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A manageable approach to integrating personal digital assistants into a family medicine clerkship

JULIE SCOTT TAYLOR, DAVID ANTHONY, LAURA K. LAVALLEE & NATHANIEL L. TAYLOR

Department of Family Medicine, Brown Medical School, Providence, RI, USA

ABSTRACT *Personal digital assistants (PDAs) were incorporated into the six-week Family Medicine Clerkship in 2002 to achieve two major goals: tracking students' outpatient encounters at preceptor sites and providing opportunities to use PDAs during medical visits. Each student collects information on each patient seen. Data are then retrieved and presented to students individually and as a group twice during the rotation. Each PDA also contains several clinical resources that students use during both small group didactic sessions and real clinical encounters. These results are based on data collected from 85 students who completed the clerkship over the course of one year who recorded information on demographics, presenting problems, procedures, and type of precepting for a total of 11,146 patient encounters. The cumulative results have allowed clerkship faculty and administrators to set standard expectations of individual students and preceptors with respect to numbers of patients seen and type of precepting received. This PDA project is manageable in terms of costs as well as effort on the part of both students and faculty and has numerous benefits to the clerkship, one of which is the ability to provide real-time feedback to clerkship students and thus promote adult learning skills.*

Practice points

- Personal digital assistants (PDAs) are increasingly common in both clinical practice and in medical education.
- We present a simple method for introducing PDAs into a required outpatient clerkship that is manageable in terms of both effort on the part of students and faculty as well as cost.
- We actively monitor each site and provide real-time feedback to both students and preceptors with a mid-course feedback session.
- We also provide students with both practice and experience using PDAs as a clinical tool.

Introduction

Medical schools are facing a challenge with the recent shift in the emphasis of medical care and medical education from the inpatient to the outpatient setting (Grum *et al.*, 1995; Hollenberg, 1996). The teaching of medical students is now spread across a multitude of settings and providers, making standardization of educational experiences difficult. Indeed, ambulatory teaching and learning have been shown to be highly variable and unpredictable (Irby, 1995; Manyon *et al.*, 2003). Rising to the challenge, the Liaison Committee on Medical Education (LCME) has emphasized standardization of ambulatory educational experiences—a position shared by educational leaders at most US medical schools (Kassenbaum *et al.*, 1998; Liaison Committee on Medical Education, 2003). Clerkship directors are now faced with the tasks of documenting and assessing the quality of medical students' experiences, and of making adjustments when necessary.

A variety of systems have been developed to document students' clinical experiences, including those using logbooks (Dolmans *et al.*, 1999), scanable forms (Kowlowitz *et al.*, 1996), encounter cards (Rattner *et al.*, 2001) and, more recently, personal digital assistants (PDAs) (Kurth *et al.*, 2002; Pipas *et al.*, 2002). Systems using PDAs additionally teach the use of medical informatics, provide opportunities for real-time data analysis, and have been demonstrated to identify more clinical encounters than card-based systems (Kurth *et al.*, 2002). However, they have the disadvantage of increased startup and maintenance costs.

The role of the student is a separate factor that may be considered in the standardization of ambulatory medical education. Medical students, when given the tools to advocate for themselves and the information with which to make informed assessments of their education, are in the most immediate position to correct deficiencies and achieve standards (Jolly, 1999). Applying adult learning principles to ambulatory medical education thus has potential advantages in the short term as well as the desirable long-term effect of encouraging self-directed learning (Stagnaro-Green, 2004). The combination of real-time clinical and educational data with benchmarks and the fostering of self-directed learning among medical students thus may achieve standards and improve ambulatory medical education.

We instituted the use of PDAs into our Family Medicine Clerkship primarily to collect information on students' clinical experiences. We had several objectives for the use of this information, including the creation of standardized expectations for clerkship students as well as the ability to monitor each practice site and to provide immediate feedback to both students and preceptors. A second major goal was to provide students with experience using PDAs in the clinical setting as part of their clerkship. In this paper, we describe both the process of implementing this project into the

Correspondence: Julie S. Taylor, Department of Family Medicine, Memorial Hospital of Rhode Island, 111 Brewster Street, Pawtucket, RI 02860, USA. Tel: (401) 729-2753; fax: (401) 729-2923; email: julie_taylor@brown.edu

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clerkship as well as our initial results. In addition, we will outline how our results have affected change in the clerkship itself.

Methods

In this section, we describe our clerkship structure, the development of the project, program implementation including ongoing organizational and management issues, and costs. We conceived of this project in early 2002, piloted it from October 2002 to January 2003, and implemented it in February of 2003. Since that time, we have made only minor changes.

Family medicine clerkship

Our medical school has 48 weeks of required clinical rotations including a six-week rotation in Family Medicine which is primarily based in the outpatient setting. Students spend seven half-days per week at a single clinical site. For three half-days per week, they participate in small group didactic sessions. The number of students is limited to 14 per rotation in order to maximize small group learning and to manage the limited number of preceptors. Between 80 and 90 students complete the rotation annually at one of 29 clinical sites.

Project development

Hardware and software selection for the project focused on low cost and ease of use. Palm m125 PDAs which use disposable batteries were chosen to eliminate the need to distribute charging or synching cables. Durable aluminum flip-top cases were obtained separately. We purchased the HanDBase version 3.0 database application and designed a datafile template and data-entry screen. The project was pre-piloted with a faculty volunteer and then piloted with students for two rotations. The Palm M125s proved problematic, given the frequency of data loss resulting from premature power drain (a result of flawed capacitors in some of the Palm m125s) or accidentally dislodging the batteries. To protect the data, we next purchased 16MB SanDisk expansion cards, preloaded with 'BackupBuddy' data backup software, and configured each PDA to backup the dataset at each power-off. We subsequently replaced the Palm m125s with more reliable Palm M130s, which have rechargeable rather than disposable batteries.

A customized database was then created. It consists of a single data-entry screen with a brief fixed-choice questionnaire of nine visible fields. Information is entered on patient demographics including age, gender, and race. Students can choose from among five routine visit types (complete physical, well child check, prenatal care, contraceptive counseling, and risk factor assessment and counseling) and 51 common diagnoses or they may enter 'Other'. Up to three diagnoses can be entered for each patient encounter, in order of importance for the visit. There is an additional field if a procedure is performed, which has a closed-choice list of ten procedures, plus 'Other'. The field values for diagnoses and procedures were developed by clerkship faculty. HanDBase software limits closed-choice field values to 60 choices. The field-value lists (Routine Visits, Diagnoses, and Procedures) are printed on labels inserted inside the lid of the durable aluminum case for ready reference by students during data entry. Additional fields, whose values are invisible to the student, are preset automatically or post-set manually on each PDA: date of patient encounter, site location, and specific rotation within the academic year. Finally, we created two fields for students to indicate the type of precepting received in both the history and physical exam portions of the patient visit. The three distinct category choices are: 'Primary unobserved' (the student took the history or performed the exam without the preceptor being present); 'Primary observed' (the preceptor observed the student's work); or 'Secondary' (the student watched the preceptor).

Table 1. Electronic clinical resources installed on individual PDAs.

Item	Description/use
ABX Guide	Antibiotic guide - Johns Hopkins
BabyCalc	Pregnancy calculator
BreastCa	Risk calculator
COPD Gold guidelines	Interactive emphysema management tool
dT-MMSE	Mini mental status exam template
Go To Goal	Customized version of ATP III cholesterol management tool
Growth-BP	Pediatric growth profile tool
HerbalZone	Herbal medications reference
Medmath	Multi-use medical calculator
Med rules	Interactive clinical decision tool set
Shots 2005	Pediatric immunization quick reference
OEI Obesity Guidelines	Interactive obesity management tool

Since one of the original goals of the project was to give students experience using PDAs as a clinical resource, we also installed several freely licensed clinical resource applications onto each PDA (Table 1). Many of these applications have now been incorporated into the didactic sessions of the clerkship. As preceptors become aware of the project, they have been increasingly interested in having the students use their PDAs in the clinical setting.

Program implementation

At the beginning of the rotation, clerkship staff issue a numbered PDA, case, and charging cable to each student. The faculty then provide verbal and written instructions on using the PDAs as part of orientation. During the third week of the clerkship, the PDAs are collected at the start of a didactic session, synched to retrieve data to that point, and returned to students the same day. These data are then concatenated and analysed as described below to provide individual reports for each student. On the next class day, the clerkship director spends one hour of didactic time reviewing individual and global data with the students as a group. Individual mid-clerkship reports are accompanied by written commentary and suggestions. Cumulative data tables are also distributed so that the students may compare their experiences to overall norms and expectations. At the end of the

Table 2. Most frequent diagnoses and procedures ($n = 11,146$).

Visit type or diagnoses	Frequency (%)†	Procedures	Frequency (%)‡
*Complete physical exam	15.5	PAP smear	34.3
*Well child care	6.1	Rapid strep test	16.4
*Prenatal care	2.6	Earwax removal	4.8
		*Sutures	4.7
*Hypertension	12.1	*Excision biopsy	3.9
*Dermatology	7.4	Blood draw	2.7
*Back pain	5.8	*Punch biopsy	2.7
*Hyperlipidemia	5.3	*Shave biopsy	2.2
*Depression	5.2	Toenail removal	1.4
*Diabetes mellitus	5.0		
*URI	4.7		
*Lower extremity problem	4.6		
*Anxiety	3.7		
Sore throat	3.4		

* Denotes topics covered in clerkship didactic curriculum.
† Reflects frequency of diagnosis appearing as either primary, secondary, or tertiary code field.
‡ For encounters in which any procedure occurred (10.6% of logged patient encounters, $n = 1182$).

clerkship, PDAs are collected for synching and reconditioning. All student data for the block are combined and added to a cumulative datafile for longitudinal study. Individual final data reports are then sent to each student who completed the clerkship.

Data analysis is accomplished in a two-step procedure. After synching to a dedicated computer, data from the completed block are concatenated and appended to a cumulative datafile within the HanDBase desktop environment. The new cumulative dataset is exported for analysis using SAS version 8.0 (SAS Institute, Cary, NC, USA).

Costs

Total start-up costs were $4,035 plus 30.5 hours of consultant's time ($2,288) through the end of the pilot period, for a total of $6,323. The purchase of newer Palm M130s to replace the unsatisfactory Palm M125s, plus backup cards and charging cables, brought total startup expenses to $10,671. Currently used hardware and software (PDA, card, software, case, and cable) cost $315 per student, with no hardware upgrades or replacements foreseen in the immediate future. The continuing costs of implementing this program are limited to technical support, hardware maintenance, and database management by the consultant, which amounts to approximately 10 hours per rotation, for a cost of $750 per rotation or $6,000 annually.

Results

The results reported here are from eight separate six-week rotations completed by 85 individual students over a 12-month period (February 2003 to February 2004) which provided us with information on 11,146 patient encounters. The mean number of patient visits recorded was 131. The range was 24 to 317, with low outlying values generally clustered in the first few blocks of the study. Although no individual site produced consistently low numbers of patient encounters, some sites routinely had high numbers. With respect to the demographics of patients seen, some individual sites have very distinct profiles, offering higher or lower rates of female, Hispanic, pediatric, or geriatric patients.

Table 3. The type of precepting that clerkship students received at their clinical sites.

Type of precepting	History	Physical
Primary unobserved (student took the history/performed the exam alone)	49%	41%
Primary observed (student was directly observed by the preceptor)	7%	16%
Secondary (student watched the preceptor)	40%	38%
Not reported	4%	6%

Table 2 shows the frequency of preventative medicine encounters, the 10 most common diagnoses (the combined frequency of any value appearing either as primary, secondary or tertiary diagnoses in a patient encounter), as well as procedures that were either observed or performed by students. The 'complete physical exam' is the most frequent single code, followed by hypertension management. The other most frequent diagnoses represent many common acute and chronic conditions in the areas of heart disease, dermatology, orthopedics, and mental health. More than 10% of all visits included a procedure of some kind. Almost every student has the opportunity to participate in a PAP smear during the rotation. Other procedures are too infrequent to be predictable.

The global distribution of different types of precepting is shown in Table 3. With respect to taking a history, students reported that 49% of the time, they were not being observed when they saw a patient and that 40% of the time, they were observing their preceptor and not playing an active role in the encounter. Only 7% of the time, on average, were students

being observed taking a history, with a range from 0% to 36%. A similar pattern was seen for precepting physical exams. Here, again, we have seen a certain amount of predictable variety in the sites, with some sites (and preceptors) habitually allowing either more or less student autonomy.

Discussion

We incorporated the use of PDAs in our clerkship primarily to track students' outpatient encounters at individual preceptor sites. Many medical educators have expressed concerns over the cost, organization, and management of this type of project. At a minimum of cost and effort, we have created standardized expectations for clerkship students and are now able to monitor each precepting practice site, to provide feedback directly to students and indirectly to preceptors, and to correct deficiencies prior to the end of a clerkship. Students also have the opportunity to incorporate PDAs into the medical visit.

This project has been enormously successful in creating standardized expectations for students. Some low numbers of encounters were logged earlier in the year as a result of cavalier record keeping or occasional data loss. Yet the data have allowed us to set a standard expectation that clerkship students will see at least 100 patients during the rotation, which is now documented more consistently. By reviewing site-specific encounter numbers over time, we have determined the busier practices and can send more experienced students to those sites. Conversely, the slower practices are more accommodating of a student who is just beginning clinical rotations, though at no site do the students consistently fail to meet the 100 patient threshold. In addition, we are alerted mid-clerkship to those who are not on target to achieve that goal with enough time to rectify the situation.

Information regarding the kind of teaching and precepting that occurs at the clinical sites has been of great interest and importance to the project. A mid-clerkship discussion between core faculty and students with real data is an opportunity to help students problem-solve around working with a preceptor in the outpatient setting under significant time constraints and to teach students to advocate for themselves and develop their own adult learning skills. Frequently, students are encouraged to increase the amount of time they are directly observed by their preceptor as much as possible ('primary observed') so that a final evaluation will more accurately reflect an individual's performance. We have now established a goal of one observed encounter per day per student as a minimum standard. Students have begun to mentor each other during this session by making suggestions to classmates based on their own positive experiences at different sites. In addition, we use these data to motivate preceptors to improve the active learning experiences that students have at their sites.

One of the main goals of the Family Medicine Clerkship is to expose students to the specialty of family medicine. Our mid-clerkship discussions of the data results have also become an opportunity to demonstrate the wide spectrum of diagnoses seen in Family Medicine and to consider the reasons for differences and similarities among practices, such as different patient populations, different geographic locations, the influence of obstetrics on patient demographics, and the role of the training and personal interests of the practitioner. The data have also dictated changes in our didactic curriculum and supported our reasoning for certain curricular decisions. For example, students often observe that we have excessive didactic time devoted to hypertension, but when we can show them that it is a diagnosis for one in ten patients, our educational intent becomes clearer.

With respect to the electronic clinical resources installed on the PDAs, we initially chose free, simple stand-alone applications based on ease of use and relevance to family medicine. Informal feedback from students has been uniformly positive. Medical education literature is now starting to provide systematic evaluation of some of these resources, which will influence our future selection of applications (Johnston *et al.*, 2004; Sutton *et al.*, 2004).

Although this project has been very successful for reasonable cost and effort, we have had some challenges as well, especially with student compliance. We have thus far been reluctant to link this project directly to students' grades even though we do feel that it would improve data entry. Our future endeavors include the incorporation of curriculum and PDA programs in the area of predictive cancer genetics and the refinement of the process for providing feedback to individual preceptors using these data. Future analyses may examine both the pedagogical and the clinical data with reference to the gender of the medical students and preceptors, the patients' severity of disease, and the impact of the mid-clerkship feedback session on students' clinical experiences during the second half of the rotation.

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Notes on contributors

Julie Scott Taylor, MD, MSc, is Assistant Professor of Family Medicine, Director of Predoctoral Education, and the Clerkship Director for the six-week Family Medicine rotation at Brown Medical School.

David Anthony, MD, MSc, is Assistant Professor of Family Medicine and the Assistant Director of Predoctoral Education at Brown Medical School.

Laura K. Lavallee is Education Coordinator and the former Family Medicine Clerkship Coordinator at Brown Medical School.

Nathaniel L. Taylor, PhD, is an independent technical consultant.

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