Tablet Computing in Clinical Training of Pediatric Residents

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Abstract

Background: *Medical residents receive both medical education and clinical skills training. New technologies and pedagogies are being developed to address each of these phases. Our research focuses on the efficacy of an iPad® (Apple, Cupertino, CA) for clinical skills training.* ***Materials and Methods:*** *For a period of 3 years, the University of South Florida provided incoming pediatric residents (*n*= 94) with an iPad. At the end of the 3-year program, we surveyed the residents, measuring perceptions and satisfaction of iPad use in clinical training.* ***Results:*** *Sixty percent of the residents responded to the survey. Ninety-three percent reported at least some iPad usage per day on clinical activities. We classified 13 facets of clinical training into three conceptual areas and provided figures detailing iPad use for each facet relative to other facets in the same cluster. The obtaining, management, and display of information are primary uses of iPad applications in clinical training. Finally, we provide information relative to perceived obstacles in clinical training, with weight of the device being the most frequently cited.* ***Conclusions:*** *The role of graduate medical education is changing with the introduction of new technologies. These technologies can differentially impact the various aspects of residency education and training. Residents reported using an iPad extensively in their clinical training. We argue that in addition to impacting traditional educational strategies, iPads can successfully facilitate aspects of clinical training in medical education.*

Key words: *education, technology, telehealth, telemedicine*

Introduction

From the largest hospital to the independent practice physician, the use of computers is ubiquitous in healthcare. At the time physicians began adopting technology in the form of electronic medical records, the general population started to embrace cell phone technology, followed shortly thereafter by the personal digital assistant (PDA). One major advantage of the PDA is portability, as the user can hold it in a hand and carry it throughout the day. PDAs are smaller in size and weigh far less than laptops, making them an ideal technology for healthcare providers to use in their daily routine.

Although PDAs are an incremental advance over paper, there are three major factors[1] that hinder the acceptance of using PDAs in the workplace: screen size, memory capacity, and battery life. Many PDA users also find it difficult to use a miniature keyboard to perform activities such as data entry and Web site navigation. PDA users also have a tendency[2] to make many errors while typing and using a scroll-wheel to point. The smartphone has solved the problems of memory capacity and battery life, but the issues of small screen size and input difficulty remain. Cell phone and text messaging technology can lead to improvements in healthcare processes,[3] and ameliorating any impediments to proper input can only bolster these findings. The debut of tablet computers, such as the iPad® from Apple (Cupertino, CA), created a remedy to the aforementioned usability complaints. Compared with the PDA and smartphone, the tablet boasts a larger screen to improve both input and visibility, likely leading to fewer errors. Additionally, physicians feel the iPad could fill the gap between computers and smartphones.[4]

USE OF THE IPAD IN CLINICAL TRAINING

Adoption of the iPad is increasing in a variety of medical education contexts, such as radiology,[5,6] neurosurgery,[7] and anesthesiology.[8] Much like other medical fields, pediatric medicine is reaping the benefits of tablet computing. Test scores among pediatric residents improved after the introduction of the iPad in an evidence-based medicine classroom.[9]

The focus of this present research was to determine the extent to which tablet devices were useful on the clinical side of training in graduate medical education. Our purpose was multifold: first, to gather baseline information on what was necessary for successful use as well as what was currently being done on the clinical side; second, to ascertain the role of tablet devices in fulfilling those needs; and third, in order to determine limitations of utilization, we asked about factors that inhibit the adoption of technology in clinical training. Finally, we inquired how and to what extent the residents are using social media in order to establish a baseline of familiarity with technologies that are receiving high levels of everyday use.

Materials and Methods

PARTICIPANTS

The Office of Children's Health in the College of Public Health and the Department of Pediatrics in the College of Medicine of the University of South Florida combined to provide iPads to first-year residents who were training in pediatrics and medicine-pediatrics. Residents received the iPads as part of the initial orientation in their respective programs, and this occurred for three successive incoming classes (2010–2013). In total, 94 residents in the two programs received the device. Each incoming class received the most current iPad. The

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specifics of the population are as follows. Of the 94 recipients, 75 were in the pediatric and 19 were in the medicine-pediatric residency programs. The demographics roughly followed the national norm in pediatric residency programs in that 72 are female and 16 male, with 6 preferring not to respond. Their ages upon entering the residency ranged from 24 to 40 years, with the majority (79%) being between 25 and 30 years old. In addition to receiving the iPads free of charge, residents were also given an iTunes® (Apple) gift card that was used to purchase software for the device.

INITIAL RESIDENT TRAINING

All residents were required to attend an iPad training class at the beginning of their first semester. During this class, they were instructed on the functionality of the iPad. The training included information about which iPad applications (apps) (such as UpToDate) are relevant to their residency. The residents learned practical skills such as how to access patients' electronic health records remotely from the device. To alleviate theft concerns, the residents were informed of security devices, such as an iPad cable lock, that could be purchased for the device. Once the initial iPad training was complete, the residents were offered the opportunity to use the iPad both in the classroom and during their clinical training. Additionally, both residents and faculty completed formal Health Insurance Portability and Accountability Act training.

SURVEY TO ASSESS IPAD UTILITY AND USE

Development. We developed a survey to determine impact and use of the iPad technology, and experts in medicine and the technology field reviewed the instrument for content validity. (The survey is available from the authors upon request.) The survey asked about several distinct areas associated with time spent using the iPad during their residency. These included a focus on specific aspects of clinical training, hindrances to the adoption of technologies, and expected impact on three aspects of their professional lives.

Administration. Upon graduation, all pediatric and medicine-pediatric residents received an e-mail that described the nature of the research project and the survey. Subsequently, an informed consent form was sent electronically to the residents. Qualtrics (Provo, UT) Internet software was used to deliver the survey.

Results

We received 56 completed surveys, for a return rate of 60%; the return rates were 57% ($n=43$) for pediatrics and 68% ($n=13$) for medicine-pediatrics, respectively. Ten males and 46 females responded to the survey. Our first question inquired about the resources used during a week's time to answer clinical questions. *Table 1* provides a summary of responses.

As highlighted in *Table 1*, many individuals rely on one or more sources for clinical information throughout the week. The UpToDate medical app is clearly the most used at this point, with search engines and the PubMed database receiving somewhat less use.

A follow-up question inquired as to the frequency whereby "electronic resources" are used to answer clinical questions, with 82% of residents reporting using such a resource at least once a day, 14% once a week, and 4% once a month. It is clear having digital access to clinical information is important for clinical training purposes.

Table 1. Percentage of Individuals Who Reported Using Each Resource During the Past Week to Answer Clinical Questions

	PERCENTAGE
"Up to Date" or other bedside product	80
Search engine	50
PubMed	45
Epocrates	25
Textbook	23
Medline/OVID	14
Other	21

Note that individuals were to select all that applied so numbers do not sum to 100%.

In terms of the device of choice, 58.9% report using a smartphone and 37.5% the iPad, and this difference is significant [χ^2 (2) = 26.18, $p < 0.001$]. Even though the smartphone may be used more frequently than an iPad, when residents were asked specifically about the frequency of using iPad apps per day on clinical activities, the following usage levels are reported: 35.7%, more than 1 h; 30.4% 30–60 min; 12.5%, 10–30 min; 14.3%, less than 10 min; and 7.1%, no usage per day. Thus, 92.9% of the residents reported using the iPad on a daily basis in clinical activities.

These data establish having access to electronic resources is imperative on the clinical side of training. Several questions on the survey drilled down to see where specific types of apps are used and how often for each type of resource.

Previous research[10] identified 13 specific facets of clinical training. To ease interpretability and presentation, we clustered those facets into three conceptual clusters. The first five facets of interest cover those most closely associated with broad clinical training (general/medical knowledge, textbook/reference, techniques/guide, clinical exam and finding, and classification/treatment algorithms). Respondents used the following scale to indicate the amount of time using an app on the iPad for each purpose: very often (several times a day), often (once or twice a day), somewhat often (two or three times per week), very little (once a week), rarely (one or two times per month), or I never use an app for this purpose. Results for the five facets in the broad clinical training cluster are presented in *Figure 1*. For completeness, the numbers in *Figure 1* represent the percentage of respondents indicating each frequency.

To help make some general inferences about what is going on in *Figure 1*, we aggregated and discussed the percentage of individuals who responded at least somewhat often on a facet (thus, we sum the percentage responses for very often, often, and somewhat often). This allows us to consider the percentage of residents who use the app at least two or three times per week and to compare them with those

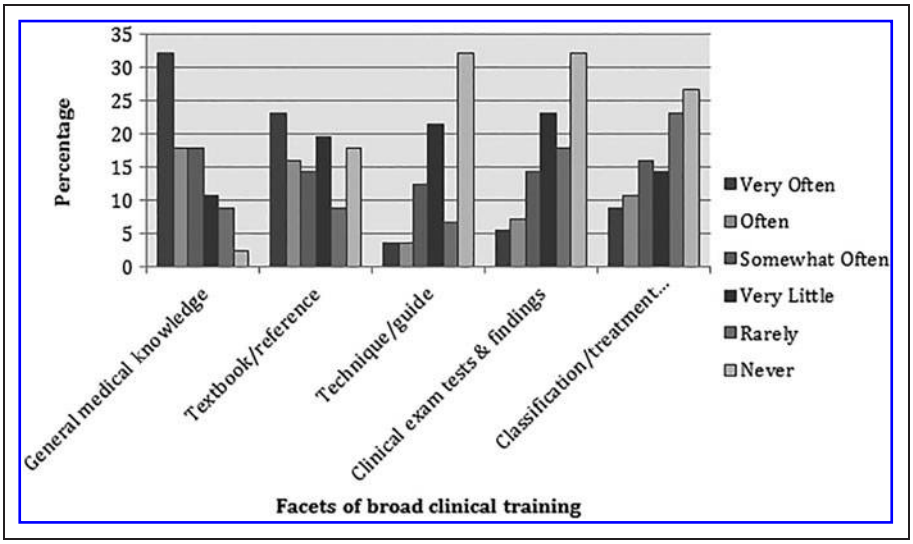

Fig. 1. The percentage of individuals indicating the frequency with which an application is used for a particular type of broad clinical training. The scale ranged from very often (several times a day), often (once or twice a day), somewhat often (two or three times per week), very little (once a week), rarely (one or two times per month), to I never use an application for this purpose.

who responded they use the app with little or no frequency (very little, rarely, or never). Examination of *Figure 1* shows that two-thirds of individuals (68%) reported using an app during clinical training for obtaining general medical knowledge at least two or three times per week. A somewhat smaller percentage (54%) used an app during clinical assessments to obtain textbook or reference information. The remaining three areas—classification/treatment algorithms, clinical exams tests and findings, and technique/guide—have 36%, 27%, and 20%, respectively, reporting usage at least two or three times per week. Thus, the two areas where digitized medical information is typically found in tests, papers, and other similar sources are the highest usage areas of the iPad in clinical training.

The second cluster of clinical apps is patient focused. We identified two facets: one providing patient education materials and the second on patient-focused record keeping. As we did with *Figure 1*, *Figure 2* presents the details of the results of the patient-focused apps.

For ease of discussion we use the same aggregation method described above with *Figure 1*. Here, only 25% of residents reported using the iPad for providing patient educational material at least two or three times per week. A slightly higher percentage (29%) reported the same frequency for using the device for patient-focused record keeping.

A final group of apps used in clinical training is also of interest. These are apps that help or can facilitate the performance of a resident in one or more areas. Insofar as they are broad ranging in goal and purpose, we group them together as a cluster labeled additional clinical facets, as apps developed for any one facet are intended to impact that particular side of clinical training.

The six additional clinical facets are as follows: (1) in training exams or board study material; (2) management and display of journal articles; (3) the identification/filtering of current news and updates; (4) industry-sponsored product information; (5) language translation; and (6) productivity management and reporting. *Figure 3* provides the percentages for the various usage levels for apps targeted at these additional areas of clinical training. *Table 2* presents the rank order from most to least frequently used.

Examination of *Table 2* reveals the management and display of information are the primary uses of these apps in clinical training.

In summary, the use of tablets and apps is extensive in clinical training. As stated above, 92.9% claimed some usage every day, whereas 78.6% of residents reported using it between 10 min to more than an hour per day. However, across the three cluster areas (broad clinical training, patient focused, and additional clinical facets) those apps most frequently used are, arguably, those that focus on the display and management of textual information. Given the embryonic state of development of apps that impact the other facets of clinical training, residents are using them, just not with the same frequency.

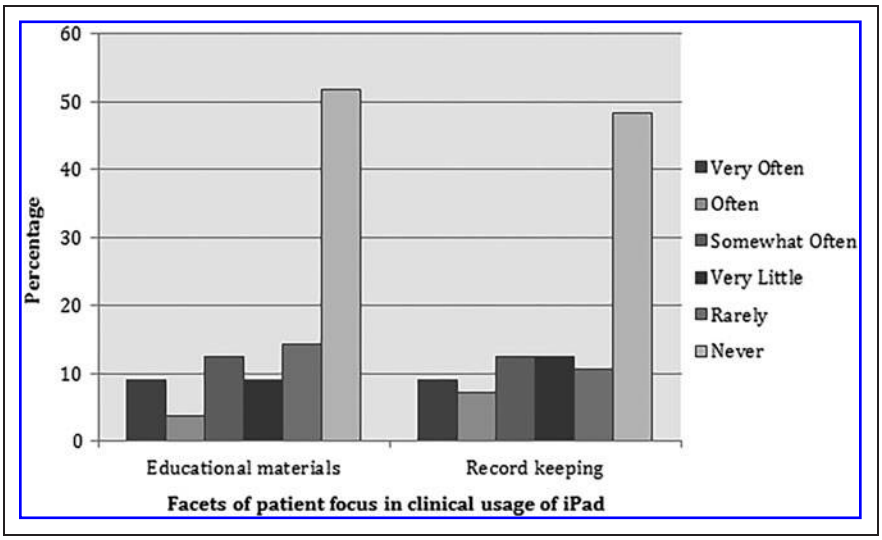

Fig. 2. The percentage of individuals indicating the frequency with which an application is used for a particular type of clinical training with a patient focus. The scale ranged from very often (several times a day), often (once or twice a day), somewhat often (two or three times per week), very little (once a week), rarely (one or two times per month), to I never use an application for this purpose.

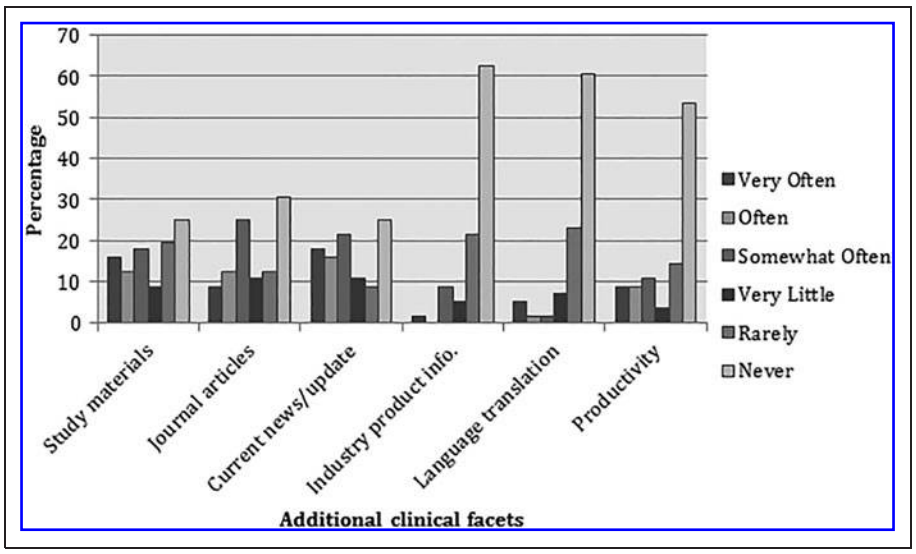

Fig. 3. The percentage of individuals indicating the frequency with which an application is used for a particular type of additional clinical training. The scale ranged from very often (several times a day), often (once or twice a day), somewhat often (two or three times per week), very little (once a week), rarely (one or two times per month), to I never use an application for this purpose.

OBSTACLES TO INCORPORATING TABLETS INTO CLINICAL ACTIVITIES

As part of the process of understanding why a technology is or is not adopted, it is important to ask users about obstacles to adoption. Preliminary work in the area[11,12] identified several factors identified as inhibitors to technological adoption in a medical setting. We asked about those factors in this work and report the findings in *Table 3*.

Weight of the device was identified by the largest percentage of individuals as an obstacle to adoption. It is important to remember, however, that the majority of individuals in the study received either first- or second-generation iPads, and none received an iPad Mini or iPad Air. This concern of weight may be at least partially mitigated by the newer tablet devices.

Table 2. Frequency of Use for Applications Impacting Additional Clinical Facets

CLINICAL TRAINING FACET ADDRESSED BY APPLICATIONS	PERCENTAGE
Current news and updates	55.1
In training exam and board study material	46.5
Journal article management and display	46.4
Productivity management and reporting	28.5
Industry sponsored product information	16.1
Language translation	9.0

Percentages are based on summing (very often + often + somewhat often). Note that individuals were to select all that applied so numbers do not sum to 100%.

EFFICACY OF THE DEVICE FOR CLINICAL TRAINING

We deem it useful to address the perceptions of the residents regarding the overall efficacy of using the iPad for clinical training by asking about how it will impact them in three critical areas of their work life: organization, collaboration, and effectiveness. A final set of three questions asked residents to indicate their agreement on a 6-point scale (from 1 = strongly agree to 6 = strongly disagree) indicating the extent the iPad will impact those three areas of their work life. Tests of significance for all three revealed that residents believe the iPad will make them a more organized (mean = 1.80; standard deviation [SD] = 0.98) ($t_{55} = 13.77$, $p < 0.001$), collaborative (mean = 2.04, SD = 1.11) ($t = 13.71$, $p < 0.001$), and effective (mean = 1.80, SD = 1.01) ($t_{55} = 12.83$, $p < 0.001$) physician.

SOCIAL MEDIA

Given the predominance of social networking in the lives of individuals today, we inquired regarding the extent it is used by our sample for three different purposes: keeping in touch, work-related issues, and school-related issues. The largest proportion of individuals (91%) reported using social networking for keeping in touch with family and friends. Much smaller proportions (16% and 5%) used social networking at work or school, respectively.

Table 3. Percentage of Individuals Who Reported Each Factor Was an Obstacle to Incorporating an iPad into Clinical Activities

OBSTACLE TO ADOPTION	PERCENTAGE
Weight of the device	55
Insufficient funds to purchase hardware/software	25
Security concerns (no way to secure the device if unattended)	25
Lack of knowledge of the device	23
Other (those mentioned: keyboard, EMR, charting difficult, WiFi issues, size to large)	16
Securing patient information (HIPPA compliance)	14
Lack of institutional support	11
Time required to learn the new system	9
Lack of personal interest	9

Note that individuals were to select all that applied so numbers do not sum to 100%.

EMR, electronic medical record; HIPAA, Health Insurance Portability and Accountability Act.

Discussion

Technology is finding an increasing role in nearly all aspects of modern life, both personal and professional. In our research, nearly all residents used social media for keeping in touch with family and friends; thus the baseline for personal use is quite high. Our research interest is focused on understanding the role of technology for facilitating and adding value to clinical education.

If a technology is to be successful for instruction in the clinical realm, there are at least three things that must work in synergy. The first is the hardware of the device. Early adopters of the PDA found it useful, but also lacking in terms of screen size, memory, and power. The tablet computer (e.g., iPad) overcame these limitations through increased screen size and acuity, plenty of memory, and powerful processing units. Yet here, residents report the trade-off in weight is still an important obstacle to adoption. This is likely why the smartphone is still quite popular for researchers.[13–15] and, indeed, we found it used more than the tablet in our sample.

A second factor is the availability of suitable software for requisite apps. There is the issue of many software programs being legacy systems, requiring a desktop/laptop to run. However, the market for software specifically created for telemedicine apps is already increasing rapidly.[16] As time proceeds and apps targeted at clinical training and use are developed, this issue should recede.[17]

The third factor is the usability[18] of the device. Usability is a critical issue for the successful adoption of any technology and is the focus of many issues associated with human–systems integration. Topics we uncovered include insufficient knowledge of the device, lack of institutional support, and security concerns. Training programs can be developed to facilitate the learning curve and to help deal with security issues. The institution, however, must commit its support to ensure successful adoption.

In conclusion, the process by which we educate individuals in our society is being dramatically impacted by technology. Graduate medical education[19,20] and clinical training are no exception. Previous research has examined the role of technology in graduate medical education. Our work extends this research by focusing on the utility of tablet devices as a tool in clinical training. Although tablet devices overcome many problems associated with PDAs and hold great promise for clinical training, issues associated with fully integrating the device within the work context still exist.

Disclosure Statement

No competing financial interests exist.

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