3*, along with a short description of their course/curriculum design relating to evidence-based medicine. The information in *Table 3* further verifies that schools without evidence-based medicine are working toward the implementation of evidence-based medicine within their curriculum.

Conclusions

Results of the survey indicate that colleges of osteopathic medicine have evidence-based medicine education within their curricula. For those schools that have an established evidence-based medicine course or curriculum, the years in which each institution delivers its evidence-based medicine education vary, as well as the faculty delivering the evidence-based medicine curriculum (*Table 1*). Several schools without evidence-based medicine have plans of integrating it into their curriculum in the

Table 3
Evidence-based Medicine Course/Curriculum Development From Two Schools

School	Course Description From Syllabus Included With Survey	Comments
5	Educational experiences are modeled around 115 clinical diseases of which students must relate the diseases in the form of differential diagnosis, signs and symptoms, and current literature in the medical field. The basic sciences are used to tie the loose ends of the medical literature together and are used to explain why certain diseases, signs, and symptoms are linked together. Further, basic science faculty members cite all sources of their information in lectures.	"In short, evidence-based medicine is too important to be regulated to a course. It should be a pervasive element of an integrated curriculum. We are working to implement such a curriculum here."
8	This course is a medical information sciences course aimed at teaching students the application of epidemiology and biostatistics toward understanding the medical literature. Through the application of the medical information sciences course, it is hoped that students can understand the conclusions of any medical research paper and relate them to the data presented in the same paper.	"Students will learn to apply epidemiologic methods to critically evaluate evidence used in medical decision-making and use the epidemiological and biostatistical principles to assess data and evaluate conclusions based on study data."

future or are working toward the goal of implementing evidence-based medicine (*Table 3*). Respondents from all but one school (school 12) indicated that evidence-based medicine is an important part of a medical school curriculum (*Table 2*).

Recommendations for Implementation of an Evidence-based Medicine Curriculum

Several articles have been published about how to implement an evidence-based medicine curriculum throughout the medical education experience.[20-25] The best possible scenario for an evidence-based medicine curriculum would be one that teaches the following five concepts[20]: (1) what types of information are important in the patient care setting; (2) formulation of focused, clinically relevant questions; (3) application of a focused literature search based on the clinical question; (4) critical appraisal of the medical literature gathered; and (5) ability to apply the evidence in the clinical situation. It is our belief that an evidence-based medicine curriculum should extend from the first year of osteopathic medical school through the fourth year of osteopathic medical school to allow students the most complete understanding of these concepts.

Although we suggest an integrated evidence-based medicine curriculum, there are several examples of evidence-based medicine curriculum programs. Indiana University School of Medicine recently reported an evidence-based medicine course in the first 2 years of medical school that showed students can have successful learning experiences in a separate evidence-based medicine course.[26] There are examples of schools that emphasize their evidence-based medicine curriculum predominantly in the clinical years.[27] Finally, there is an example of an integrated, evidence-based medicine curriculum that emphasizes search strategies for information retrieval in the preclinical years and critical appraisal skills in the clinical years.[28] The recommendation of the Medical School Objective Project Writing Group is to develop an evidence-based medicine curriculum that is integrated throughout all 4 years of medical school.[29] Colleges of osteopathic medicine most likely have to examine their current programs to identify which model of evidence-based medicine curriculum design fits best with their unique characteristics. We also believe that if an integrated evidence-based medicine curriculum is not feasible at a particular institution, a stand-alone evidence-based medicine course is a valid option, and it is encouraging to know that successful outcomes have already been seen in a stand-alone course design.[26]

Possible Prerequisites for Evidence-based Medicine Courses

Possible prerequisites or components for an evidence-based medicine course or integrated curriculum include those reported by schools 1 through 4 in the survey, including the following: (1) public health, (2) epidemiology, (3) biostatistics, (4) Internet and computer technology, and (5) library media use (data not shown). These same suggestions for components of evidence-based medicine curriculum or separate course designs are found in the literature.[5,11,26] In the past, evidence-based medicine would have been nearly impossible to practice without rapid access to the body of medical literature provided by computers, the Internet, and evidence-based consortiums currently available. We recommend that all courses or curricula incorporating evidence-based medicine take advantage of these tools and prerequisites in content delivery.

Basic Science Faculty Involvement in Evidence-based Medicine

The survey results suggest that the role of basic science professors in evidence-based medicine education delivery is not clear. However, the results also suggest that a multidisciplinary approach to teaching evidence-based medicine is already in place with regard to clinical instructors. Evidence-

based medicine has previously been described as an organizing curriculum theme for faculty in both clinical sciences and basic sciences,[25] particularly when a problem-based learning approach is established.[20,25] Students can practice researching the medical literature, formulating clinical questions, and applying their acquired knowledge in problem-based sessions related to a clinical scenario. At the same time, students can learn the pathology, biochemistry, and physiology of a disease related to the same clinical scenario. Limitations on this approach to teaching evidence-based medicine are generally related to staffing considerations.[20]

Evidence-based Medicine Education in the Clinical Years

Computers and their integration into hospitals and clinical offices allow for evidence-based medicine educational opportunities in the clinical years. The literature describes possible ways to instruct evidence-based medicine in the clinical years.[5,21-23] The critical point is that the evidence-based medicine process (including the differential diagnosis, diagnostic testing, management, and treatment decisions relating to a patient in a clinical situation) should be user-friendly for the student.[21,22] Sackett[5] and Rucker[22] have suggested forms or teaching tools to help students apply the practice of evidence-based medicine. Overall, preceptors or clinical educators can require students to research evidence related to clinical problems via the Internet, computers, and medical literature. Students can then discuss the validity of the research and its possible application to patient care. Students can use the "evidence-based medicine learning prescription" teaching tool[5,22] and discussion with their clinical instructors to build skills in the practice of evidence-based medicine.

Assessment of Students in Evidence-based Medicine Courses and Characteristics of Evidence-based Medicine Courses

While our results are limited to the four schools in *Table 1*, we believe that it is encouraging to note that two of them incorporate the characteristic of using the Internet in training students in evidence-based medicine. We believe that the Internet offers access to several evidence-based medicine information tools, including evidence-based literature reviews such as the Cochrane Database[9] and POEMs (Patient-Oriented Evidence that Matters).[10] In addition, clinical guidelines such as those provided by the National Guideline Clearinghouse are important information resources that are accessible via the Internet.[30] Although we recognize the importance of all information resources for the practice of evidence-based medicine, we believe that information accessibility via the Internet expands the ability to view a larger variety of evidence-based medicine resources, making its incorporation into evidence-based medicine education programs an important design characteristic.[5,9-11,30]

While this study concentrated on evidence-based medicine in colleges of osteopathic medicine, we did not specifically address which factors influence assessment of students in evidence-based medicine curricula. Nor did we address the entire curriculum of any school to determine which factors related to the design of evidence-based medicine curriculum characteristics such as those outlined in *Table 1*. The factors influencing evidence-based medicine curriculum design, evidence-based medicine education characteristics, and assessment of students in evidence-based medicine curricula programs are areas that warrant future studies at colleges of osteopathic medicine.

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