A Web-based Approach to Teaching Students About Diagnostic Reasoning

John Smucny, MD; John W Epling, MD, MEd

Background: Web-based curricula can decrease classroom time and provide self-paced, active learning experiences for medical students. Intervention: In our family medicine clerkship, we implemented a Web-based module on applying diagnostic reasoning to determine the likelihood that a patient has Group A beta-hemolytic streptococcal pharyngitis based on the history, physical examination, and diagnostic tests. Results: Students rated the module more favorably than other classroom sessions and homework assignments. Most students accurately calculated pretest and posttest probabilities in a write-up of an actual patient with a sore throat. Conclusions: This Web-based module was well received and effective.

(Fam Med 2004;36(9):622-4.)

In the family medicine clerkship at SUNY Upstate Medical University, we wish to decrease classroom teaching time to maximize the time students spend seeing patients in preceptors’ offices. However, there are core concepts, such as evidence-based decision making, that we wish to teach to every student. One way to achieve this goal is through Web-based learning (WBL). WBL is as effective as and may be preferred by learners over other educational methodologies, provided download times are fast.1 Other advantages of WBL are that it allows students to learn at their own pace, provides a more active learning experience than a typical classroom lecture, and may enhance problem solving and intellectual skill development.2,3 Older, small studies on computer-assisted instruction in medical education also showed promise in terms of acceptability, knowledge acquisition, and improvement in clinical decision making.4,5 In addition, using Web-based curricula to teach medical decision making addresses informatics objectives in the Association of American Medical Colleges Medical School Objectives Project.6

We implemented our first Web-based module during the 2002–2003 academic year. The content involved applying diagnostic reasoning using the history, physical examination, and diagnostic tests to determine the likelihood of a patient having group A beta-hemolytic streptococcal pharyngitis (GABHS).

Description of Intervention

It took approximately 50 hours to develop the module using commercially available software (www.macromedia.com. Macromedia’s Dreamweaver Ultradev 4.0, Coursebuilder extension 4.1.0, and Cold Fusion 5.0). The first author, who had no prior experience, developed the structure and wrote the basic code. The second author, who had previously developed WBL cases in preventive medicine, acted as consultant and constructed the
Web database application. The module’s content supplements the “Sore Throat” chapter in our clerkship textbook, Essentials of Family Medicine, Fourth Edition.

We give students a brief introduction to the module early in the clerkship. The module opens with a description of an adolescent with a sore throat and continues with five screens of information about the utility of the history, physical examination, and diagnostic tests in determining the probability that a patient has GABHS. As students work through the module, they answer questions and receive immediate feedback. The module concludes with a case write-up of an actual patient that the students see during their clerkship. Responses and write-ups are stored in a database for grading and retrieval.

**Evaluation**

We evaluated the module in three ways. First, students completed an evaluation form at the end of the module that consisted of four questions and space for free text comments. Second, students completed an anonymous clerkship evaluation form for the registrar’s office. This evaluation included questions about all didactic and clinical experiences in the family medicine clerkship, of which three pertained to the sore throat module. Finally, we examined the pretest and posttest probabilities included in the case write-up for accuracy.

**Results**

All 111 students completed the module, and 102 completed the case write-up. Their evaluations at the end of the module were generally positive (Table 1). All students strongly agreed or agreed that the module was easy to navigate and that the questions were stated clearly. Almost all agreed that the module helped them understand the utility of the history, physical examination, and diagnostic tests in diagnosing streptococcal pharyngitis. However, a significant minority (n=17) stated that they did not apply this information to actual patients. Free-text responses suggested two problems in applying the information: students either saw too few patients with sore throat during the clerkship or completed the module too late in the clerkship to apply it to actual patients. Most other free-text responses were positive. Students liked the module because it was helpful, easy to use, interesting, brief, effective, practical, straightforward, and reinforced the information in their textbook. A few students complained, however, that they were logged out of the module while they were typing their case write-up. Only two students wrote that they considered the module to be unnecessary.

The anonymous evaluations that the students completed for the registrar’s office were generally positive (Table 1). The mean student evaluation scores for the three questions about the sore throat module were significantly greater ($P < .0001$) than were the scores for all the other clerkship classroom sessions and homework assignments.

Most students correctly calculated pretest and posttest probabilities included in the case write-up. Responses to the evaluation at the end of the module (n=101) are summarized in Table 1.

Table 1: Student Evaluations of the Sore Throat Module

<table>
<thead>
<tr>
<th>Responses to the evaluation at the end of the module (n=101)</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy to navigate through this module.</td>
<td>72</td>
<td>29</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The questions were stated clearly.</td>
<td>73</td>
<td>28</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>This module helped me better understand the utility of the history, physical examination, and diagnostic tests in determining whether or not a patient has group A beta-hemolytic streptococcal pharyngitis.</td>
<td>51</td>
<td>46</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>I applied this information to actual patients that I saw in my preceptor’s office.</td>
<td>25</td>
<td>59</td>
<td>16</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Responses to the registrar’s anonymous questionnaire (n=102)</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Web-based sore throat module was a good use of my time.</td>
<td>39</td>
<td>43</td>
<td>6</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>The module provided a helpful opportunity to practice calculating pretest probability.</td>
<td>41</td>
<td>48</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>The module provided a needed opportunity to practice calculating posttest probability.</td>
<td>41</td>
<td>45</td>
<td>5</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>
ties in their case write-ups. Of the 102 students that completed write-ups, 89 correctly calculated pretest probabilities, nine did so incorrectly, and four did not include enough information in the history and physical part of the write-up to accurately calculate probabilities. Regarding posttest probabilities, 84 students calculated them correctly, one did so incorrectly, and three did not calculate one even though a diagnostic test (rapid test or culture) was performed. In 14 cases, a diagnostic test was not performed because the patient either had a very high (51%) or very low (1%) pretest probability of streptococcal pharyngitis.

Conclusions
We successfully implemented the Web-based module on diagnostic reasoning. Most students evaluated the module positively and correctly calculated pretest and posttest probabilities of GABHS in their case write-ups.

The main problem reported by students was that some were logged out of the module while typing their write-up into the Web form. To address this, we now give students the option of e-mailing the write-up instead of typing it directly into the module. To ensure that students have time to apply the information to real patients, we now ask them to complete the module early in the clerkship.

There are two main limitations to our evaluation. First, the Web-based evaluation forms after the module were not anonymous, which may have biased students toward positive responses. However, students’ anonymous evaluations for the registrar’s office were also very positive. Second, our objective evaluation is limited to the information provided in case write-ups; nonetheless, this is an appropriate approach to assessing problem-solving skills such as diagnostic reasoning.

In summary, this Web-based module on sore throat was a well-received educational experience for our clerkship students. Its success has encouraged us to expand our Web-based teaching, and we implemented four new modules in the clerkship this year.

Acknowledgments: This module was developed with support of a Title VII Predoctoral Training in Primary Care Grant from the Health Resources and Service Administration of the Department of Health and Human Services.

Corresponding Author: Address correspondence to Dr Smucny, SUNY Upstate Medical University, Department of Family Medicine, 475 Irving Avenue, Suite 200, Syracuse, NY 13210. 315-464-6960. Fax: 315-464-6982. smucnyj@upstate.edu.

REFERENCES