Developing Metrics Tools for a Medical Computing and Informatics Course  

at Brody School of Medicine

Background
With the growing acceptance of evidence-based medicine and the use of technology in modern medical practice, the Brody School of Medicine recognizes the need to offer coursework in medical computing and informatics to its undergraduate medical students. In March-April 2006, Brody will offer a four-week elective, “Medical Computing and Informatics” to fourth-year medical students.

The faculty committee that developed this course over the past year determined that conducting a pre-test of student skill levels would serve two purposes: 1) to provide valuable information to instructors so that the curriculum could be adjusted before the course begins to accommodate what students know and what they don’t know, and 2) to provide a skills assessment that would serve as a baseline of what students learn in the course. The same test would be given as a post-test. Since this is a new course, the faculty also wanted to conduct exit interviews with the 2-10 students who would be enrolled in the class to “debrief” them on their experience. The results from these interviews would be used to evaluate the course. This project will develop instruments for these assessments and post them on BlackBoard.

Introduction
The nation’s medical schools have offered training in medical computing and informatics for more than two decades. In 1998, the Association of American Medical Colleges wrote that medical students needed training in medical informatics, a “particularly challenging contemporary issue that medical school deans and facilities must confront in order to align the content of their medical student education programs with evolving societal needs, practice patterns, and scientific developments” (Association of American Medical Colleges).

Advocates of training in evidence-based medicine contend physicians do a better job of caring for their patients when they base treatment on objective evidence. Traditionally, doctors facing a difficult case might call another physician to discuss treatment options. However, evidence-based medicine has emerged in recent years as a more effective means of informing treatment. Medical informatics, “the rapidly developing scientific field that deals with resources, devices and formalized methods for
optimizing the storage, retrieval and management of biomedical information for problem-solving and
decision-making,” (Shortliffe et al.) plays a key role in this approach to medicine.

In its 1998 recommendations, the Association of American Medical Colleges (20) described nine key
issues, including assessment, that schools might consider in establishing a curriculum in medical
informatics. The three steps for assessment could include: 1) “tests are specific to objectives,” 2)
“assessment is built into overall evaluation schema,” and 3) “build questions addressing informatics
objectives into course examinations. Develop ‘open computer’ (analogous to ‘open book’) examinations.”
This research project seeks to meet the first step in the assessment process, which is “tests are specific to
objectives.”

The literature on teaching evidence-based medicine and medical computing provides assessment artifacts
that medical school librarians and other have developed over the years. The literature also includes
reports on the methodology used to conduct debriefing interviews on medical students. Considering the
rapid advances in evidence-based medicine and computer technology used in the medical school, the
assessment tools in the literature reviewed for this project date from 2000 forward.

Researchers have described how they developed surveys on computer and medical informatics knowledge
and skills by adapting basic computer and evidence-based medicine assessment tools. Examples of these
tools include Florida State University’s survey of basic computer knowledge and skills in 13 areas using a
3-point Likert scale, as well as the Berlin Questionnaire developed for various short courses in medical
informatics given in Germany (Florida State University College of Medicine; Fritsche et al.).

In 2000, the applied medical informatics and computer skills of first-year medical students, family
practice residents, and family medicine faculty at the University of California-Davis were surveyed
(Jerant and Lloyd). The survey was administered to the medical students during orientation and emailed
to residents and faculty. The survey used 5- and 7-point Likert scales, which respondents used to rate
access to computers, computer ownership, confidence and knowledge in using computers and computer
applications, and attitudes toward computer training.

An Evidence-Based Medicine Skills Test was administered in 2000 to residents at Cook County Hospital
and Rush Medical Center (Smith et al.). Responses to questions about cases and abstracts included fill-in-
the-blank and multiple choice.
In 2002, a “Needs Assessment Survey” was administered during the development of a medical informatics curriculum for residents at the Cedar Rapids Medical Education Foundation (Zelnick and Nelson). This assessment tool combined Yes/No questions about computer usage, knowledge, and skills with 3-point Likert scale questions on medical informatics. Participants also provided “open responses” on the written form after training.

A 2005 report described the interviewing techniques used to debrief a group of randomly selected medical students at two northeastern medical schools on their “most memorable” patient deaths (Rhodes-Kropf et al.). Interviews of attending physicians and residents were conducted in 2004 at the Portland, Oregon, Veterans Affairs Medical Center for a study on the impact of computerized physician documentation in a teaching hospital (Embi et al.).

**Problem**
In offering a new course on medical computing and informatics, Brody School of Medicine needs pre- and post-course assessment tools to measure students’ skill levels, outcomes, and attitudes.

**Research Question**
What are the characteristics of effective pre- and post-course assessment tools that would measure skill levels, outcomes, and attitudes for a one-month course in medical computing and informatics at the Brody School of Medicine?

**Hypothesis**
Pre- and post-course assessment tools can be developed to measure skill levels, outcomes, and attitudes for a one-month course in medical computing and informatics at the Brody School of Medicine.

**Variables**
- 2-10 students who sign up for the medical computing and informatics elective during March-April 2006 will take the pre- and post-test, as well as participate in the post-course debriefing.
- Assessment artifacts found during literature review.
- Feedback from faculty teaching Medical Computing and Informatics elective
- Criterion: 1) Pre- and post-test (one instrument) and 2) post-course debriefing questionnaire and format

Comment [E3]: The approach to variables is not an absolute. Describe participants, the criterion (the ways/ methods you will use to gather data), and the treatments (the instruments, instructions, etc) needed to use the methods to gather data.

Comment [E4]: Add heading and the word “the” Participants. The 2-10 …
Outcomes/ effects

The purpose of this research is to develop: 1) a tool to measure fourth-year medical student knowledge of medical computing and informatics before and after four weeks of instruction in an elective course, and 2) a debriefing questionnaire to be used in an interview with students after they complete the course.

Key terms

Medical computing: Use of computers to inform medical decision-making.
Medical informatics: Scientific field dealing with systematic collection, storage, and use of biomedical information for use in problem-solving and decision-making.
Evidence-based medicine: Applies the scientific method to clinical practice.
Assessment tool: An instrument used to determine knowledge, skill level, and opinion.

Subsequent research

This work focuses on a self-selected group of 2-10 fourth-year students at Brody School of Medicine enrolled in the medical computing and informatics elective in 2006. Research using a control group of fourth-year medical school students who don’t take the computing and informatics course could help validate quantitatively how much progress students make in the course. Also, there are inherent weaknesses in using a written, self-assessment tool to determine computer knowledge and skill, as well as evidence-based medicine skills. A test that assesses students’ actual computer skills would provide a more accurate measure of what skills students have going into the course and what skills they learn during the course. A skills assessment using a simulator or actual patient cases could more accurately determine whether students improve their evidence-based medicine skills in patient care as a result of the course.

Design

The research is designed to develop two assessment tools using qualitative and quantitative data. This study will analyze and assess artifacts found in medical literature in order to identify the characteristics that make an assessment tool effective. This study also will incorporate relevant content from these artifacts, as well as the input from the stated course goals (Appendix A) and the faculty teaching the course in developing the assessment tools.

The research design for this project is divided into three phases:

Phase 1: Artifacts found during the literature review will be used to develop prototype assessment tools using the stated goals for the course and a heuristic developed for this project (Appendix B). In 2003, a
holistic approach to assessment at the University of Miami School of Medicine helped to shape that institution’s move from didactic instruction to an outcomes-based curriculum (Burrows et al.). The authors measured student progress, which involved “knowing, knowing how, showing how, and doing” (35) in this way:

<table>
<thead>
<tr>
<th>Skill tested</th>
<th>What is tested</th>
<th>How it is tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing</td>
<td>Knowledge</td>
<td>Multiple choice questions, self-assessment questionnaires</td>
</tr>
<tr>
<td>Knowing how</td>
<td>Clinical skill</td>
<td>Practicals, essays, patient-management problems, orals</td>
</tr>
<tr>
<td>Showing how</td>
<td>Performance</td>
<td>Observation, standardized patients, objective structured clinical examinations</td>
</tr>
<tr>
<td>Doing</td>
<td>Practice</td>
<td>Real patients, videos, logs and portfolios</td>
</tr>
</tbody>
</table>

The assessment tools developed for this course will measure the “knowing” and “knowing how” skills using multiple-choice questions, self-assessment questionnaires, and patient-management problems found in the artifacts and provided by the faculty. The debriefing sessions will use a tool based on the methods described by Rhodes-Kropf and Embi for conducting interviews of medical school students.

Phase 2: The prototype assessment tools will be presented to the course faculty. The feedback from these discussions will be used to refine the assessment tool content and design.

Phase 3: The assessment tools will be posted on BlackBoard.
Reference List


Rhodes-Kropf, Jennifer, et al. "'This is just too awful; I just can't believe I experienced that...': Medical Students' Reactions to Their "Most Memorable" Patient Death." Academic Medicine 80.7 (2005): 634-40.


Appendix A

Medical Computing and Informatics Course Goals Developed by Faculty

On this foundation, students will be taken directly to the endpoint of the course: that data are largely meaningless until they are “synthesized” into information. In other words, information arises when seemingly unrelated facts are combined into a “bigger” picture. To achieve these and related goals, students need to refine their abilities at deductive reasoning. Information is often best conveyed in graphical formats. The process of converting data into information requires deductive reasoning, also known as inference. Several examples of the distinctions between data and information will be reviewed. As often as possible, students are expected to teach each other these skills.

This course relates to the work of the preceding 4 years of medical school by:

- helping students develop the skills to organize and integrate the vast fund of medical knowledge they have already acquired and will continue to build on;
- continuing practical exposure to statistics introduced in the Introduction to Medicine and the Biostatistics courses;
- generalizing the experience students have developed with ECU and PCMH versions to the electronic medical record in preparation of work on different platforms, in other environments.

Objectives:

The skill set students are expected to be at least acquainted with by the end of the course includes:

- conducting literature searches;
- evidence-based medical decision making;
- scientific literature review;
- understanding association and causation;
- hypothesis development;
- analyzing the diagnostic performance of clinical tests;
- validation, particularly of instruments [not just the electronic variety] used in clinical settings;
- database creation, database management, data extraction, data collection, data scrubbing, and data aggregation;
- statistical inference;
- hypothesis testing;
- the graphical display of data;
- how to use commonly accessible software to complete these tasks.

Student Experience:
Roughly a week before the elective, students will be given a test to assess their skills in related computing areas. The course will be tailored to the average level of student expertise. More advanced students are expected to teach necessary skills to their colleagues.

Evaluation of Student Performance:
Students will engage in 3 structured projects throughout the course. Faculty will use their performance during these sessions to assess their progress. The goal of each of these projects is to develop in students the skill set necessary to complete the fourth (and final) project. The fourth project will be developed from the very beginning, throughout the 4 weeks of the elective. During the last week of the elective, nearly all the time will be for students to develop this project. Faculty will be supervising to assure that proper progress is made. On the morning of the last day, students will their findings in a formal slide presentation, accompanied by a full-sized scientific poster. Faculty will assess this final presentation to determine to what extent students were able to develop the computing and deductive reasoning skills using a standard set of questions / metrics. Students will be given the evaluation tool at the beginning of the course. It is expected the products of these projects may be of sufficient quality to be presented in other settings in the Brody School of Medicine (summer and/or departmental research programs), possibly elsewhere.
Appendix B
Assessment Tools Heuristic

(adapted from “Usability Heuristic for User Interface” (Nielsen) and “Heuristic Evaluation - A System Checklist” (Xerox Corporation)

Content
Reflect the stated learning goals for the medical computing and informatics elective. (Appendix A) Asks students to apply knowledge they have learned, rather than what they have memorized.

Ability level
Based on the medical computing and informatics knowledge and skill levels of fourth-year medical students.

Consistency and standards
Available for students to access on BlackBoard before the course begins in March 2006. Questionnaires follow the BlackBoard conventions familiar to the medical students at Brody. Interview follows the conventions of debriefing interviews conducted on medical students and residents found in the literature (Rhodes-Kropf et al.; Embi et al.) Students take all assessments at their own pace.

Match between assessment tools and the real world
Use the language of the medical school, with words, phrases and concepts familiar to the students. The tools follow real-world conventions, making information appear in a natural and logical order.

Recognition rather than recall
Minimize the student’s memory load by making objects, actions, and options visible. Students do not have to remember information from one part of the dialogue to another. Instructions for using the assessment tools are visible or easily retrievable whenever appropriate.

Aesthetic and minimalist design
Dialogues within the tools do not contain information which is irrelevant or rarely needed.