SGIM Workshop WA03
April 29, 2010

Creating or Upgrading Your Evidence-Based Medicine Curriculum

Advance Materials

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How to use this toolkit:

This toolkit has been developed to accompany a workshop in creating or upgrading curricula in evidence-based medicine at the national meeting of the Society of General Internal Medicine, April 2010, in Minneapolis. Much of the material contained herein can be used as reference. We recommend the following steps in the use of this toolkit to aid in the formation of a new curriculum:

1. Define the learners within your teaching setting in advance. Estimate the teaching time frame and available faculty. Conduct a needs assessment of your learners through surveys, focus groups, or written testing. See section VII, Tools for evaluating curricula, for the best reference regarding tests.

2. Write goals and objectives for your curriculum. See section III for sample goals and objectives.

3. List the specific EBM content areas and domains you will cover. See section IV for examples.

4. Outline the teaching methods you will use. See section V for pros and cons of different methods.

5. Draft a teaching session based on the content and methods you have chosen. See section VI for ideas.

6. Argue for the necessity of implementing your curriculum. Present your proposal to the stakeholders at your institution. Refer to section VIII for a summary of available literature regarding efficacy of curricula. Plan to use evaluation tools noted in section VII to assess your own curriculum to support it’s value at your institution.

7. Use the resources outlined in section X in the development of teaching sessions and for ongoing review.
Background and rationale for Evidence-Based Medicine teaching

“Evidence based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research.” (Sackett et al. BMJ 1996;312:71-72)

Evidence-Based Medicine (EBM) can trace its roots back to the 17th century, where we find the first recordings of patient data to evaluate fair comparisons, the use of historical and concurrent controls, and the use of prospective trials. The first reports of what would become modern clinical epidemiology can be found in the late 18th and early 19th century. In 1935, William Pickles wrote an article describing in detail the investigation of various outbreaks of infectious diseases in small towns. Only with a clear recording of the details of each case in his ledger did he see the patterns of contact and incubation. In the 1950’s, Kerr White emerged as a pioneer of health services research as well as primary care. He chaired the Department of Epidemiology and Community Medicine, the first in the United States to include epidemiology in its label, at the University of Vermont in 1962. He later established the International Clinical Epidemiology Network in 1978, which has trained hundreds in the skills of epidemiology. Alvan Feinstein, author of “Clinical Judgement” (1967), “Clinical Epidemiology” (1985) and “Principles of Medical Statistics” (2002), was the founding director of the Robert Wood Johnson Clinical Scholars Program at Yale in 1974. Another pioneer in the field of epidemiology, Archie Cochrane, wrote the book for which he is best known, “Effectiveness and Efficiency: Random Reflections on Health Services”, in 1972. In 1987, one year before his death, he emphasized the great value of a systematic review of randomized controlled trials. The Cochrane Collaboration was founded in his name in 1993. In 1981, David Sackett introduced the term “critical appraisal” in a series of articles designed to assist clinicians in interpreting research. He, along with others, published the text “Clinical Epidemiology” in 1985, now in its third revision. Sackett’s colleague, Gordon Guyatt, first used the term “evidence based medicine” in an article in the ACP Journal Club in 1991. He wrote the “User’s Guides to the Medical Literature” in 2002, now in its second revision.

EBM has become a frequently used phrase among physicians and medical institutions in recent years. While the use of the phrase can be subject to interpretation and is sometimes controversial, as many things can be described as evidence, most clinicians are in agreement about the importance of reviewing and appraising the literature and applying it to the care of our patients. Skill in EBM is now a part of the Practice-Based
Learning and Improvement competency outlined by the ACGME, and is an expected component of medical training.

Practicing EBM requires a good working knowledge of information sources, an understanding of the hierarchy in quality of evidence, and a facility with certain core EBM concepts. Patients trust us to have assimilated information correctly, and benefit when we communicate the evidence to them in a fashion that’s tailored to their needs. Medical students, residents, and fellows expect that their training will prepare them for these tasks. The teaching of EBM in medical training is widely variable. Some programs address EBM topics in forums such as morning report and journal club. Others develop EBM curricula of varying lengths and depths. In this toolkit and through this workshop, we aim to present resources to guide the formation or expansion of EBM curricula.

Participants will start with their learners’ needs, faculty resources, and institutional resources. In this workshop, participants will outline course goals and objectives, course content and methods, and evaluation tools, and will address common barriers in the creation of their own curricula.

**Objectives:**
By the end of the workshop, participants will:
1. Argue for the necessity of a curriculum in EBM
2. Draft a novel or upgraded course
3. Navigate a toolkit of resources
4. Develop an ongoing network of colleagues for sharing innovation and feedback
## Sample curricular goals and objectives:

<table>
<thead>
<tr>
<th>Course Length</th>
<th>Learner Level</th>
<th>Goals [This course will...]</th>
<th>Objectives [Learners will be able to...]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Course</td>
<td>Novice (MS, PGY-1)</td>
<td>• Introduce the language of EBM</td>
<td>• Articulate a well-structured clinical question</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Illustrate question formation, study selection, and the hierarchy of evidence</td>
<td>• Choose the best study design for their clinical question</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Introduce core EBM definitions for different types of clinical questions</td>
<td>• Calculate likelihood ratios and correctly use a nomogram</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Highlight sources of bias in studies</td>
<td>• Identify sources of bias in studies on diagnostic testing and therapy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide resources and references for critical appraisal and model several examples</td>
<td>• Calculate absolute risk reduction, relative risk reduction, number needed to treat</td>
</tr>
<tr>
<td></td>
<td>Intermediate (PGY-2)</td>
<td>• Enhance skills of question formation and study selection</td>
<td>• Interpret confidence intervals and describe their relationship to precision</td>
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<tr>
<td></td>
<td></td>
<td>• Improve knowledge and skills involved in critical appraisal</td>
<td>• Critically appraise a study and defend its applicability to a clinical question</td>
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<tr>
<td></td>
<td></td>
<td>• Understand the process of diagnostic testing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve ability to detect and assess the impact of bias on study conclusions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hone the selection of best published research evidence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve skills related to presentation of articles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced (PGY-3, fellow, faculty)</td>
<td>• Teach critical appraisal and evidence synthesis on-the-fly during direct patient care</td>
<td>• Identify sources of best evidence efficiently during direct patient care</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Defend the use of a paper as best evidence for a specific patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Accurately identify sources of bias and their impact on studies’ conclusions</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Calculate summary measures for a specific patient’s baseline risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Present evidence to a patient and check for understanding</td>
</tr>
<tr>
<td>Block or Semester</td>
<td>Novice (MS, PGY-1)</td>
<td>Intermediate (PGY-2)</td>
<td>Advanced (PGY-3, fellow, faculty)</td>
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<tr>
<td>-------------------</td>
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</tr>
</tbody>
</table>
|                   | • Introduce the principles of critical appraisal of the literature  
• Role model effective literature search skills  
• Review sources of bias through examples  
• Clarify levels of the evidence hierarchy  
• Introduce the skill of succinct article presentation | • Teach the knowledge and skills of critical appraisal of the literature  
• Refine skills of electronic searching of the literature  
• Describe the process of establishing a diagnosis  
• Improve ability to detect and assess the impact of bias on study conclusions  
• Identify features of best published research evidence  
• Improve skills related to presentation of articles | • Teach learners to teach EBM concepts to medical students and interns |
|                   | • Articulate a well-structured clinical question  
• Choose the best study design for their clinical question  
• Calculate likelihood ratios and correctly use a nomogram  
• Identify sources of bias in various studies and describe the direction of their impact  
• Appropriately interpret results expressed as likelihood ratios, relative risks, odds ratios, risk reductions, and number needed to treat  
• Accurately interpret confidence intervals  
• Critically appraise various study types  
• Apply the results of a study of therapy to an individual patient | • Articulate focused clinical questions  
• Identify high-quality papers via electronic search methods  
• Identify strategies for testing clinical hypotheses  
• List and define key critical appraisal criteria for major study types  
• Accurately identify bias and calibrate its impact on published studies  
• Appropriately interpret results expressed as likelihood ratios, relative risks, odds ratios, hazard ratios, and number needed to treat  
• Assess the validity of a subgroup analysis  
• Calculate number needed to treat for an individual patient using available relative risk data  
• Succinctly present an article and apply results to a clinical case | • Plan, prepare, and execute a teaching session involving one EBM concept, using clinical examples (builds on above objectives) |
Classic EBM Domains and Content Areas

A curriculum in EBM can cover any or all of the following skill domains and classic content areas. Common examples include:

Domains:

“Doing”
Asking a clinical question
Acquiring evidence - Searching the medical literature
Appraising evidence critically
Accurate interpretation of study results
Applying results to patient care

“Using”
Employing pre-appraised sources of evidence to guide patient care

“Replicating”
Following the evidence based recommendations of mentors and trusted sources


“Communicating”
Communication of evidence to patients
Communication of evidence to colleagues

Content Areas:
- Searching the medical literature
- Clinical measurement and agreement
- Diagnostic testing – probabilities, medical decision making, operating characteristics of diagnostic tests
- Screening
- Treatment or Effectiveness
- Harm or Causation
- Measures of association, basic statistics, confidence intervals
- Prognosis
- Meta-analysis and Systematic reviews
- Decision analysis
- Cost-effectiveness analysis
**EBM Curriculum Methods**

Many curricula will employ a mixture of different methods to conduct the teaching. While one literature review has suggested that clinically based formats demonstrate better improvement in outcomes regarding knowledge and skills, little data exists to directly compare methods. Here we review the pros and cons of commonly used formats:

<table>
<thead>
<tr>
<th>Format</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didactic</td>
<td>• Concise</td>
<td>• Passive learning</td>
</tr>
<tr>
<td></td>
<td>• Efficient</td>
<td>• Difficult to assess learners’ needs and responses</td>
</tr>
<tr>
<td></td>
<td>• Address larger groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prepared in advance</td>
<td></td>
</tr>
<tr>
<td>Journal Club</td>
<td>• Use of clinical example</td>
<td>• Non-presenting learners may be passive</td>
</tr>
<tr>
<td></td>
<td>• Critical appraisal focus</td>
<td>• Informal, may not convey core concepts</td>
</tr>
<tr>
<td></td>
<td>• Established in many programs</td>
<td></td>
</tr>
<tr>
<td>Small group interactive/ workshops</td>
<td>• Learner involvement</td>
<td>• Address smaller groups</td>
</tr>
<tr>
<td></td>
<td>• Stimulate discussion</td>
<td>• Requires more faculty time</td>
</tr>
<tr>
<td></td>
<td>• Flexibility, change direction as needed</td>
<td>• Impact of learner level may create variability</td>
</tr>
<tr>
<td></td>
<td>• Experiential</td>
<td></td>
</tr>
<tr>
<td>Clinical (bedside or on rounds,</td>
<td>• Grounding in clinical context may lead to deeper learning and</td>
<td>• Difficult to incorporate into the pace of clinical work</td>
</tr>
<tr>
<td>outpatient)</td>
<td>• Retention</td>
<td>• Faculty readiness and availability</td>
</tr>
<tr>
<td></td>
<td>• Role model real-time use of resources</td>
<td></td>
</tr>
<tr>
<td>Web based</td>
<td>• Prepare in advance</td>
<td>• May be difficult to assess learners’ needs and provide feedback</td>
</tr>
<tr>
<td></td>
<td>• No faculty time needed for teaching</td>
<td>• May lack direct clinical relevance</td>
</tr>
<tr>
<td></td>
<td>• Wide range of options for content and formats, can be experiential</td>
<td></td>
</tr>
</tbody>
</table>
### Sample Curriculum Schedules:

(1) Short course for internal medicine interns at Duke, four half-day sessions in one week.

<table>
<thead>
<tr>
<th>Session 1:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Asking a clinical question</strong></td>
<td>The anatomy of a well-framed clinical question. Residents will form their own clinical question and present their answer in the last session.</td>
</tr>
<tr>
<td><strong>Study design</strong></td>
<td>Cross-sectional, cohort, case control, randomized controlled trial, meta-analysis - the relative merits and drawbacks.</td>
</tr>
<tr>
<td><strong>Bias and Random Error</strong></td>
<td>Things that make the truth harder to find... Discussion points: Trials stopped early for benefit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 2:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Diagnostic Testing</strong></td>
<td>Discussion points: Gold standard, likelihood ratio</td>
</tr>
<tr>
<td><strong>Medline Search Strategies</strong></td>
<td>Get started finding an article to answer your question. Discussion points: Incorporating study design into your search, MeSH (medical subject headings), limits tab, details tab</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 3:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Screening</strong></td>
<td>Discussion points: Lead time bias, length time bias.</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Discussion points: Absolute risk reduction, relative risk reduction, number needed to treat, randomization, composite outcomes, surrogate outcomes</td>
</tr>
<tr>
<td><strong>Harm</strong></td>
<td>Discussion points: Relative risk vs. odds ratios</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Session 4:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Applying the results of trials to your patient</strong></td>
<td>How to apply results when your patient’s baseline risk differs from that of the study participants. Discussion points: Subgroup analysis.</td>
</tr>
<tr>
<td><strong>Prognosis</strong></td>
<td>Discussion points: Inception cohort.</td>
</tr>
<tr>
<td><strong>Presentation of Mini-Journal club</strong></td>
<td>Each resident will state: their clinical question, key points of search strategy, summary of article [population, intervention or exposure, outcomes, and primary results]. Are the results valid?</td>
</tr>
</tbody>
</table>
(2) Block course given over 6 weeks for PGY-2 internal medicine residents at NYU Primary Care

**Title:** Evidence-Based Medicine (EBM) and Teaching – 5 credits

**Faculty:** Drs. Mark Schwartz, Adina Kalet, Kathleen Hanley, and Sandy Zabar

**Meeting Hours:** daily 2-hour classes – 8 hours/week over 6 weeks, spring semester

**Course Description:** This innovative, rigorous course in EBM to model a scholarly, evidence-based approach to the care of the underserved and teaching physicians. Whereas the *Clinical and Education Research Methods* course aims to train “doers” of research, this course trains sophisticated “users” of research. In interactive seminars, students will learn basic principles of Clinical Epidemiology, medical decision-making, and critical literature appraisal skills. They will read and critique current or classic medical and educational literature, do regular problem sets and assignments, and complete a small project of their own with mentoring from the faculty.

**Goals of this course are to:**
1) teach the knowledge and skills of critical appraisal of the literature
2) refine skills of electronic searching of the literature
3) improve ability to detect and assess the impact of bias on study conclusions
4) identify features of best published research evidence
5) improve skills related to presentation of articles

**Objectives:** By the end of the course, student will be able to…
1) articulate focused clinical questions
2) identify high-quality papers to answer questions via electronic search methods
3) list and define key critical appraisal criteria for major study types
4) accurately identify bias and calibrate its impact on published studies
5) appropriately interpret results expressed as likelihood ratios, relative risks, odds ratios, risk reductions, and number needed to treat
6) succinctly present an article with assessment of its validity

**Evaluation Method:** Students are evaluated based on class participation, completion of homework problem sets, two journal club presentations, and oral and written final project presentation. Projects typically take the form of a mini-systematic review of the literature, decision analysis, or study design protocol.

**Course Topics:** A sample of seminar titles is listed below
1. What is EBM? Orientation to Clinical Epidemiology and EBM Principles.
2. Clinical Measurement Unit: (Or Can We Agree To Disagree?). Principles of reliability, validity, agreement, Kappa, and improving clinical measurements
3. The Diagnostic Process: (Or You Find What You Look For & You Look For What You Know). Intro to probability and thresholds, medical decision making, and Bayesian reasoning
4. Diagnostic Tests I: (Or What Is A Likelihood Ratio Anyway?). Operating characteristics of Dx tests, LR, ROC curves, pre and post-test probability
5. Diagnostic Testing II: (Or the 2x2 dance). Sensitivity, specificity, impact of pre-test probability, determining Dx thresholds
6. Diagnostic Tests III: (Or Testing a Test). Critical appraisal of the validity and applicability of an article on diagnosis
8. Medical Informatics I: (in Library). Evidence Based Medicine & Medline searching
9. Medical Informatics II: (in Library). Formulating and Answering Clinical Questions
10. Prognosis: Cohort studies, RR, OR, confounding, bias, and critical appraisal of the validity and applicability of an article on prognosis
11. Basic Statistics For Clinical Epidemiology: (Or The "Tao Of P"). Statistical and clinical significance, confidence intervals, common tests used in clinical studies, interpreting and evaluating the statistics section in an article
12. Review Session I: Critical appraisal of articles on diagnosis & prognosis
13. Deciding On The Best Therapy: Effectiveness: (Or "First, Do No Harm"). Principles of selection and measurement bias, randomization, blinding, and critical appraisal of the validity and applicability of an article on therapy
14. Effectiveness II: (Or "Yeah, But How Do I Explain This Stuff to My Patient?"). RRR, ARR, NNT/NNH; interpreting results of therapy study
15. Compliance: Role of compliance in clinical trials and implication for interpreting results (bias and intention to treat analyses) and generalizing to clinical practice
16. Epi Journal Club: Prep Session: (Or I Can Present That Study In 5 Minutes!). Analogy of patient case presentation and concise EBM article presentation
17. Medical Informatics III: (in Library). Answering clinical questions with evidence from other electronic resources; “Cochrane Collaboration,” “Best Evidence,” electronic textbooks, & Internet
18. Journal Club Presentation I (each student presents an article)
19. Qualitative Studies: Interpreting studies using qualitative approaches to data analyses
20. Review Articles And Meta-Analyses: (Or How To Read A Study Of Studies). Distinguish narrative and systematic reviews, principles of clinical and statistical heterogeneity, critical appraisal of a systematic review
21. Causation: (Or "Big E Epi" Meets The Chicken And The Egg). Hill criteria, case control studies, bias, confounding, and critical appraisal of the validity and applicability of an article on etiology
22. Review Session II: Critical appraisal of articles on effectiveness & causation
23. Journal Club Presentation II (each student presents an article)
24. Decision Analysis I: (Or How To Not Lose The Trees For The Forest). Anatomy and physiology of decision making – expressing clinical questions as decision trees
25. Decision Analysis II: (Or What Good Is All This Anyway?). Applications, critical appraisal of article using decision analysis
26. Project Presentations and Course Evaluation

Course Text: Guyatt G and Rennie D. Users’ Guides to the Medical Literature. AMA Press, 2002

Reading Assignments: chapters assigned from the core text, supplemented by many papers from the medical and medical education literature.
### CLINICAL EPIDEMIOLOGY EPID 642

**Course Director:** Lydia A. Bazzano, MD, PhD  
**Teaching Assistant:** Erin Curtin, MPH  
**Fall Semester, 2008 Friday, 4:00 to 6:30 PM**  
**School of Public Health & Tropical Medicine**  
**Tidewater Bldg. Room 1208**

<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
<th>Course Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/29</td>
<td>Introduction to Clinical Epidemiology and the Evidence Base of Medicine</td>
<td>Text: 1A, 2A</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>9/5</td>
<td>What is Abnormal? Clinician-Observer Agreement</td>
<td>Text: 2C Diagnosis: Measuring Agreement Beyond Chance</td>
<td>1,3</td>
</tr>
<tr>
<td>3 Quiz 1</td>
<td>9/12</td>
<td>The Process of Diagnosis and Differential Diagnosis</td>
<td>Text: 1C Process of Diagnosis, 1C1 Differential Diagnosis</td>
<td>1,3</td>
</tr>
<tr>
<td>4</td>
<td>9/19</td>
<td>Diagnostic Testing and Likelihood Ratios</td>
<td>Text: 1C2 Diagnostic Tests</td>
<td>1,3</td>
</tr>
<tr>
<td>5 Quiz 2</td>
<td>9/26</td>
<td>Introduction to Therapy and Harm Randomized Controlled Trials (RCTs)</td>
<td>Text: 1B Therapy and Harm: An Introduction, 2B2 Hypothesis Testing and Confidence Intervals</td>
<td>1,2,5</td>
</tr>
<tr>
<td>6</td>
<td>10/3</td>
<td>Intention to Treat Analysis and Other Aspects of RCTs</td>
<td>Text: 2B Why Study Results Mislead Bias and Random Error, 2B1 The Principle of Intention to Treat and Surprising Results of RCTs</td>
<td>1,2,5</td>
</tr>
<tr>
<td>7</td>
<td>10/10</td>
<td>Measures of Association and Number Needed to Treat Midterm Review</td>
<td>Text: 2B2 Measures of Association</td>
<td>1,2,5</td>
</tr>
<tr>
<td>8</td>
<td>10/17</td>
<td><strong>Mid-Term Examination</strong></td>
<td></td>
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<tr>
<td>9</td>
<td>10/24</td>
<td>Surrogate Endpoints and Subgroups</td>
<td>Text: 2E When to Believe a Subgroup Analysis, 2B3 Surrogate Outcomes</td>
<td>1,5</td>
</tr>
<tr>
<td>10</td>
<td>10/31</td>
<td>Principles of Screening</td>
<td>Text: 2F Recommendations About Screening</td>
<td>1,3,4</td>
</tr>
<tr>
<td>11</td>
<td>11/7</td>
<td>Summarizing the Evidence Meta-analysis Overview</td>
<td>Text: 1E Summarizing the Evidence, 2E Publication Bias, Fixed-Effects and Random Effects Models, Evaluation Differences in Study Results</td>
<td>1,2,4,6</td>
</tr>
<tr>
<td>12 Quiz 3</td>
<td>11/14</td>
<td>Finding the Evidence: Searching Pubmed and MEDLINE</td>
<td>Text: 1A1 Finding the Evidence</td>
<td>1,2,6</td>
</tr>
<tr>
<td>13</td>
<td>11/21</td>
<td>Prognosis and Outcomes</td>
<td>Text: 1D Prognosis, 2D Regression and Correlation</td>
<td>1,2</td>
</tr>
<tr>
<td>11/28</td>
<td><strong>Thanksgiving Break</strong></td>
<td></td>
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<tr>
<td>15</td>
<td>12/5</td>
<td>Putting It All Together: Clinical Decision Making</td>
<td>Text: 1F Moving from Evidence to Action</td>
<td>2,3</td>
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<tr>
<td>12/14</td>
<td><strong>Final Examination</strong></td>
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Sample Exercises:
(1) Diagnosis 1, NYU

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THE DIAGNOSTIC PROCESS 1
(OR YOU FIND WHAT YOU LOOK FOR
& YOU LOOK FOR WHAT YOU KNOW)

GOALS: To begin to explore the art and science of making decisions without adequate information. To use the clinical evaluation to estimate probability of disease.

SPECIFIC OBJECTIVES: the above goals can be achieved if you are able to:

1. define the following diagnostic strategies: pattern recognition, multiple branching algorithm, exhaustive, and hypothetico-deductive
2. identify the strategies you use to test clinical hypotheses
3. explain the concepts of probability and uncertainty

INTRO:
This material comes from a number of evolving domains (clinical epi, clinical reasoning, medical decision making, and cognitive psychology). This session is meant to be an exploration of what could be thought of as the philosophy or epistemology of how we doctors think.

Clinical reasoning is the mental process by which physicians solve clinical problems presented by their patients. Optimal patient care depends on this core clinical skill. It is an inferential and iterative process in which clinicians assess a patient’s problem, generate diagnostic hypotheses as to the cause, gather information via the medical interview and physical exam to refine the hypotheses, select appropriate diagnostic and correctly interpret their results. The outcome is generally a “working diagnosis” that sufficiently explains the patient’s findings, and upon which we make treatment decisions.

It is still somewhat mysterious how we evolve from classroom learners of medical facts into real-time clinical problem solvers. The leap from the standardized history and physical to the complex set of synthetic reasoning strategies is difficult to teach even for excellent clinician educators. There is no well-accepted comprehensive theory of clinical cognition. Even thoughtful and competent physicians are unaware and therefore unable to explain their own reasoning process.

We hope you will deepen your understanding of the cognitive process of “making a diagnosis.”

READING ASSIGNMENT: (listed in order of priority; the reading & the cases are meant to stimulate your thinking - skim and have fun with them!)
1. JAMA Users’ Guides - Chapter 1C, 101-108

EXERCISES: to be done before this session
• Estimate probabilities of disease for each of the clinical scenarios on the next page

Think about what you mean when you use the word diagnosis.
CLINICAL SCENARIOS

Estimate the probability of disease for each of the following patients:  
[Give estimates in 2 forms: in words (e.g. very likely), and probability (e.g. 90%)]

Patient 1: Mr. Blue is a 55 y/o man with mild HTN and a 4 week h/o substernal pressure that radiates to his neck. It is precipitated by climbing stairs or walking uphill, and abates after 3-5 minutes of rest. His exam reveals a BP of 150/96. A resting EKG is WNL.  
What is the probability that Mr. Blue has ischemic CAD?  
Words: _______________ Probability: _____

Patient 2: Mr. Green is a 35-y/o otherwise healthy man with no cardiac risk factors (he quit smoking 10 years ago). He has had “heartburn off and on for years and now c/o a 6 week h/o non-exertional, squeezing pain deep to his lower sternum and epigastrium, usually radiating to his back. It's most likely to occur when he lies down after a heavy meal. The PE is negative.  
What is the probability that Mr. Green has ischemic CAD?  
Words: _______________ Probability: _____

Patient 3: Mr. Orange is a 45-y/o obese man with no cardiac risk factors save for a 1PPD smoking habit. He c/o 3 weeks of substernal pain, usually fleeting and stabbing but occasionally pressure-like. It is sometimes related to exertion. On exam you find a tender area over his sternum but he thinks this is different from his pain.  
What is the probability that Mr. Orange has ischemic CAD?  
Words: _______________ Probability: _____

Patient 4: Ms. Magenta is a 60 y/o mildly obese woman with moderate DJD of the knees and mild varicose veins who c/o 3-4 days of pain and swelling of her left calf with no h/o trauma. Your exam reveals a tender left calf with some warmth and edema, mild erythema, a positive Homan's sign, but no palpable cord.  
What is the probability that Ms. Magenta has a DVT?  
Words: _______________ Probability: _____

Patient 5: Ms. Red is a 23 y/o otherwise healthy woman who c/o 2-3 days of sore throat, pain on swallowing, fever and swollen glands in her neck. You find her temperature is 101°F, she has whitish pharyngeal exudates, and tender cervical nodes.  
What is the probability that Ms. Red has a streptococcal pharyngitis?  
Words: _______________ Probability: _____
Diagnostic Testing Worksheet

The Case: You are treating a 75 year old man in the CCU post-MI. You note a mild anemia on routine labs, with a Hct of 33 and an MCV of 89. There is no clinically evident bleeding. You want to know if he has iron deficiency, and you order some labs – the ferritin is 39, and is listed in the normal range of values on the lab report.

Question 1: What is your pretest probability (prevalence) of iron deficiency anemia in this patient?

The Task: Based on the article you have read, construct the following 2x2 table, using a cutoff of ferritin below 45 as positive, and above 45 as negative. (where do you find this information in the article?)

<table>
<thead>
<tr>
<th></th>
<th>Disease present</th>
<th>Disease absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Pos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Neg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculations:

Sensitivity = ________________________________

Specificity = ________________________________

Positive Likelihood Ratio = _____________________________

Question 2: Based on the likelihood ratio you calculated, and using the nomogram in the handout, what is the post-test probability of iron deficiency anemia?

Question 3: Is this information clinically useful?

Bonus Question: Describe positive predictive value and discuss why it changes as prevalence changes. Use the nomogram to demonstrate!
Teachers’ Notes for the Diagnostic Testing session:

Before the session, learners have read a background handout and the article entitled *Diagnosis of Iron Deficiency Anemia in the Elderly* (Guyatt GH, Patterson C, Ali M et al. *Am J Med* 1990;88:205)

We assess the validity of the study as a group, using the User’s Guides validity criteria re-printed in the handout.

We walk through the worksheet, creating a 2x2 table as shown, and defining sensitivity, specificity, and likelihood ratio, as well as calculating them together and applying the nomogram to find a post-test probability.

Finally, and most importantly, we draw the ferritin data from table III in the paper on the board, ask the learners to fill in frequencies, and visually illustrate where likelihood ratios arise. We disconnect the likelihood ratio concept from sensitivity and specificity, and focus on proportions with disease over without at every level of the test.

This method has been illustrated in one paper from the series on Tips for Teachers of EBM:

(3) Therapy, NYU:

Effectiveness 1: Deciding on the Best Therapy

(Or "first, do no harm")

GOAL: By the end of the session you should be able to determine and demonstrate whether an article advocating a specific therapy has drawn conclusions about efficacy that are both valid (true) and applicable (sensible and feasible) in your clinical practice.

OBJECTIVE: The above goal can be achieved if you are able to answer the critical appraisal questions and explain why they are important.

INTRODUCTION:
One of the most difficult parts of our jobs as physicians is to heed the advice, "first, do no harm." The difficulty lies in the uncertainty that surrounds almost every diagnostic and therapeutic decision we make. The purpose of this session is to learn how to distinguish useful from useless, or even harmful therapy.

The quality of the evidence about effectiveness of a treatment, whether it is a drug, a surgical procedure, psychotherapy, or a nutritional intervention, depends on many factors. In a relatively small number of cases we have evidence from methodologically sound clinical research. While randomized, placebo-controlled trials (RCT's) are considered the "best" evidence of effectiveness remember that only a small part of what we do day to day has been studied in this rigorous a fashion.

ASSIGNMENT: in order of priority…

1. JAMA Users’ Guides Book. Chapter 1B & 1B1, 49-76
2. Read the clinical scenario on the next page
3. Read the article and come prepared to discuss how well they meet the critical appraisal criteria.
4. For deeper understanding:
   o Chapter 2B1, 267-74 – ITT
   o Chapter 2B1, 247-66 – surprising results of RCTs
   o Chapter 2B1, 275-90 – N of 1 Trials
   o Chapters 2B3, 385-392 – Examples of NNT
Clinical Scenario

Ms. Lopez is an otherwise healthy 68 year-old woman who you are seeing 3 months after she suffered a transient ischemic attack (~2 hours of slurred speech right sided weakness) in another hospital. She shows reports of a normal head CT and a carotid Doppler study with mild stenosis bilaterally.

Her major medical problems have been mild asthma and anxiety, both well controlled. She has no history of clinical heart disease, a normal EKG, and except for her age has no cardiac risk factors (DM, Tob, HTN, obesity, FH, etc…). She has excellent exercise tolerance and in fact is an avid walker with a BMI of 27.

Her last lipid panel showed: 216 Total; 54 HDL; 132 LDL; 150 Trig
Given her health and dislike for pills, you felt fine not prescribing medications to lower her LDL.

She feels well and has had no further neurological symptoms on one baby aspirin daily.
Her exam is benign with BP=128/74, and a normal neuro exam.

Her sister told her she should be taking a statin to prevent a stroke.
She does not like taking prescription medications – thinks they are more toxic than “natural” remedies but wonders if she should try one of those cholesterol pills she sees advertised on TV.

Read and critically appraise the study and then decide what you will tell your patient.
**Screening**

**Objectives:**
After this session, residents will be able to
1. Describe why randomized controlled trials are the best design for questions about screening
2. Define sources of bias in studies about screening
3. Describe evidence behind several current screening recommendations

The objective of early diagnosis is the early detection of pre-symptomatic disease. Certain assumptions are made regarding a screening test: (1) the biologic onset of disease precedes clinically evident disease, (2) the correct test can detect disease at this early point, (3) identifying disease at this time leads to therapy which is more effective or easier to apply than afterward. Screening is an intervention, one which *employs* a diagnostic test. Studies of screening, therefore, should meet the criteria for any study of an intervention – randomization into both screened and non-screened groups. Beware of cross-sectional or cohort studies that discuss screening implications, as they may be more appropriately interpreted as diagnostic testing studies only!

<table>
<thead>
<tr>
<th>User’s Guides for an Article About Screening:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is there randomized trial evidence that earlier intervention works?</td>
</tr>
<tr>
<td>2. Were the data identified, selected, and combined in an unbiased fashion?</td>
</tr>
<tr>
<td>3. What are the benefits? (What outcomes were measured?)</td>
</tr>
<tr>
<td>4. What are the risks?</td>
</tr>
<tr>
<td>5. How do benefits and risks compare in different people and with different screening strategies?</td>
</tr>
<tr>
<td>6. What is the impact of individuals’ values and preferences?</td>
</tr>
<tr>
<td>7. What is the impact of uncertainty associated with the evidence? (i.e. how wide are the confidence intervals?)</td>
</tr>
<tr>
<td>8. What is the cost-effectiveness?</td>
</tr>
</tbody>
</table>


The only definitive evidence for the efficacy of a screening test is a **randomized controlled trial**, where experimental subjects receive an intervention at the point of screening if disease is found, and controls receive an intervention at the time of ‘usual’ diagnosis without screening. Why is this important? Without a randomized trial, sources of bias emerge:

**LEAD TIME BIAS** – Early diagnosis will always appear to improve *survival* as measured from the time of diagnosis, even when therapy is worthless. In those cases, we’ve simply known about the disease longer, not improved *mortality*. Early diagnosis shifts the time point for calculating the survival estimate forward. This is why disease-specific *mortality* is a more clinically important outcome than *disease-free survival*. (see Figure)
LENGTH TIME BIAS – Slowly progressive diseases are easier to detect than faster ones because they are more prevalent at any given point in time. Therefore, people with diseases found more easily through screening may appear to live longer. (Imagine the differences between pancreatic cancer with its high mortality, and prostate cancer where people can be screened and can do well for many years...)

VOLUNTEERISM BIAS – People who volunteer for screening studies may be more concerned about their health, and are generally healthier than non-volunteers. Therefore, studies regarding screening may not represent outcomes in the general population.

When the benefits of screening are enormous and drawbacks are minimal, widespread screening may be implemented based on observational data alone, as is the case with cervical cancer screening. A randomized controlled trial of PAP screening for cervical cancer has never been done, because population-wide reduction in rates of cancer after screening was implemented were so compelling. More often, however, the benefits and risks of screening are more closely aligned, and randomized trial data is needed.

The results of a screening trial will often be presented as absolute risk reduction and relative risk reduction. Please refer to the section on Therapy for a discussion of these concepts. Number needed to screen can be calculated in the same way as number needed to treat.

In assessing the benefits of screening, it is important to note which outcomes were chosen. Mortality reduction is the ultimate goal. Cause-specific mortality is the most important outcome. If the burden caused by the disease is high, then lowering cause-specific mortality may also impact total mortality. Other outcomes may include health related quality of life and ‘intangibles’ such as reassurance, or piece of mind. The risks of screening may include anxiety, complications from pursuit of a diagnosis, side effects of treatment, adverse effects of labeling a patient with a diagnosis, and costs of work-up and therapy.

Teachers’ notes for the Screening session:

After reviewing the material above in the small group with diagrams and discussion, the following abstracts are read and assessed as a group, with discussion of key points of the methodology and the measures of association presented:

FIGURE – LEAD TIME BIAS

SCENARIO 1:

Screen:

Dx  Tx  

If death occurs at the same time, mortality is not reduced, but disease free survival is longer.

No Screen:

Sx  Dx  Tx  

Death

SCENARIO 2:

Screen:

Dx  Tx  

If death occurs later in the screened group, mortality is reduced. This can only be determined when there is a control group.

No Screen:

Sx  Dx  Tx  

Death
Evaluation Methods

A systematic review published by the SGIM EBM Task Force in 2006 is still the most complete resource regarding curriculum evaluation tools, as of our updated literature search in January 2010:

Evidence for efficacy of curricula in EBM: A review of the literature

The quality of the evidence regarding efficacy of EBM curricula in improving learners’ knowledge, skills, or behaviors or patients’ clinical outcomes is limited. What follows is an annotated bibliography of systematic reviews and other reviews or commentaries. Following that, selected abstracts of trials reporting interventions since the date of the most recent review are listed.

Systematic Reviews:


A systematic review of randomized, non-randomized, and before-after studies. Main outcomes were knowledge, skills, attitudes and behavior towards EBP. Data presented as standardized effect sizes. 24 studies included, 10 for which effect sizes (E-S) could be calculated. 11 RCTs, 5 non-randomized, 8 before-after. Sample sizes ranged from 12 to 800. Teaching methods included workshops, multifaceted intervention, internet-based intervention, or journal club, with journal club being most common. 22 instruments were used, 10 with 2 or more types of validity or reliability evidence. Results: None of knowledge, skills, attitudes and behavior outcomes had E-S > 0.79. One of two studies measuring knowledge had E-S 0.57. Two of four total test score outcomes had significant E-S > 0.79 (McCluskey et al 0.91 and Fritsche et al 1.32).

This systematic review was thorough and attempted to convert heterogeneous outcome data to comparable effect size numbers. It is the most recent such review available. The overall impact of the data is weak.


A systematic review of randomized, non-randomized, and before-after studies. They explored the effect of teaching methods (standalone vs. integrated into clinical practice). 23 studies included: 4 RCTs, 7 non-randomized, 12 before-after. Teaching methods included workshops, seminars, and journal clubs. 18 were standalone curricula, 5 were integrated teaching methods. 17 studies assessed knowledge and reported improvement overall. 9 studies assessed critical appraisal skills: 1 of 1
standalone RCT found no improvement, 3 of 6 non-randomized standalone trials found an improvement, while 1 of 1 integrated RCT found an improvement, and 1 of 1 non-randomized integrated found an improvement. 14 studies assessed a behavioral outcome: the two standalone RCTs found no change, while the two integrated RCTs showed improvement.

This systematic review was really a test of the authors’ hypothesis that teaching integrated into clinical context is more effective than standalone. While the authors concluded that on the whole, evidence was stronger for an integrated approach, this is not a robust finding.


A very thorough search for randomized trials, controlled clinical trials, controlled before and after studies, and interrupted time series analyses of educational interventions teaching critical appraisal to health professionals. Outcomes were process of care, patient mortality, quality of life, satisfaction, health professional knowledge/awareness using standardized and reliable instruments. Only one study met inclusion criteria. One randomized trial (Linzer, 1988) of 44 interns, attending 5 journal clubs, assessed critical appraisal knowledge. 25% improvement (1.5 correct test questions) was seen in the intervention group compared to 6% (0.3 test questions) in the control (p=0.02)

This Cochrane review illustrates the extreme lack of data in teaching critical appraisal as of 2001. As they state in the paper, however, “absence of evidence is not evidence of absence”!


Included studies of educational interventions aimed at improving critical appraisal skills, presence of a control group, and an objective measurement of an educational or health care outcome. Quality assessment of studies was done. Ten studies were included, with a median quality score of 3 out of a possible 12. 22 outcomes were reported, including knowledge, attitudes, critical appraisal skills, and medical literature reading behavior. Ten of twelve knowledge outcomes were reported as positively improved. One of four critical appraisal outcomes was positive.
A review with less rigorous inclusion criteria than the Cochrane review done around the same time, and without quantification of outcomes reported. This review contributes little to the evidence base.

**Reviews/Commentaries:**


A well-written review of the limitations of the journal club format, with suggestions for integration of curricula into clinical contexts. They suggest four strategies for implementing curricular change: (1) developing faculty role models, (2) integrating EBM into clinical settings (inpatient and ambulatory), (3) integrating EBM into morning report, and (4) assessment of residents’ EBM skills and behaviors. This review employs good examples of alternative curricula based on published descriptions, and suggests clinically relevant assessment modalities.

**Straus SE, Green ML, Bell DS et al. for the SGIM Evidence-Based Medicine Task Force. Evaluating the teaching of evidence-based medicine: conceptual framework. *BMJ* 2004; 329:1029**

The SGIM Evidence-Based Medicine Task Force presents in this article a conceptual framework for evaluating EBM teaching based upon three questions: Who is the learner? What is the intervention? What is the outcome? Not all learners will require expertise in all of the steps of EBM. Learner domains include “doing” (performing the steps of asking, acquiring, appraising, and applying), “using” (employing pre-appraised sources), and “replicating” (following recommendations of others). Interventions vary in “dose and delivery” and in which steps they attempt to teach. Interventions can cover any or all of the steps – asking, acquiring, appraising, applying, assessing. Outcomes can include attitudes, knowledge, skills, behavior, and clinical outcomes. Scales used might assess an outcome domain in only one intervention, and from the perspective of only one type of learner. The outcome measure should assess what is being taught.

In this article, Dr. Green reviews the history of EBM in medical education, argues for the integration of EBM teaching and proposes an agenda for future work. With a firm grounding in the history of EBM teaching, this excellent narrative outlines the charge facing all teachers of EBM – to move beyond journal club and critical appraisal alone, and to make EBM teaching relevant and clinically grounded.

Abstracts of selected reports of EBM educational interventions published since 2007, and not included in above reviews:


OBJECTIVE: To assess the impact of a structured, clinically integrated evidence-based undergraduate medicine training programme using a validated tool. DESIGN. Before and after study with no control group. SETTING: A medical school in Malaysia with an affiliated district clinical training hospital. PARTICIPANTS: Seventy-two medical students in their final 6 months of training (senior clerkship) encountered between March and August 2006. INTERVENTION: Our educational intervention included two plenary lectures at the beginning of the clerkship, small-group bedside question-generating sessions, and a journal club in the paediatric posting. MAIN OUTCOME MEASURES: Our primary outcome was evidence-based medicine knowledge, measured using the adapted Fresno test (score range, 0-212) administered before and after the intervention. We evaluated the performance of the whole cohort, as well as the scores of different subgroups that received separate small-group interventions in their paediatric posting. We also measured the correlation between the students' evidence-based medicine test scores and overall academic performances in the senior clerkship. RESULTS: Fifty-five paired scripts were analysed. Evidence-based medicine knowledge improved significantly post-intervention (means: pre-test, 84 [standard deviation, 24]; post-test, 122 [22]; P<0.001). Post-test scores were significantly correlated with overall senior clerkship performance (r=0.329, P=0.014). Lower post-test scores were observed in subgroups that received their small-group training earlier as opposed to later in the clerkship. CONCLUSIONS: Clinically integrated undergraduate evidence-based medicine training produced an educationally important improvement in evidence-based medicine knowledge. Student performance in the adapted Fresno test to some extent reflected their overall academic performance in the senior clerkship. Loss of evidence-
based medicine knowledge, which might have occurred soon after small-group training, is a concern that warrants future assessment.


**BACKGROUND:** As the overall evidence for the effectiveness of teaching of evidence-based medicine (EBM) is not strong, and the impact of cultural and societal influences on teaching method is poorly understood, we undertook a randomised-controlled trial to test the effectiveness and learning satisfaction with two different EBM teaching methods (usual teaching vs. problem based learning (PBL)) for undergraduate medical students. **METHODS:** A mixed methods study that included a randomised-controlled crossover trial with two intervention arms (usual teaching and PBL) and a nested qualitative study with focus groups to explore student perceptions of learning and to assess the effectiveness and utility of the two teaching methods. All 129 second-year medical students at the University of Hong Kong in 2007. The main outcomes measures were attitudes towards EBM; personal application and current use of EBM; EBM knowledge; future use of EBM. **RESULTS:** PBL was less effective at imparting knowledge than usual teaching consisting of a lecture followed by a group tutorial. After usual teaching students showed improvement in scores for 'attitudes towards EBM', 'personal application and current use of EBM' and 'EBM knowledge, which were not evident after PBL. In contrast to the usual teaching, students found PBL difficult as they lacked the statistical knowledge necessary to support discussion, failed to understand core concepts, and lost direction. **CONCLUSION:** The evidence presented here would suggest that the teaching of EBM within an Asian environment should adopt a format that facilitates both the acquisition of knowledge and encourages enquiry.

**Liabsuetrakul T, Suntharasaj T, Tangtrakulwanich B et al. Longitudinal analysis of integrating evidence-based medicine into a medical student curriculum. *Fam Med.* 2009; 41:585-8.**

**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.


BACKGROUND: To evaluate the educational effects of a clinically integrated e-learning course for teaching basic evidence-based medicine (EBM) among postgraduates compared to a traditional lecture-based course of equivalent content. METHODS: We conducted a cluster randomised controlled trial in the Netherlands and the UK involving postgraduate trainees in six obstetrics and gynaecology departments. Outcomes (knowledge gain and change in attitude towards EBM) were compared between the clinically integrated e-learning course (intervention) and the traditional lecture based course (control). We measured change from pre- to post-intervention scores using a validated questionnaire assessing knowledge (primary outcome) and attitudes (secondary outcome). RESULTS: There were six clusters involving teaching of 61 postgraduate trainees (28 in the intervention and 33 in the control group). The intervention group achieved slightly higher scores for knowledge gain compared to the control, but these results were not statistically significant (difference in knowledge gain: 3.5 points, 95% CI: 2.7 to 9.8, p = 0.27). The attitudinal changes were similar for both groups. CONCLUSION: A clinically integrated e-learning course was at least as effective as a traditional lecture based course and was well accepted. Being less costly than traditional teaching and allowing for more independent learning through materials that can be easily updated, there is a place for incorporating e-learning into postgraduate EBM curricula that offer on-the-job training for just-in-time learning.

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.


BACKGROUND: Evidence-based medicine (EBM) is widely taught in residency, but evidence for effectiveness of EBM teaching on changing residents' behavior is limited. OBJECTIVE: To investigate the impact of an EBM curriculum on residents' use of evidence-based resources in a simulated clinical experience. DESIGN/PARTICIPANTS: Fifty medicine residents randomized to an EBM teaching or control group. MEASUREMENTS: A validated test of EBM knowledge (Fresno test) was administered before and after intervention. Post intervention, residents twice completed a Web-based, multiple-choice instrument (15 items) comprised of clinical vignettes, first without then with access to electronic resources. Use of electronic resources was tracked using ProxyPlus software. Within group pre-post differences and between group post-test differences were examined. RESULTS: There was more improvement in EBM knowledge (100-point scale) for the intervention group compared to the control group (mean score increase 22 vs. 12, p = 0.012). In the simulated clinical experience, the most commonly accessed resources were Ovid (71% of residents accessed)
and InfoPOEMs (62%) for the EBM group and UptoDate (67%) and MDConsult (58%) for the control group. Residents in the EBM group were more likely to use evidence-based resources than the control group. Performance on clinical vignettes was similar between the groups both at baseline (p = 0.19) and with access to information resources (p = 0.89).

CONCLUSIONS: EBM teaching improved EBM knowledge and increased use of evidence-based resources by residents, but did not improve performance on Web-based clinical vignettes. Future studies will need to examine impact of EBM teaching on clinical outcomes.


BACKGROUND: Assessing in undergraduate medical education the educational effectiveness of a short computer-based session, integrating a lecturer’s video with a standardized structure, for evidence based medicine (EBM) teaching, compared to a lecture-based teaching session of similar structure and duration. METHOD: A concealed, randomized controlled trial of computer based session versus lecture of equal duration (40 minutes) and identical content in EBM and systematic reviews. The study was based at the Medical School, University of Birmingham, UK involving one hundred and seventy nine year one medical students. The main outcome measures were change from pre to post-intervention score measured using a validated questionnaire assessing knowledge (primary outcome) and attitudes (secondary outcome). RESULTS: Participants' improvement in knowledge in the computer based group was equivalent to the lecture based group (gain in score: 0.8 [S.D = 3.2] versus 1.3 [S.D = 2.4]; p = 0.24). Attitudinal gains were similar in both groups. CONCLUSION: Computer based teaching and typical lecture sessions have similar educational gains.


BACKGROUND: To practice Evidence-Based Medicine (EBM), physicians must quickly retrieve evidence to inform medical decisions. Internal Medicine (IM) residents receive little formal education in electronic database searching, and have identified poor searching skills as a barrier to practicing EBM. OBJECTIVE: To design and implement a database searching tutorial for IM residents on inpatient rotations and to evaluate its impact on residents’ skill and comfort searching MEDLINE and filtered EBM resources. DESIGN: Randomized controlled trial. Residents randomized to the searching tutorial
met for up to 6 1-hour small group sessions to search for answers to questions about current hospitalized patients. PARTICIPANTS: Second- and 3rd-year IM residents. MEASUREMENTS: Residents in both groups completed an Objective Structured Searching Evaluation (OSSE), searching for primary evidence to answer 5 clinical questions. OSSE outcomes were the number of successful searches, search times, and techniques utilized. Participants also completed self-assessment surveys measuring frequency and comfort using EBM databases. RESULTS: During the OSSE, residents who participated in the intervention utilized more searching techniques overall (p < .01) and used PubMed's Clinical Queries more often (p < .001) than control residents. Searching "success" and time per completed search did not differ between groups. Compared with controls, intervention residents reported greater comfort using MEDLINE (p < .05) and the Cochrane Library (p < .05) on post-intervention surveys. The groups did not differ in comfort using ACP Journal Club, or in self-reported frequency of use of any databases. CONCLUSIONS: An inpatient EBM searching tutorial improved searching techniques of IM residents and resulted in increased comfort with MEDLINE and the Cochrane Library, but did not impact overall searching success.


RATIONALE, AIMS AND OBJECTIVES: Traditional continuing medical education programmes that offer passive learning have been shown to be poorly effective at changing doctors' clinical behaviour. A multifaceted evidence-based medicine (EBM) intervention was conducted at the largest health maintenance organization (HMO) in Israel, attempting to facilitate a change in doctors' attitudes, knowledge and clinical behaviour. No study thus far has examined the association between the teaching of EBM principles and doctors' clinical behaviour. This study evaluated the intervention programme through a controlled trial and before and after study. The objective of the evaluation is binary: first, to examine the impact of an educational intervention on family doctors' test ordering performance and drug utilization by their patients; and second, to assess the impact of the intervention on attitudes towards evidence-based practice and knowledge. METHODS: Controlled trial and before and after study. Primary care clinics comprising similar patient characteristics were randomly allocated to the experimental or to the control group. Doctors in the experimental group participated in an EBM educational intervention, while the control group did not take part in the intervention. Clinicians' test ordering performance and their patients' drug utilization were derived from
the HMO's database before intervention, after workshops and after intervention. Participants in the controlled trial consisted of 75 doctors and their 106 349 patients. The before and after study evaluated intervention doctors' (n = 70) EBM attitudes and knowledge through a validated questionnaire before and after workshops. RESULTS: EBM workshops enhanced intervention doctors' EBM knowledge scores from 22.4/100 before workshops to 40.8/100 after workshops (P = 0.000). Doctors improved their ability to formulate clinical questions while enhancing their search strategy using Medline. In a linear regression model, two covariates, specialization (B = 12.59; P = 0.001) and habitually reading medical journals (B = 6.45; P = 0.052), best explained the variance in doctors' EBM knowledge scores, while controlling for pre-intervention scores (R2 = 0.569; P = 0.000). Results from the controlled trial indicated that no statistically significant differences were found between intervention and control doctors' test ordering performances, and their patients' drug utilization. CONCLUSIONS: The results of the study suggest that the intervention positively influenced attitudes and knowledge; however, no statistically significant impact was found on doctors' test ordering performance and on their patients' drug utilization. The intervention's inability to change doctors' clinical behaviour might be remedied by improving future interventions through adding additional facets to the educational intervention, such as social marketing techniques and personal feedback. A longer and more extensive intervention might be more effective but is extremely difficult to execute as we found in this study. Future larger-scale interventions must incorporate the intervention into the routines of the organization, thus minimizing barriers towards EBM implementation.


INTRODUCTION: Evidence-based medicine (EBM) integrates published clinical evidence with patient values and clinical expertise, the output of which is informed medical decision making. Key skills for evidence-based practice include acquisition and appraisal of clinical information. Faculty clinicians often lack expertise in these skills and are therefore unable to demonstrate this process for students and residents. METHODS: We conducted a yearlong case-based EBM workshop for 28 clinician educators, with precourse and postcourse evaluations of EBM resource use and literature appraisal skills. RESULTS: Of the original 28 participants, 26 completed the course. Self-assessed EBM resource use improved significantly. Self-reported EBM knowledge correlated with measured skill (r = 0.45), and both improved with the intervention (both p < .001). Higher
EBM skills scores correlated with time logged on the course's EBM Web sites ($r = 0.56; p < .05$), workshop attendance rates ($r = 0.55; p = .003$), and fewer years since medical school graduation ($r = -0.56; p < .005$).

DISCUSSION: An interactive, longitudinal, EBM course derived from a needs assessment can improve 2 skills important for evidence-based practice: online literature retrieval and critical appraisal skills.
Common Challenges

The challenges we face in establishing curricula are numerous. We will briefly list common ones here, and reserve a more detailed discussion for the workshop itself. The workshop will be an opportunity for participants to share their own experiences and solutions.

- Accurate assessment of learner needs and abilities
- Recruiting faculty and supporting time for teaching
- Assessing faculty skills regarding content and teaching
- Buy-in of stakeholders at the program, division, and departmental levels
- Scheduling teaching time in the setting of work hours restrictions
- Teaching in clinical environments
- Engaging learners; experiential lesson plans
- Evaluating curricula and demonstrating benefit
- Sustaining curricula from year to year
EBM Resources on the Web and In Print

The Duke University Medical Library includes publicly accessible pages with links to searchable EBM resources. Prepared by Connie Schardt, medical librarian:

http://www.mclibrary.duke.edu/tools/lifeafterduke/evidence

Clinical Gateway
Publicly-Available Tools for Health Professionals

Duke EBM Website, direct link:
http://www.mclibrary.duke.edu/subject/ebm
### Web-based Tutorials:

<table>
<thead>
<tr>
<th><strong><a href="http://www.hsl.unc.edu/services/tutorials/ebm/index.htm">http://www.hsl.unc.edu/services/tutorials/ebm/index.htm</a></strong></th>
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<tbody>
<tr>
<td><strong>An introduction to Evidence Based Medicine</strong></td>
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<tr>
<td>This self-paced tutorial will take you through the complete EBM process, emphasizing the elements of a well-built clinical question and the key issues that help determine the validity of evidence. This program was developed by the Medical Center Library at Duke University and the Health Sciences Library at the University of North Carolina at Chapel Hill.</td>
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<tr>
<th><strong><a href="http://library.umassmed.edu/EBM/tutorials/index.cfm">http://library.umassmed.edu/EBM/tutorials/index.cfm</a></strong></th>
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<tr>
<td>After completing these exercises you should be able to:</td>
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<tr>
<td>1. Define a Clinical Question</td>
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<td>2. Translate a Clinical Question into a Searchable Question</td>
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<tr>
<td>3. Decide on the Best Type of Study to Address the Question</td>
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<tr>
<td>4. Perform a Literature Search (Ovid or PubMed)</td>
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<td>Please select the tutorial category below and read all instructions carefully!</td>
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<td><strong>Prognosis</strong> <strong>Therapy</strong> <strong>Diagnosis</strong> <strong>Etiology</strong></td>
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<th><strong><a href="http://www.rationalrx.org/">http://www.rationalrx.org/</a></strong></th>
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<td>A web based learning tool created by Stephanie Halvorson MD and Andrea Cedfeldt MD at Oregon Health &amp; Science University.</td>
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<td>Objective of the program include:</td>
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<tr>
<td>1. Analyze the process of drug discovery and approval by the FDA</td>
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<td>2. Employ the principles of EBM when making decisions about pharmaceuticals</td>
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<tr>
<td>3. List the ways pharmaceutical companies market to physicians, and pay attention to the resulting conflict of interest</td>
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Journal Series

Tips for Teachers of Evidence-based Medicine (originally began in CMAJ, now in JGIM):
http://www.mclibrary.duke.edu/subject/ebm?tab=overview&extra=teaching

ACP Primers – short primers on selected topics in interpreting the medical literature
http://www.acponline.org/clinical_information/journals_publications/ecp/primers.htm

How to Read a Paper - A series of full text articles by Trisha Greenhalgh published in BMJ.
All the articles are listed at:
http://www.mclibrary.duke.edu/subject/ebm?tab=appraising

http://www.mclibrary.duke.edu/tools/clinical/decision/bmjstats.html

Rational Clinical Exam series – a series of papers examining elements of history, physical exam, and laboratory testing in establishing accurate estimates of disease prevalence for a wide variety of conditions, edited by David Simel.
http://jama.ama-assn.org/cgi/collection/rational_clinical_exam

The Cochrane Collaboration glossary of statistical and research terms:
http://www.cochrane.org/resources/glossary.htm
A PDF version (52 pages!) is available at:
http://www.cochrane.org/resources/handbook/glossary.pdf
### Textbooks:

**Users' Guides to the Medical Literature: A Manual for Evidence-Based Clinical Practice, 2nd Edition**  
Gordon Guyatt, Drummond Rennie, Maureen O. Meade, and Deborah J. Cook  
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**Clinical Epidemiology: A Basic Science for Clinical Medicine, Second Edition**  
David L. Sackett, R. Brian Haynes, Gordon H. Guyatt, Peter Tugwell  
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