Handheld Computer Use in U.S. Family Practice Residency Programs

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Abstract
Objective: The purpose of the study was to evaluate the uses of handheld computers (also called personal digital assistants, or PDAs) in family practice residency programs in the United States.

Study Design: In November 2000, the authors mailed a questionnaire to the program directors of all American Academy of Family Physicians (AAFP) and American College of Osteopathic Family Practice (ACOFP) residency programs in the United States.

Measurements: Data and patterns of the use and non-use of handheld computers were identified.

Results: Approximately 50 percent (306 of 610) of the programs responded to the survey. Two thirds of the programs reported that handheld computers were used in their residencies, and an additional 14 percent had plans for implementation within 24 months. Both the Palm and the Windows CE operating systems were used, with the Palm operating system the most common. Military programs had the highest rate of use (8 of 10 programs, 80 percent), and osteopathic programs had the lowest (23 of 55 programs, 42 percent). Of programs that reported handheld computer use, 45 percent had required handheld computer applications that are used uniformly by all users. Funding for handheld computers and related applications was non-budgeted in 76 percent of the programs in which handheld computers were used. In programs providing a budget for handheld computers, the average annual budget per user was $461.58. Interested faculty or residents, rather than computer information services personnel, performed upkeep and maintenance of handheld computers in 72 percent of the programs in which the computers are used. In addition to the installed calendar, memo pad, and address book, the most common clinical uses of handheld computers in the programs were as medication reference tools, electronic textbooks, and clinical computational or calculator-type programs.

Conclusions: Handheld computers are widely used in family practice residency programs in the United States. Although handheld computers were designed as electronic organizers, in family practice residencies they are used as medication reference tools, electronic textbooks, and clinical computational programs and to track activities that were previously associated with desktop database applications.

ed that the handheld computer was useful for providing ready access for conference scheduling and phone numbers. In a separate study, a hospital used handheld computers to develop laboratory and x-ray report tracking for inpatients. The authors indicated that 15 percent of U.S. physicians are currently using handheld computers. Potential benefits of handheld computer use described in the literature could be reduced prescribing errors and usefulness as research tools. Personal digital assistants are portable, are relatively inexpensive, and have the ability to interface with other electronic devises, including desktop computers.

The most popular brands of handheld computers are those equipped with either the Palm (Palm, Santa Clara, California) or the Windows CE (Microsoft, Redmond, Washington) operating system. The Palm is used in 88 percent of the handheld market in the United States. Ebell and Royner have published an article that fully describes available handheld computer hardware.

Since family practice residency training involves not only state-of-the-art clinical medicine but also training in useful technologic tools, including computers, an understanding of handheld computer use in family practice residencies would be helpful for planning future curricula and implementing new information technology. The objective of this study is to assess use of handheld computers in family practice residency programs, including actual use, factors influencing non-use, costs, handheld computer training, and types of handheld computer applications.

**Methods**

**Data Source and Administration**

A cross-sectional survey with a cover letter was mailed in mid November 2000 to directors of family practice residency programs in the United States and Puerto Rico. They included 493 directors of programs listed in the American Academy of Family Physicians (AAFP) 2000 Directory of Family Practice Programs and 117 directors of osteopathic family practice residency programs described in American College of Osteopathic Family Practice (ACOFP) materials. We obtained demographic data from the AAFP directory, consisting of the presence of a Web site, the type of program (program structure), the residency location (urban, suburban, rural), total number of beds, year of initial approval, number of graduates, and whether research by residents was required. Comparable demographic data for the ACOFP programs were not available.

**Questionnaire Development**

The questionnaire was developed and pilot tested on six physician faculty. The instrument included questions about handheld computer use or non-use. If non-use was indicated, we asked questions about organized plans to use and past experiences with handheld computers. If use was indicated, we asked questions about specific use. We also asked questions about operating systems, costs and budgets, upkeep and maintenance, and training, as well as questions about types of specific handheld computer applications. We included questions about wireless service use as well as the ability of the handheld computers to interface with computerized EMR applications. Finally, we asked the person completing the survey to identify their role in the program, and we asked whether they would be interested in participating in a LISTSERV dedicated to handheld computer application. The actual survey tool is shown in the Appendix.

**Data Analysis**

Descriptive data are shown as percentages or actual number counts for all nominal and ordinal data. We used the chi-square to test association between program demographics and survey responses with an alpha of 0.05. We evaluated the strength of these associations with a relative risk. Finally, we calculated a mean for annual budget and hours of handheld computer training.

**Results**

A total of 306 surveys, 257 from the AAFP residencies and 49 from the ACOFP residencies, were returned in the self-addressed stamped envelopes, giving a total response rate of 50 percent. As directed in the cover letter, the survey was to be completed by the department person regarded as having the most complete knowledge of handheld computers. Sixty percent of the program directors completed the survey, and the other 40 percent were completed by other faculty, residents, or staff (Figure 1). Categories of handheld computer use are shown in Table 1. Use of handheld computers either by an individual or group was reported in 67 percent (204 of 306) of the programs. Thirty percent of programs have required applications used uniformly by all users.

Eight percent of the programs plan to implement in less than 6 months, and 6 percent plan implementation in 6 to 24 months. Five of the non-user programs indicated prior use of handheld computers. Reasons
percent use Windows CE either as the sole operating system or in combination with the Palm OS. Two programs use the PSION operating system.

Funding sources for handheld computers are shown in Figure 2. Programs that budget for the handheld hardware and software have an average annual budget per user of $461.58. One program indicated an annual budget per user of $15,000. (This amount was not used in computation. The top limit otherwise was $1,900 for annual budget per user). Faculty or residents, or both, performed the upkeep and maintenance of the handheld computer hardware and software in 72 percent of the programs in which handheld computers are used. Computer information services (27 percent) and others (1 percent) perform the handheld computer upkeep and maintenance in programs in which faculty or residents do not perform this service.

The most commonly used applications are the programs included with the handheld computer at time of purchase; these include the calendar, address, and memo applications. Figure 3 shows the percentage use of added application programs. Medication reference tools, medical textbooks, and clinical computational programs are the most common. Slightly less than half of the programs use handheld computers for inpatient tracking, resident procedure tracking, and the monitoring of drug interactions. Only two programs have handheld computers that integrate with the EMRs.

Fifty-one percent of the programs in which handheld computers are used provide initial training for users,
with an average of 1.17 hours/year (range, 1–12
hours/year). Thirty-one percent of these programs
provide ongoing training, with an average of 0.9
hours/year (range, 1 to 24 hours/year). A wireless
service is used for their handheld computers by 3.5
percent of the programs.

Finally, 73 percent of the respondents indicated a
desire to participate in a LISTSERV dedicated to hand-
held computers.

Discussion

Our results indicate that handheld computers are
being used for any purpose in two thirds of the
Family Practice Residency Programs, and use is
mandatory in 30 percent of the programs. Prior to
this study, there were no published estimates of
handheld computer use in family practice residency
programs. This finding is of interest in light of the
fact that only 22 percent of family practice residencies
currently make use of an EMR.\* The use of handheld
computers in family practice residencies is also con-
siderably higher than the estimated use of handheld
computers by U.S. physicians (15 percent).15 This
may reflect demographic differences between physi-
cians in residency training and the physician popula-
tion at large. Even for programs not using handheld
computers, almost half surveyed expect to imple-
ment use within 24 months, indicating growth.

There are several possible explanations for the adop-
tion of handheld computers in family practice resid-
encies. Handheld computers offer significant
advantages over desktop computers. The costs per
user are significantly lower. This is supported by the
findings in this study that the purchase of handheld
computers is often a non-budgeted expense. Our
results also suggest that faculty and residents main-
tain the devices and applications, indicating familiar-
ity and acceptance. Desktop computers and networks
typically require computer information service per-
sonnel for maintenance. Another possible explana-
tion for the adoption of handheld computers in fam-
ily practice residencies is that the training require-
ment is low. Only half the programs require initial
and ongoing training, at a rate of about 1 hour per
user per year. Yet the handheld computers are being
extensively used for numerous applications.

Family practice residencies may be adapting this tech-
nology to meet specific clinical and administrative
needs.16 In virtually all the programs, the calendar,
address, and memo type functions of the handheld
computer are used either by individuals or groups.
Although handheld computers are not as versatile as
desktop computers and are more limited in graphics
applications, our data suggest that handheld comput-
ers are being used in family practice residencies to
perform specific point-of-care applications, such as
prescription database-type applications, electronic
textbooks, and medical formula-clinical computa-
tional type programs. Other applications, such as tracking
resident procedures, inpatient information, and pre-
scription writing, indicate specific targeted uses.

Surprisingly, only two programs have handheld com-
puters that interface with their EMRs. This could
reflect low use of EMRs, lack of need for both EMRs
and handheld computers, or immaturity of the inter-
facing technology. Only 3.5 percent of the programs
use a wireless service. This may represent a lack of
need, lack of a wireless service, or lack of resources, in
addition to other factors. The interest in this technol-
ogy among users is strong, with almost three quarters

\*Finnie M. Are EMRs useful in the provision of adult health main-

Figure 3 Handheld computer applications in family practice residency programs. The applications are indicated by numbers as follows: 1, handheld-computer-type database; 2, electronic textbooks; 3, clinical computation; 4, resident procedures; 5, inpatient tracking; 6, drug interactions; 7, infrared print; 8, e-mail; 9, resident call; 10, outpatient tracking; 11, Web browsing; 12, prescription writing; 13, resident hours; 14, telephone message tracking.
of the respondents indicating a desire to participate in a LISTSERV dedicated to handheld computers.

The adoption of this technology may also have significant implications for how we teach or train residents to appropriately access and use available up-to-date clinical information to improve patient care. Readily available patient-specific or application-specific information at point-of-care allows for more complete and accurate information for the patient encounter. Drug dosages and clinical computational formulas that, prior to the advent of handheld computers, were accessible only by pencil-and-paper methods are immediately available on handheld computers, reducing potentials for errors or outdated information. Likewise, applications for up-to-date clinical information—from electronic textbooks and online sources like AvantGo and InfoRetriever to endless other clinical information sources—encourage users to continue as lifelong learners.

The rapid adoption of handheld computers in family practice residencies may also have implications for the future of generalist disciplines. Family practice, along with other “generalist” specialties, has been criticized for both poor quality of care for chronic illnesses like diabetes and for not keeping up with the rapidly expanding body of medical knowledge. In their recent report on the chasm that exists in the quality of health care, the Institute of Medicine stated: “What is perhaps most disturbing is the absence of real progress toward...applying advances in information technology to improving administrative and clinical processes.” Weed notes that “good medical practice requires tools to extend the human mind’s limited capacity to recall and process large numbers of relevant variables.” Yet from 1998 to 2000, the number of family practice residencies with EMRs increased from only 17 to 22 percent. In the meantime, two thirds of the programs have adopted handheld computer technology. Handheld computer technology may provide generalists with the tool they need to maintain their generalist practices and yet deliver optimal patient care for the diverse clinical problems they encounter. Our findings suggest that handheld computers seem to be widely accepted in family practice residencies and are being used as such a tool.

Limitations

Although the response rate of 50 percent creates the possibility of a response bias, this response rate is comparable with the average of 55.6 percent (SD, 19.7 percent) for academic research using questionnaires, as published by Baruch. Another limitation may be that these findings may be out-dated very quickly, because this technology is developing so rapidly. It is also important to note that the data are dependent on personal reporting and are subject to recall bias. For example, approximate rather than actual annual budget amounts for handheld computer users could have been reported, and specific handheld computer applications may have been assumed rather than precisely noted.

The initial question of the survey (“we use handheld computers in our program for any purpose”) was designed to be somewhat inclusive, and the responses may overestimate handheld computer use. Future surveys designed to specifically study use of handheld computers might define the word “use” more exclusively and specify types of uniform or mandatory use to quantify results. An attempt was made to limit potential confusion in terminology by operationally defining a handheld computer as a device devices “using the Palm(tm), Windows CE(tm) or EPOCH(tm) operating system running on a small individual handheld computer.” Assurance handheld computers are being used for more than just individual use is supported by thirty percent use for common uniform applications.

A particular strength of our study was the comprehensive scope, in that all U.S. allopathic and osteopathic family practice residency programs were surveyed.

Conclusions

Handheld computers are widely used in family practice residency programs in the United States. Family practice programs are funding and supporting this new technology and are using the devices for more than just the personal data function for which the devices were originally designed. Handheld computers may offer solutions to administrative and information management that are more realistic than those offered by desktop computers or traditional EMRs. Whether handheld computer adoption represents just the enthusiasm generated by new technology or whether handheld computers will actually prove uniformly useful in the practice of clinical medicine remains to be seen. It is possible that handheld computers will continue to evolve at a rapid pace and find many applications in all types of residency education settings. Additional research is needed to understand how best to integrate handheld computer technology into residency training curricula and to understand the potential effect of handheld computer use on patient care quality and outcomes.
The authors thank the entire staff of the Waco Faculty Development Center, especially Cindy Passmore for suggestions on statistical methods.

References


Appendix

Handheld Computer Use Questionnaire

The following questions are intended to obtain factual information regarding use of handheld computers in your residency. For purposes of discussion, handheld computers are defined as devices using the Palm, EPOCH, or Windows CE operating system running on a small, individual handheld computer with the capacity to interface with a desktop computer.

1. We use handheld computers in our program (for any purpose).  
   ___ YES (go to question 2)  
   ___ NO  
   a. Are there any organized plans to include use?  
      ___ YES.  
      When do you plan to implement use?  
      ___ (months) ___ (years)  
      ___ NO  
   b. Has your program had prior experience with handheld computers?  
      ___ YES  
      Why did you cease using them? (check all that apply):  
      ___ Lack of interest  
      ___ Lack of support  
      ___ Lack of budget  
      ___ Too complicated  
      ___ Did not prove useful  
      ___ Hassle factor(s) outweighed benefit  
      ___ Other  
   (Please go to question 16.)

2. Is the usage by individual residents/ faculty?  
   Y  N

3. Are there specific required handheld computer applications used uniformly by all users (calendar, scheduling, log-procedure, patient tracking)?  
   Y  N

4. Which operating system(s) are in use for the handheld units used in your department (check all that apply)?  
   ___ Palm OS  
   ___ Windows CE  
   ___ Other (specify)  

5. Does your program provide handheld computers (check all that apply)?  
   ___ To the faculty  
   ___ To the residents  
   ___ To other staff  

   continued
6. If so, how is the cost for hardware/software budgeted?
   __ Non-budgeted
   __ Deducted from annual faculty/residents book allowance
   __ Provided under a separate budget for handheld hardware/software.
     If so, what is your annual budget per user? $ ___
   __ Other ___

7. Who provides the upkeep and maintenance for hardware/software (check all that apply)?
   __ Representative of computer information services department
   __ Interested faculty
   __ Interested resident(s)
   __ Other (identify) _____________________________

8. Please indicate which handheld applications are in use. If the use is individually only, please check all that apply. However, if the use is common as referenced in Question 3, please underline each specific application as well as checking.
   __ Calendar
   __ Address
   __ Memo pad
   __ Medical textbooks
   __ Database
     __ In-patient tracking
     __ Outpatient tracking
     __ Resident procedure tracking
     __ Resident hour tracking
     __ Patient demographics
     __ Telephone message tracking
     __ Call scheduling
     __ Practice-based research
   __ Medication
   __ Databases (e.g., PDR-type programs)
     __ Prescription-writing programs
     __ Monitor drug interactions
   __ Medical computational programs (i.e., formula-type computational programs)
   __ E-mail
   __ Web browsing
   __ Direct infrared printing from handheld computers
   __ Integrated function with electronic medical records
   __ Other _____________________________

9. Do you provide initial training for users?  Y  N
   If so, how many hours/year? ______________

10. Do you provide ongoing training for users?  Y  N
    If so, how many hours/year? ______________

11. Do you use a wireless service for the handheld computers?  Y  N

12. If your program uses a computerized electronic medical record (EMR), do your handheld units interface?
    If so, how?
     __ Proprietary with the EMR
     __ Customized application

13. The person completing this questionnaire is:
    __ The program director
    __ Other clinical faculty
    __ A resident
    __ An information service department representative
    __ Other staff

14. I wish to receive a copy of the results of this survey  Y  N

15. I would like to participate in a LISTSERV dedicated to handheld computer applications in family practice residency education.  Y  N

16. E-mail address of person completing this portion: ______________________________.

Thank you for your time and effort. If anyone wishes to contact me about this survey or for another purpose, please direct correspondence to dan-criswell@ouhsc.edu.