Evidence-Based Medicine Competencies

by

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Abstract:

Evidence-Based Medicine (EBM) curricula are now an integral part of medical education. These curricula are taught in various formats and to students of various medical disciplines. While competency based learning is being promoted by prominent medical education entities, no formal attempt has been made to develop competencies that a practicing clinician needs from an EBM course.

The purpose of this project was to develop competencies for the EBM course being taught at Oregon Health and Science University (OHSU). Competencies were developed based on the perceived needs of a practicing clinician. Each competency was written to follow the SMART paradigm. Finally the competencies were linked to the particular unit or subunit of the OHSU EBM course in which the student was expected to acquire it.

Competencies are listed in the results section and have been classified under broad curricular areas; however, there is some overlap between the curricular areas. These competencies although developed for a specific course can provide a framework for future development of new EBM curricula or to optimize the existing curricula.

Introduction:

Evidence-Based Medicine (EBM) curricula are increasingly becoming an integral part of medical education. (1) There are also many courses and avenues for learning EBM for practicing clinicians as well as students of other disciplines. There is, however, a need to developing competencies that define the skills a clinician needs to successfully use EBM, with a particular focus on answering questions at the point of care. (2)

One of the barriers to using electronic EBM resources is the ability to interpret the results and use the findings in clinical care. (3) Other barriers include low knowledge and unfamiliarity with basic competencies in EBM. (4) Developing these core competencies can be a way to address this barrier. An evaluation of one Web-based curriculum teaching EBM to family medicine students reported that the students who took the course performed better with "higher-quality literature search strategies, identification of higher-quality evidence, and improved confidence in information retrieval and analysis skills." (5)

Competency-based learning is being promoted and recommended to be adopted by prominent medical education entities like the Accreditation Council for Graduate Medical Education. (6) Competency-based learning has been evaluated and found useful in nursing education for implementing evidence-based practice. (7) Allied health disciplines like Health Promotion have also successfully incorporated competency-based learning,

authors concluded “Education programs should be based on research about the knowledge and skills required for practice, rather than on intuition or tradition.” (8) There are also examples of successful use of EBM courses in Family Medicine curricula. (9)

The lack of specific competencies has been cited as one of the barrier to wider use of EBM. (10) There clearly is a need of developing individual competencies that a practicing clinician needs to successfully integrate the vast body of ever changing evidence into day-to-day practice. While various approaches have been suggested to teach EBM no research has been done on developing specific competencies. The goal of this project was to develop competencies in EBM generally as well as for application to a specific on-line course in the Biomedical Informatics Graduate Program at Oregon Health & Science University (OHSU) to better inform the content of the course.

Methods:

EBM experts have recommended the broad competencies of an EBM practitioner include (a) being able to formulate a clinical question in a way that is answerable; (b) know which resources are best suited for answering which questions and be able to efficiently locate and search those resources; (c) being able to appraise the retrieved evidence, understand its limitations and decide if and how to use it in patient care. (11) The competencies in the results section have been designed to meet these broad tenets of EBM education.

Clearly defined educational competencies have been shown to guide assessment and promote learning in higher education settings. (14) Educational objectives and competencies should preferably follow the SMART paradigm for optimum results, which includes:

- S- Specific: Competencies that are specific tell us what exactly needs to be achieved by learning that competency.
- M- Measurable: Competencies need to be defined so that we can directly measure if the competency objective has been attained.
- Attainable: Competencies need to be attainable given the logistics and resources of the course and of the students.
- R- Realistic: Competencies need to take into account the tools and knowledge a clinician needs to know to practice EBM, they should build on the expected knowledge of the clinician and are appropriate for their level of education.
- T- Time Bound: Competencies need to be designed so that they can be completed within the time limits of the EBM course (10 weeks). (12)

A goal for the competencies in the results section was to meet the SMART criteria.

The methodology of this project involved researching the broad competencies in EBM, looking at best ways to develop individual and specific competencies and implementing those recommendations to come up with a set of competencies for various areas of EBM curriculum.

The Department of Medical Informatics and Clinical Epidemiology at OHSU offers an on-line course in EBM. (13) This course, entitled "Evidence-Based Medicine," is an elective course for the Graduate Certificate, Master's, and Doctoral programs offered by the OHSU Biomedical Informatics Graduate Program. It has also been adapted and taught to students of other medical disciplines as well, such as the OHSU Master of Clinical Research Program.

The course materials from the OHSU EBM course were used to develop the competencies, although the goal was to develop competencies for EBM generally. The next step involved linking the competencies with the course materials. The competencies were divided into seven broad areas and individual competencies were then designed to the Unit and sub unit where they were expected to be achieved. The outline of the EBM course at OHSU appears in Table 1.

Table 1 - OHSU Evidence-Based Medicine Course Outline.

Unit	Topic
1a 1b 1c 1d	Introduction Definitions of Evidence-Based Medicine Applications of Evidence-Based Medicine Searching for the Best Evidence
2	Diagnosis - diagnostic tests
3	Diagnosis - clinical prediction guides, screening
4	Prognosis
5	Intervention - single studies
6	Intervention - systematic reviews
7	Intervention - qualitative studies, clinical decision analyses, economic analyses, practice guidelines
8	Harm
9	Evaluation and limitations

Results:

Pubmed and Google searches for "evidence-based medicine competencies" and "EBM competencies" were run on 11/25/2007 and did not yield any relevant results containing information about competencies in EBM. Specific competencies were developed with the guiding principle being to outline the needs of a clinician who is practicing EBM. All competencies were designed to meet the SMART criteria. Individual competencies were then linked to the specific units of the OHSU EBM course where they are expected to be achieved.

Following is a list of the competencies categorized by the areas of the EBM curriculum, each competency is followed by a short description of how the competency can be used by a clinician practicing EBM.

Area 1: General Competencies:

1. Determine factors involved in clinical decision making as they relate to an individual patient. [Unit 1 (1b)]. In order to phrase an answerable question, clinicians need to be able to determine what factors are relevant for a particular condition / patient. Determining these factors is often the first step involved in selecting an appropriate clinical question.

2. Determine which source of evidence is most appropriate for answering a particular clinical question. [Unit 1 (1c)]. Clinical questions can be answered by consulting various sources, this competency helps clinicians determine which sources are most appropriate for which question.

3. Phrase a clinical question so it fits into one of the four main areas (diagnosis, prognosis, intervention and harm) and can be answered by finding and using the best evidence. [Unit 1 (1c)]. In order to efficiently search for and retrieve answer to a clinical question, it needs to be classified into one of the four main areas. This competency helps clinicians focus their search and thus make the process more efficient.

4. Select sources of EBM material that can be used for a given question. [Unit 1 (1c)]. This competency builds on the previous competency and involves actually determining the best source to answer a clinical question.

5. Retrieve appropriate evidence by appropriate querying of selected sources. [Unit 1 (1c)]. This competency is an exercise in querying appropriate sources and retrieving evidence.

6. Determine factors that make a study / article valid, important and applicable. [Unit 1 (1c)]. Once the evidence has been retrieved the next step is to determine if the

retrieved evidence can be applied to a particular clinical situation. This involves determining if the evidence was collected using appropriate methodology, that the evidence is clinically important and the population that was studied has similar characteristics as that of the individual / population in question.

7. Optimize searching for best evidence by appropriate querying of relevant data sources. [Unit 1 (1d)]. This competency teaches clinicians tools that can optimize answering clinical questions, it also lists various data sources that can be queried.

Area 2: Diagnosis

1. Determine when a diagnostic test is needed and when it is not needed for a particular patient with a particular condition. [Unit 2 (2a)]. Clinicians need this competency to answer one of the most common clinical questions, i.e., whether or not a particular test is helpful in diagnosis a patient's condition. Clinicians can learn to consider patient and test characteristics to select a diagnostic test.

2. Search and retrieve Pretest Probability for a test by consulting appropriate sources and determine its/their validity and applicability. [Unit 2 (2a)]. In order to determine the chances of a patient having a particular disease, a clinician needs to be able

to expediently access appropriate resources and determine whether or not the information is applicable to the patient.

3. Construct a 2x2 table of a study of test characteristics and derive Sensitivity, Specificity, Positive and Negative Predictive Values from it. [Unit 2 (2b-c)]. This competency forms the basis of using diagnostic test information in clinical practice. Using this competency a clinician can take the information that was retrieved using the previous competency and come to a firmer conclusion about the chances of a disease in a patient.

4. Use Bayes' theorem to calculate Posttest Probability given Pretest Probability and Test Characteristics. [Unit 2 (2b)]. Clinicians can use Bayes' Theorem to calculate the probability of a disease in a patient given the sensitivity, specificity and the probability of having the disease before the test was administered. Calculators are available that use Bayes' Theorem to compute the posttest probability.

5. Derive Posttest Probability using Likelihood Ratios and Pretest Probability. [Unit 2 (2b)]. This competency also allows for computation of posttest probability in a computationally less intensive manner. A clinician can use slide charts to arrive at posttest probability using likelihood ratios.

6. Apply appropriately appraised clinical prediction rules in calculating probability of a disease. [Unit 3 (3a-b)]. Clinical prediction rules can be used at point of care by a clinician to determine the probability of a disease in a particular patient. There rules allow for a more specific estimate than by prevalence alone.

7. Critically appraise the efficacy of a given screening test. [Unit 3 (3a-b)]. This competency allows a clinician to choose the most appropriate screening test for a disease and to determine whether or a not a screening test is warranted based on disease and test characteristics.

Area 3: Prognosis

1. Determine study types whose results can best be used to answer questions about prognosis. [Unit 4 (4a-b)]. This competency helps clinicians narrow the field of search and thus search faster when looking for answers regarding prognosis of a particular disease.

2. Give examples of how prognosis can be assessed by Clinical Prediction Rules or Systematic Reviews. [Unit 4 (4b)]. This competency exposes clinicians to tools that can be used to assess prognosis of a particular disease in a particular patient. Clinical

prediction rules can give a more specific measurement of prognosis than can overall prognosis.

3. Using data from a Cohort Study calculate Relative Risk and Absolute Risk. [Unit 8 (8a)]. Clinicians use Relative and Absolute Risk as a measure of quantifying harm. This competency ensures that clinicians are able to calculate this important statistic from study data.

4. Demonstrate the difference between Relative and Absolute Risk for a given prognostic risk. [Unit 5 (5a-b)]. This competency helps clinicians understand important differences between Relative and Absolute Risk. Many pharmaceutical studies cite relative risk reduction and clinicians need to be cognizant of how relative risk (reduction) can appear to be much larger than it actually is.

Area 4: Intervention / Therapy

1. Determine study types whose results can best be used for answering a question about intervention or therapy. [Unit 5 (5a)]. This competency helps clinicians conduct fast and efficient searches on questions about intervention or therapy. Questions about therapy/intervention are very common at point of care.

2. Calculate Relative and Absolute risk reduction or increase from the results of an intervention study. [Unit 5 (5a-b)]. This competency helps clinicians understand the magnitude of risk that a particular intervention / therapy can reduce or increase. Absolute and Relative risk are commonly used statistics in studies looking at intervention.

3. Calculate Number Needed to Treat from the results of an intervention study. [Unit 5 (5a-b)]. Clinicians use Number Needed to Treat to determine the number of patients that need to take a particular medication for one patient to benefit. This statistic can be used to measure the treatment effect of a particular medication or an intervention. Number Needed to Treat can also be used to compare the efficacy two medications.

4. Identify or determine the Confidence Interval of a study and its clinical relevance. [Unit 5 (5a)]. Clinicians use the confidence interval of a result to determine the precision of the measured statistic.

5. Customize statistics listed above to help answer clinical questions of individual patients or patient groups [Unit 5 (5a)]. This competency helps to customize population based data and narrow it down to identifiable patient groups, this makes the data more applicable and useful in a clinical setting.

6. Determine limitations of Randomized Controlled Trials and proposed solutions to overcome some of these limitations. [Unit 5 (5c)]. Randomized Controlled Trials are considered the "gold standard" of clinical evidence for interventions. However, they have their own limitations. This competency helps clinicians recognize those limitations and determine which efforts might be useful in overcoming some of the limitations.

7. Determine which questions are best answered by qualitative studies. [Unit 7 (7a)]. Many clinical questions relating to perceptions of patients and other similar situations are best answered by qualitative analysis. This competency helps a clinician focus search efforts and expedite looking for answers to such questions.

Area 5: Summarizing Evidence

1. Describe the steps in creating a systematic review. [Unit 6 (6a)]. This competency helps clinicians understand how a systematic review is constructed, which in turn helps in applying the results of systematic reviews to patient care.

2. Answer a clinical question using summarized evidence; determine the pros and cons of using this approach. [Unit 6 (6a)]. Clinicians can use this competency to apply summarized evidence to patient care, and determine if the summarized evidence is

applicable to their patients by considering the usefulness and limitations of the summarized evidence.

3. Derive Odds Ratio or Weighted Mean Difference from meta-analysis data. [Unit 6 (6a)]. This competency helps clinicians compare the magnitude of the effect for an intervention studied in a meta-analyasis.

4. Calculate Number Needed to Treat from the Odds Ratio of a study. [Unit 6 (6a)]. Clinicians use Number Needed to Treat to know the number of patients that need to take a particular medication for one patient to benefit. This statistic can be used to measure the efficacy of a particular medication or an intervention. Number Needed to Treat can also be used to compare two medications. This competency allows a clinician to calculate Number Needed to Treat from Odds Ratio, which is a common summary statistic.

5. Formulate a plan of incorporating a Clinical Practice Guideline into a clinical practice, determine the advantages and disadvantages of doing so. [Unit 7 (7a)]. Multiple clinical guidelines are available to improve various aspects of patient care, in order to do so there needs to be a plan to incorporate these guidelines into clinical workflow. This competency helps clinicians formulate a plan of doing exactly that.

6. Use results / conclusions of a Clinical Decision Analysis to identify best approach of managing a particular clinical condition. [Unit 7 (7b)]. Clinical decision analysis provide a framework for identifying the best approach to manage a particular clinical condition, this competency helps clinicians incorporate the results into clinical workflow.

7. Use results of an Economic Analysis to identify the most cost effective intervention for a particular condition. [Unit 7 (7b)]. This competency allows clinicians to choose the most cost effective intervention for a particular condition. Health care payers use such tools in deciding which drugs should be on a formulary and clinicians who serve on such boards / committees will find this competency an essential skill.

Area 6: Etiology / Harm

1. Determine study types whose results can best be used to answer questions about harm / etiology. Identify the best and the most practical type. [Unit 8 (8a)]. By knowing which study types best answer questions about harm / etiology, clinicians can conduct fast and efficient search of literature to answer such questions.

2. Critically appraise the difference between Case Control and Cohort study designs in relation to answering questions about harm / etiology. [Unit 8 (8a)]. This

competency helps clinicians better apply the findings of the two main study types used to assess harm / etiology.

3. Derive Odds Ratio and Number Needed to Harm from Etiology / Harm study data, determine the strength of association from these statistics. [Unit 8 (8a-b)]. Odds ratio and Number Needed to Harm are important statistical indicators that measure the magnitude of the effect of harm.

4. Critically appraise the difference between association and causality and determine which study design can be used to answer questions about causality. [Unit 8 (8a-b)]. Clinicians need this competency to determine if an agent is just associated with a disease or if it is the causative factor. A cohort study design usually cannot assign causality.

Area 7: Limitations

1. Give examples of how the limitations of the retrieved evidence change its applicability to patient care. [Unit 9 (9a)]. Clinicians need to be able to apply the limitations of retrieved evidence when making decisions based on retrieved evidence. This competency helps achieve that.

2. Determine future directions of Evidence-based Medicine. [Unit 9 (9a)]. This competency makes a clinician aware of possible future directions that the field of evidence-based medicine might take.

3. Determine possible reasons of why awareness of published evidence may not translate to improved patient outcomes. [Unit 9 (9a)]. This competency helps clinicians identify and possibly remove barriers to adoption of published evidence in clinical practice.

Conclusions:

EBM teaching programs are popular and widely available, they have also successfully been incorporated into various medical curricula and shown to be somewhat effective in helping clinicians search for, retrieve and apply evidence.

Competency-based medical education is being promoted by various accrediting agencies for health care education. Defining competencies and adapting / developing curricula to meet those competencies can optimize EBM education. While some broad competencies exist in the field of EBM, there is a need for individual specific competencies in EBM. Specifically the competencies need to be clearly stated, measurable, and attainable within

the time frame of the curricula, they also need to take into account student characteristics and educational background.

This project involved creating competencies for the EBM course offered by Department of Biomedical Informatics at Oregon Health Science University. Selected competencies were based on the perceived needs of a clinician. SMART criteria were used to select the competencies and strived to make them generally applicable to other EBM courses.

These competencies could be used as a framework for developing new EBM curricula. Existing EBM curricula may also benefit from incorporating these competencies into their framework. Further research is suggested to assess the impact of these competencies on behavior change, to assess whether learning these competencies make it more likely for a clinician to provide evidence-based care.

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