Many national organizations have emphasized the importance of teaching medical students how to use electronic point-of-care decision support tools, such as personal digital assistants (PDAs), in their clinical training. Consistent use of decision support tools has been shown to increase delivery of evidence-based care and may prevent medication errors. The clinical utility and widespread use of PDAs by medical professionals is well documented, and numerous PDA applications have been developed, used, and evaluated in educational and clinical settings.

However, despite this substantial body of literature, a 2008 literature search revealed only three articles describing curricula for teaching medical students how to use PDAs in clinical settings. In our clerkship, we developed and evaluated an innovative approach to teaching clinical use of PDAs. We combined a lecture-based introduction with self-directed practice using a Web-based course presented on Blackboard (Release 7.0, Washington, DC). The course was comprised of seven clinical
cases, on-line PDA resources, and a brief course introduction. We investigated students’ self-reported patterns of PDA use by questionnaire and tracked actual online case usage by server statistics.

**Methods**

The Uniformed Services University of the Health Sciences (USU), Bethesda, Md, is a 4-year allopathic medical school whose students are officers in the US Armed Forces and Public Health Service. Our study subjects were 119 students on six out of eight 6-week third-year clerkship rotations in the academic year 2006–2007. The USU Institutional Review Board approved the study.

**The Educational Intervention**

In the first clerkship week, students attended a 1-hour lecture on PDA use. After the lecture, we taught students how to download the clinical decision support software needed to solve the online cases. On their own time, over the course of the clerkship, we invited students to practice using their PDA software by solving the cases online. To address ongoing student questions, an online forum and chat room was available. Completing the cases was a voluntary activity. There was no penalty for non-participation.

The **Web-based Cases**

The authors had previously developed seven clinical cases as part of a day-long course on technology in medicine. Each case concerned a patient with a medical condition that required additional calculations to determine the underlying diagnosis and guide appropriate care. The cases, along with links to the PDA software, are summarized in Table 1.

For this intervention, we adapted the paper cases for self-directed learning using Blackboard. To adapt the cases for Web-based learning, faculty recorded solutions to the cases using PDA Reach (www.junefabrics.com) and Camtasia Studio (www.techsmith.com) software. This software produces PDA screen shots with voice-over instructions (an example may be accessed in full at http://faculty.virginia.edu/ssrayer/USUHScase.wmv. Before this adaptation for Blackboard, use of the cases required extensive, costly, small-group facilitation by six technologically proficient physicians and medical librarians.

**Evaluation Methods**

We administered a brief questionnaire during each rotation’s first week to assess students’ baseline familiarity with and experience using their PDAs. (All students are issued a Palm OS® PDA in their second year). We used server statistics to monitor student access to the Web-based course. Finally, we assessed student satisfaction using our standard clerkship evaluation form.

<table>
<thead>
<tr>
<th>Patient Cases</th>
<th>Required Calculation</th>
<th>Recommended PDA Software</th>
<th>Web Site for Downloading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient with renal failure. Plasma sodium and creatinine as well as urinary sodium and creatinine are provided.</td>
<td>Fractional excretion of sodium</td>
<td>MedCalc®</td>
<td><a href="http://www.med-ia.ch/medcalc/">www.med-ia.ch/medcalc/</a></td>
</tr>
<tr>
<td>34-year-old asthma patient. Height, gender, and peak flow are given.</td>
<td>Peak flow</td>
<td>MedCalc®</td>
<td></td>
</tr>
<tr>
<td>Peak flow value less than 51% of predicted for asthmatic patient.</td>
<td>ABG</td>
<td>ABG Pro®</td>
<td><a href="http://www.stacworks.com/index.html">www.stacworks.com/index.html</a></td>
</tr>
<tr>
<td>50-year-old patient who fell and complains of knee pain. Patient is able to bear weight, no patellar or fibular head tenderness, and can flex knee to &gt;90 degrees.</td>
<td>Ottawa knee rules</td>
<td>Essential Evidence Plus® (Formerly InfoRetriever®)</td>
<td><a href="http://www.essentialevidenceplus.com">www.essentialevidenceplus.com</a></td>
</tr>
<tr>
<td>Nursing home patient started on amoxicillin for sinusitis. Currently has multiple medications.</td>
<td>Check for drug interactions</td>
<td>ePocrates®</td>
<td><a href="http://www.epocrates.com">www.epocrates.com</a></td>
</tr>
<tr>
<td>Patient with nausea and vomiting with missed LMP. LMP is given along with usual cycle length</td>
<td>Estimated gestational age and due date</td>
<td>MedCalc®</td>
<td></td>
</tr>
<tr>
<td>12-month-old who has had 2- and 4-month Prevnar® immunizations.</td>
<td>Time interval between doses, total doses required</td>
<td>Shots®</td>
<td><a href="http://www.immunizationed.org/default.aspx">www.immunizationed.org/default.aspx</a></td>
</tr>
</tbody>
</table>

LMP—last menstrual period
Results
All 119 students (100%) completed our baseline PDA questionnaire. Of respondents, 95% reported having removed their PDA from the box, 59% reported using their PDA weekly, and 71% had loaded medical applications on to their PDA.

We analyzed course access data from August 2006–March 2007. Over this time period, 36 students (30% of total) accessed the course 610 times. The PDA cases comprised 63% of hits and were accessed by 33 students on average eight times (range 4–54).

Course resources (information on downloading and installing PDA programs) comprised 30% of hits and course information (a brief introduction to course) 6% of hits.

Student satisfaction with the Web-based course did not differ significantly from any other aspect of clerkship didactics at 4.31 out of 5 on a 5-point Likert scale, compared with 4.28 for all other lectures and workshops ($t=3.1$, $P=.76$).

Discussion
In our setting, it proved feasible and acceptable to teach enhanced clinical decision making incorporating PDA software using a Web-based course. Our students reported relatively low baseline use of PDAs. Despite all students being issued with a PDA in their second year, our survey revealed that only 59% reported using it weekly.

Only 30% of study subjects voluntarily used our online course, but those who did so accessed it on average 17 times during the clerkship. This high use by a small number of students suggests that for the minority of students who chose to learn online, the course was successful and met their needs. Students rated our course as above average, which was comparable with other clerkship components. Suggestions to improve student participation include allowing time to complete the cases during classroom sessions, ensuring enough computers are available in the classroom for all students to download resources, and adding a testing component to the modules.

Our study is limited to learners at one institution, all of whom possessed a PDA at the onset of the clerkship. Students’ baseline patterns of PDA use were self-reported rather than externally assessed. Our results could have underreported course usage if students studied the cases in pairs or small groups, with only one individual logged in. Finally, we made no attempt to measure if use of our online course impacted students’ clinical decision making with real patients in clinical settings.

Despite these limitations, ours is one of the first evaluations of using virtual classroom software to teach the use of PDAs in clinical decision making. We demonstrated that it is feasible to do so and that the format proved acceptable to the minority of students who chose to use it. Future interventions should assess whether skills learned using virtual classroom software impact actual decision making in clinical settings.

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