

Use of Tablet Computers to Promote Physical Therapy Students' Engagement in Knowledge Translation During Clinical Experiences

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Background and Purpose: Physical therapists strive to integrate research into daily practice. The tablet computer is a potentially transformational tool for accessing information within the clinical practice environment. The purpose of this study was to measure and describe patterns of tablet computer use among physical therapy students during clinical rotation experiences.

Methods: Doctor of physical therapy students ($n = 13$ users) tracked their use of tablet computers (iPad), loaded with commercially available apps, during 16 clinical experiences (6–16 weeks in duration).

Results: The tablets were used on 70% of 691 clinic days, averaging 1.3 uses per day. Information seeking represented 48% of uses; 33% of those were foreground searches for research articles and syntheses and 66% were for background medical information. Other common uses included patient education (19%), medical record documentation (13%), and professional communication (9%). The most frequently used app was *Safari*, the preloaded web browser (representing 281

[36.5%] incidents of use). Users accessed 56 total apps to support clinical practice.

Discussion and Conclusions: Physical therapy students successfully integrated use of a tablet computer into their clinical experiences including regular activities of information seeking. Our findings suggest that the tablet computer represents a potentially transformational tool for promoting knowledge translation in the clinical practice environment.

Video Abstract available for more insights from the authors (see Supplemental Digital Content 1, <http://links.lww.com/JNPT/A127>).

Key words: *App use, Evidence-based practice, Handheld computer, iPad, Knowledge translation, Physical therapy, Physical therapy student, Tablet computer*

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INTRODUCTION

The exponential growth of research information available to physical therapists has corresponded with an expectation that providers will integrate evidence into their clinical decision making.^{1,2} However, lack of time has been a pervasive barrier to clinicians' ability to successfully engage in the translation of research evidence into practice.^{3–5} In fact, therapists who believe that knowledge can be integrated into practice without interfering with patient care efficiency are substantially more likely to successfully integrate research into practice.⁶

The tablet computer (tablet), with mobile access to both the internet and specially designed application software programs (apps), is a potentially powerful tool for efficiently accessing evidence within the natural flow of patient care. The first modern tablet, the iPad (Apple Inc), was released in 2010.⁷ Just 2 years later, an estimated 31% of U.S. internet users owned a tablet—with primary uses associated with information seeking.⁸ Numerous additional products have become available since 2010 (eg, Surface Pro [Microsoft Corp], Galaxy [Samsung Group], and Kindle Fire [Amazon.com, Inc]). Two recent surveys of medical students, residents, and physicians found that 45% to 50% of respondents used a tablet in clinical practice.^{9,10} Accessing medical reference applications was the most common reason for clinical use. Likewise, pharmacists perceived value in mobile app technology for accessing medical information during patient care.¹¹ If physical therapists are

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able to use tablets to access relevant evidence at the point of care, they may be more likely to do so and thus integrate that evidence into their clinical decision making.

Little research has been published regarding the impact of modern tablet computers on clinical practice in any health care setting.¹² However, recent systematic reviews of the use of previous generation hand-held computers, personal digital assistants, suggest that hand-held computer devices may increase clinicians' information seeking, adherence to clinical practice guidelines, and clinical decision-making accuracy¹² including diagnostic and treatment decisions.¹³ For example, Wallace and colleagues¹⁴ found that clinicians using hand-held computers with evidence-based software installed answered their clinical questions with more frequency, efficiency, and satisfaction compared with usual practice.

Knowledge translation, as defined by the National Center for Dissemination of Disability Research, is "the collaborative and systematic review, assessment, identification, aggregation, and practical application of high-quality disability and rehabilitation research by key stakeholders (i.e., consumers, researchers, practitioners, and policymakers) for the purpose of improving the lives of individuals with disabilities".¹⁵ Although the traditional model of evidence-based practice¹ focuses on the individual clinician accessing information about an individual patient, knowledge translation takes into account the complexity of the environments (or systems) in which patient care is provided (eg, a private practice, hospital, and county health care system).¹⁶ Models of knowledge translation provide insight into the impact that technologic innovations, like the tablet computer, may have on efforts to reduce the gap between research and practice.^{16,17}

The Ottawa Model for Research Utilization,¹⁸ a broadly recognized knowledge translation model, highlights the practice environment—subdivided into 3 components: (1) structural factors, (2) patient-related factors, and (3) social factors—as having an important impact on efforts to promote knowledge translation. The structural environment (ie, physical structure, resources, and supplies) influences clinicians' ability to access and apply available evidence. A recent case study in knowledge translation among neurologic physical therapists provides an example of how the structural environment can be modified to support behavior change related to clinical practice.¹⁹ Patients, their beliefs, health literacy, and engagement in shared decision making²⁰ can encourage or discourage knowledge translation. Finally, the model suggests that the social structure of a practice environment (politics, personalities, presence of local champions for evidence-based practices, and culture and belief systems) also influences propensity for knowledge translation. Use of tablet computers is likely to impact the practice environment in which therapists work, potentially changing the structural environment (access to new resources), patient experience (interacting with a therapist using a tablet), and social structure (colleagues interacting with others with a tablet). The Ottawa Model provides context for examining the impact of tablets on the practice environment and ultimately, their potential for promoting knowledge translation.

To our knowledge, no studies have reported any aspect of modern tablet computer use in physical therapy practice. A

better understanding of how clinicians might use tablets will facilitate hypothesis generation regarding how tablets might be used to promote knowledge translation. The purpose of this study was to measure and describe patterns of tablet computer use, specifically the iPad, among doctor of physical therapy (DPT) students during clinical rotation experiences. These patterns of use are expected to provide preliminary insight into whether and how such devices might support efforts to enhance knowledge translation in physical therapy practice.

METHODS

Student Users and Clinical Setting

DPT students at the University of Southern California served as the tablet computer users for the study. Students were invited to participate via in-class announcement and email before clinical experiences occurring between August 2011 and December 2012. Students could participate during 6-week full-time clinical experiences in years 1 and 2 of the DPT program and during 16-week full- or part-time (3 days/week) experiences in the third year of the program. No restrictions were made regarding clinical setting. No experience using a tablet computer was required.

Tablet Computers

Four university-owned and 2 student-owned Apple iPad 2 devices (Apple Inc, Cupertino, CA) with 1-GHz processor, 16 -GB storage, and Wi-Fi + 3G cellular capacity were used. Each tablet was equipped with access to a cellular data network (Verizon Wireless Data Plan) to support internet connectivity in the absence of a Wi-Fi network. The iPad 2 has camera and video functionality. The operating system at the start of the study was iOS 4.8 and updates were conducted as they were released during the course of the study (final version: iOS 6.0). Access to the iCloud Drive was turned "off" to reduce the risk of patient-related data from being transferred off the device. The "find My iPad" setting, however, was enabled to facilitate relocation of the device in the case of theft or loss. University-owned iPads were managed by the primary investigator (JKT) through a single iTunes (Apple Inc) account.

App Identification and Selection

The investigators identified an initial set of 18 commercially available apps that might support knowledge translation (see Supplemental Digital Content 2, <http://links.lww.com/JNPT/A128>). Those apps were loaded onto the university-owned tablets before the start of the study. Participants were encouraged to suggest additional apps to be loaded onto the tablets. Suggested apps were added throughout the course of the study after review and approval by the primary investigator. Approval of the app was based upon its face validity for supporting knowledge translation and/or general clinical utility; all suggested apps were approved.

Participants also had access to preloaded apps (ie, *Safari* [web browser, Apple Inc], *Camera* [still and video, Apple Inc], *Mail* [email, Apple Inc], *Notes* [Apple Inc], and *YouTube* [Google, Inc]). The university-owned tablets shared a single (5-device) license for purchased apps and no limit was placed on costs for app purchases for those devices. The 2 users

who chose to use their own device were provided with a \$50 iTunes gift card to purchase apps from the list of apps provided on university-owned devices. Available operating system and apps updates were installed every 4 months (or earlier if requested by the user) on university-owned tablets. User-owned tablets were updated at the owners' discretion.

Training

Student users were issued a tablet (excluding 2 who used their own) in the week before their clinical rotation experience. Only the 2 users with their own tablet had experience with the device; all had experience using a smart phone with similar functionality. All users completed a 2-hour training session that included how to use the tablet and provided apps; explain the study and use of the tablet to their clinical instructor(s) and patients; search for apps that might facilitate knowledge translation by searching the internet and iTunes (Apple, Inc) store for medical and physical therapy-related apps; ensure compliance with the Health Insurance Portability and Accountability Act (HIPAA) as interpreted by the facility hosting their clinical experience; and record their tablet use for the study.

The users were required to explain the study to their clinical instructor and to follow all privacy regulations associated with HIPAA as designated by their host clinical facility. Video and picture release forms were provided in the event that facilities did not have their own forms. Students were required to obtain consent for any images taken of patients and to provide that information to the clinical site. Patient image information was restricted to use on the password-protected devices (with the exception of patient requests for their own images

to be sent to them or direct transfer to the medical record) and was deleted as soon as it was no longer needed. Students were instructed to avoid images of the patient's faces or voices whenever possible, and to conduct any image collection in a private area where other patients would not be inadvertently recorded. Ultimately, the clinical facilities hosting the students determined whether and how patient information was collected on the tablets.

Data Collection

Users recorded every use of the tablet through an online spreadsheet visible to the primary investigator. Each recorded use included user and clinical setting identification, app used, and a brief qualitative description of the activity conducted. After the first 2 months of data collection (2 students, 33 clinical days), the qualitative descriptions of the activities conducted were used to identify 5 common categories of use: information seeking (with subcategories background and foreground), patient education, communication documentation, and other. The categories, with definitions (Table 1), were added to the online spreadsheet. Uses recorded to that point were categorized retrospectively, and all future categorization was conducted prospectively by the user at the time of data entry. To facilitate interpretation of results, each category was subsequently linked to the most relevant component of the research environment as defined by the Ottawa Model of Research Use (Table 1).¹⁸

Users also recorded the duration of searches for research articles and syntheses (foreground searches) and identified each search as either successful or unsuccessful (ie,

Table 1. Categories of iPad Use With Examples

Use Category	Hypothesized Impact as per Ottawa Research Utilization Model	Description and Subcategories	Example Uses
Information seeking	Enhance structural environment for supporting access to research evidence	Search for information to support clinical decision making. With subcategories: Background: general medical information Foreground: research evidence directly from peer-reviewed literature	App: Epocrates Activity: Looked up adverse effects of combination of statins and alcohol consumption App: Safari Activity: PubMed search for quad strengthening for patellar tendonitis, eccentric vs isokinetic strengthening
Patient education	Promote patient education and thus support for knowledge translation	Educating patients about any component of physical therapy management	App: Camera Activity: Video of a patient's gait with/without assistive device for patient education
Communication	Facilitate a culture of accessing information to support knowledge translation	Professional communication activities (with clinical instructor, other health care providers, school faculty)	App: GoodReader Activity: Another PT in the clinic asked for a reference I have stored in GoodReader for reference for patient treatment
Documentation	Enhance structural environment for accessing patient-specific medical information to support knowledge translation	Recording information about a patient's course of care in the medical record <i>or</i> recording notes to be transferred into a documentation system	App: Safari Activity: Wrote patient note using clinic's web-based documentation software
Other	Varied	Using general iPad functions (eg, calculator, translation apps, and notepad) to complete activities that support patient care	App: Google Translate Activity: To assist in communication with a patient from Cambodia

Abbreviation: PT, physical therapist.

information was/was not identified to guide practice). The principal investigator monitored adherence to reporting and provided prompts to users via email to facilitate consistent completion of the user logs. Users met monthly, or as needed, with the principal investigator to address technical issues and to facilitate exchange of ideas regarding use of the tablets to facilitate knowledge translation.

Data Cleaning

A systematic process of data cleaning was conducted before analysis. Each recorded use was assessed for completeness and for a match between the qualitative description and the category of use selected by the user. Incidences of missing data within a recorded use (eg, app not listed or category not identified) were resolved by contacting the student user within 2 months of completion of the clinical experience. If the user could not confidently recall the information, it was left blank. Conflicts between the qualitative description and designated category of use were resolved by the principal investigator in coordination with the user as needed. No recorded uses were added beyond the calendar month of any given data collection period.

Data Analysis

Overall tablet use was calculated by comparing the number of days the tablets were deployed in the clinic with the number of days used and mean uses per day. Descriptive statistics were used to describe patterns of tablet and app use. Proportion of tablet use for each defined category was calculated and patterns of use were assessed within each category. Reports of successful and unsuccessful searches for research articles were tabulated. Duration of time spent on successful and unsuccessful searches were compared using a 2-tailed independent *t* test. Data analysis was conducted using Excel 2010 (Microsoft, Redmond, WA). Finally, though not designed as a mixed-methods or qualitative study, qualitative comments about each tablet use were reviewed to provide insight into the successes and challenges of tablet computer use in the clinical setting.

The University of Southern California Institutional Review Board determined that this study did not qualify as Human Subjects Research. Student users did, however, sign statements of agreement to participate that clearly outlined their rights and responsibilities. Users were free to stop participation at any time.

Funding

This study was funded internally by Division of Biokinetics and Physical Therapy at the University of Southern California.

RESULTS

Student Users and Clinical Setting

Thirteen DPT student users participated in the study (12 female, 1 male). All users completed data collection for at least 1 clinical experience; 3 completed data collection for 2 clinical experiences. No users dropped out of the study. Table 2 describes the clinical context in which the

tablets were used including the user's clinical experience year (1-3) in the DPT program, clinical experience setting, and tablet ownership.

Tablet Use

Students used the tablets on 70.0% of clinic days (Table 2) ranging, for individual users, from 39.4% to 100% of clinic days. Mean overall use per day was 1.3 (standard deviation = 0.8); mean use for individual users ranged from 0.5 to 3.6 uses per day. The majority of tablet uses were for information seeking with 356 uses (46.2%), and among those, 118 (33.1%) involved foreground searching and 240 (67.4%) background searching. Patient education constituted 140 (18.2%) uses, documentation 102 (13.2%) uses, professional communication 68 (8.8%) uses, and other 104 (13.5%) uses (Figure 1).

Users reported success or failure and duration for 94 (77.1%) of the 118 foreground searches (22.9% missing data). Of those reported, 68 (74.7%) were marked as successful. The average foreground search duration was 10.4 minutes (standard deviation = 8.7), with a range of 2 to 45 minutes. Successful searches took 11.0 minutes on average whereas unsuccessful took 9.3 minutes ($P = 0.47$).

App Selection and Overall Use

Sixty-one user-suggested apps were added to the original 18 provided apps. Of these 79 apps, 36 (45.6%) were free of cost. Of the 43 remaining, the mean cost was US\$10.55 (standard deviation = \$10.90; range = \$0.99-\$49.99). Of 84 available apps (79 downloaded and 5 preloaded), participants used 56 (66.7%) at least once. The 10 most used apps are listed in Table 3 including cost and primary categories of use. Supplemental Digital Content 2 lists details for all available apps including cost and date downloaded for the study.

Use by Category

Information Seeking

Figure panels A and B illustrate the topics of information seeking within foreground and background searching. Eleven apps were used for foreground searches; of those, *Safari* was the most used, 72 (61.0%) uses. *Pubmed on Tap* (References on

Table 2. Clinical Context for iPad Use

Variable	Count	Days in Clinic (%)
Total clinical experiences	16	691 (100)
Total days tablets used	NA	484 (70)
Clinical experience year, duration		
Year 1, 6-wk rotations	4	120 (17)
Year 2, 6-wk rotations	3	90 (13)
Year 3, 16-wk full-time rotations	5	322 (47)
Year 3, 16-wk part-time rotations	4	159 (23)
Clinical experience setting		
Inpatient neurologic rehabilitation	1	30 (4)
Outpatient neurology	2	105 (15)
Outpatient pediatrics	3	137 (20)
Outpatient orthopedics	10	419 (61)
iPad ownership		
University-owned iPad	14	581 (84.1)
Student-owned iPad	2	110 (15.9)

Abbreviation: NA, not available.

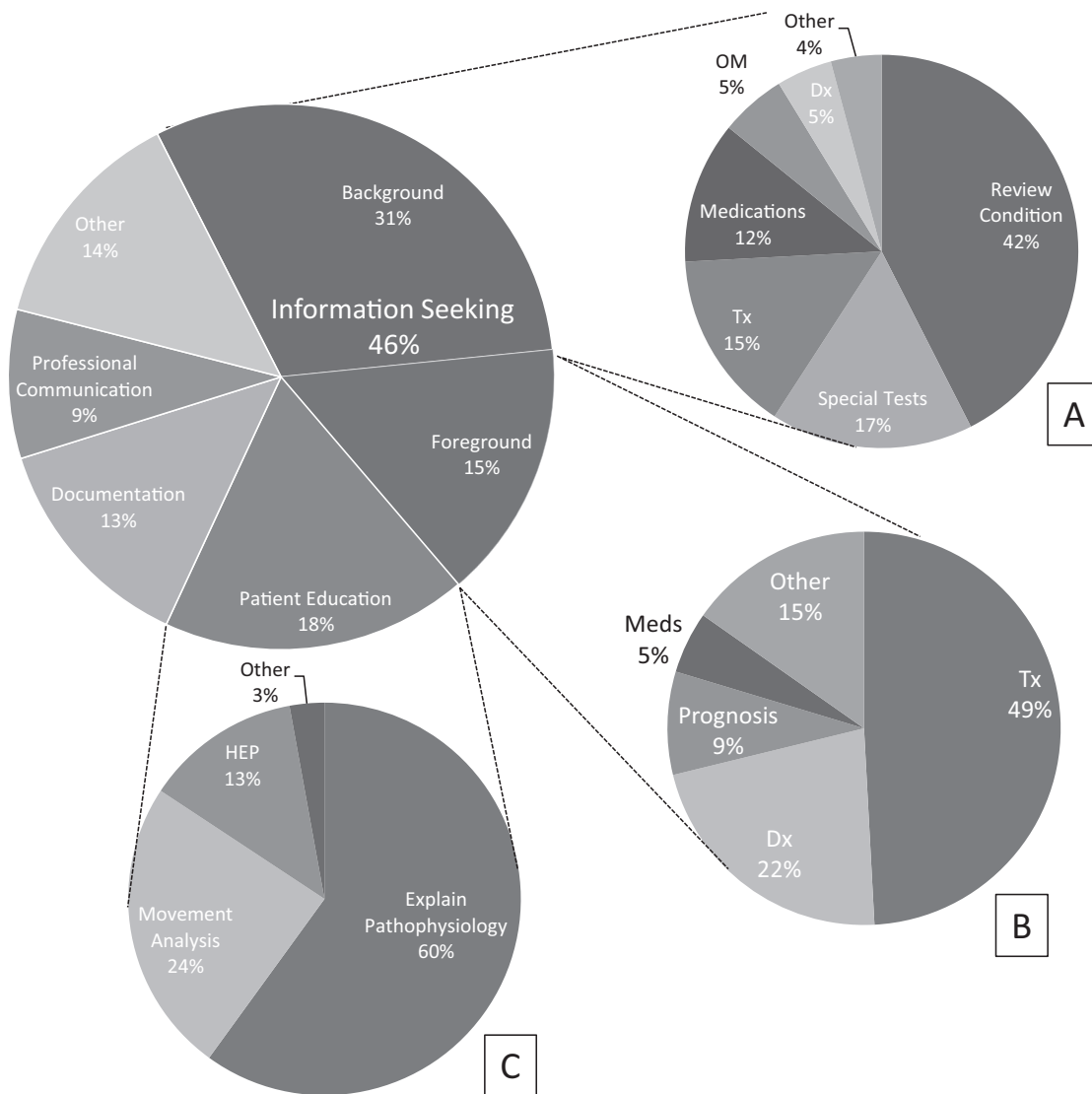


Figure 1. Large pie chart shows percentage (rounded to the nearest whole number) of tablet computer use by clinical activity category. Smaller charts show details for (A) information seeking: background, (B) information seeking: foreground, and (C) patient education. Abbreviations: Dx, diagnosis; HEP, home exercise program; Meds, medications; OM, outcome measures; Tx, treatment.

Table 3. Ten Most Used Apps

App	Developer	Cost	Uses	Percentage	Primary Use Category
Safari	Apple Inc	Preloaded ^a	281	36.5%	Information seeking (foreground and background) and documentation
Camera	Apple Inc	Preloaded ^a	52	6.8%	Patient education
Muscle System Pro III	3D4medical.com, LLC	\$19.99	37	4.8%	Patient education
GoodReader	Good.iWare Ltd	\$4.99	35	4.5%	Other: Article management
Epocrates	Evernote	Free	30	3.9%	Information seeking (pharmacology)
Notepad	Apple Inc	Free	29	3.8%	Other: Self-organization
CORE—Clinical Orthopedic Exam	Clinically Relevant Technologies	\$39.99	24	3.1%	Information seeking: Clinical exam
V1 Golf (for motion analysis)	Interactive Frontiers, Inc	\$4.99	19	2.5%	Patient education: Motion analysis
Motion Doctor	Blue Whale Web	\$14.00	18	2.3%	Information seeking: Background
Nerve Whiz	University of Michigan	Free	17	2.2%	Information seeking: Background

^aPreloaded apps involve no additional cost.

Tap) was the next most common with 13 (11.0%) uses followed by *Pubget: Science Library* (Pubget, Inc) with 8 (6.8%) uses.

Forty apps were used for background information seeking; of those, 17 were used only once. The most commonly used app was the preloaded web browser *Safari*, with 88 (37.0%) uses for background searching. *Epocrates* (Epocrates Inc) was used 25 (10.5%) times, *CORE Clinical Orthopedic Exam* (Clinically Relevant Technologies) was used 22 (9.2%) times, and *Nerve Whiz* (University of Michigan) was used 12 (5.0%) times.

Patient Education

Figure 1 panel C illustrates the general patient education topics addressed using the tablets. Twenty-three apps were used for patient education. Anatomy apps were used most often for education about pathoanatomical information: *Muscle System Pro* (3D4Medical.com, LLC) 28 (20% uses, *DrawMD* [Visible Health, Inc]), 11 (7.9%) uses, and *Biomet Virtual Bone Model* (Biomet Inc), 8 (5.7%) uses. Education regarding patient movement or posture was predominantly conducted using the preloaded *Camera* app, 34 (24.3%) uses. Education relating to home exercise programs was predominantly completed using the *Safari* app, 11 (7.9%) uses, to access web-based resources such as HEP2go.²¹ (Note that percentages reported are the percent of app uses for all of patient education.)

Professional Communication

Participants recorded 68 uses of the tablets to support professional communication: communicating with clinical instructors, faculty, and other health care providers; sharing articles; and showing tablet features to colleagues (including tablet related in-service preparation and presentation).

Twenty two apps were used for professional communication. The majority of uses, 39 (57.4%), were distributed between 19 apps that were shared with colleagues.

Documentation

Users recorded 102 uses to support documentation. Most uses, 80 (78.4%) from 2 users, involved documenting directly into a web-based electronic medical record. A smaller number, 11 (10.8%), from 3 users, involved notes written for transfer later, via a desktop computer, to an electronic medical record incompatible with the tablet. Additional uses included accessing billing information, 6 (5.9%) uses, and taking a picture of a skin lesion for the medical record, 5 (4.9%) uses.

Five apps were used for documentation. The *Safari* app was used most, 80 (78.4%) uses, to access to web-based electronic medical records. Documentation written directly on the tablet was conducted using 2 apps: *Notepad* (Apple Inc), 6 (5.9%) uses, and *Notability* (Ginger Labs, Inc), 5 (4.9%) uses. Billing information was accessed via the *ICD-9 Consult* (Evian Schoenberg) app, 6 (5.9%) uses. Four uses (3.9%) involved the *Camera* app to document skin conditions.

Other

Participants reported 104 uses that were best categorized as “other.” The most common activity was treatment planning 28 (26.9%) uses, followed by organizing research articles 17 (16.3%) uses, and movement analysis 16 (15.4%) uses.

Thirteen (12.5%) uses involved translation for non-English-speaking patients.

Fourteen apps were used for “other” activities. *GoodReader* with 12 (11.5%) uses and *Penultimate* (Evernote) with 9 (8.7%) uses were frequently used to organize research articles (ie, pdf files). Movement analysis was most often conducted using *V1 Golf*, 11 (10.6%) uses, and the *Camera* app, 10 (9.6%) uses. *Nursery Rhymes Tap* (Little Ones Studio, LLC) was used 10 (9.6%) times in pediatric settings to facilitate patient distraction and/or direction of gaze.

User Comments—Successes and Challenges

Qualitative comments indicating success in using the tablets (the vast majority of comments) related to success finding clinically useful information, communicating with and educating patients, and sharing new knowledge with clinical instructors. For example, from the patient education category, “Found image of saphenous nerve distribution, and path of saphenous nerve to explain current symptoms to a patient” and from the Information Seeking category, “Literature search in 5 minutes on differential for progressive supranuclear palsy and Parkinson’s Disease—two articles found in five minutes via—Medical Library PubMed, discussed with CI [Clinical Instructor].” None of the users reported concerns from host facilities about use of the tablet in patient care setting once full disclosure of the project was communicated, including systems in place for security and patient privacy.

Challenges were fairly uncommon and generally related to apps not working as expected because the user lacked practice with the app, the app lacked needed features, or the app was malfunctioning. For example, from the patient education category, “Video was in slow motion and was too slow to be useful for movement education.” In addition, unsuccessful foreground searches were rarely associated with tablet malfunction. A representative unsuccessful search description: “Searched for article about varicose veins, DVT, and massage but was unsuccessful in finding what I was looking for.” Users reported concern about tablet theft or damage—though no theft or damage to the tablets occurred during the study.

Finally, one user completed a clinical experience in a remote location that did not have cellular or wireless access to the internet. She used apps that did not require an internet connection during the day and had to do most information seeking after work hours. As expected, this user had the lowest frequency of tablet use among participants.

DISCUSSION

Tablet computers, loaded with commercially available apps, were used daily by physical therapy students during their clinical experiences. Nearly half of all tablet uses were for information seeking. Two thirds of information seeking was for background medical information, one third for research articles and syntheses. Foreground searches took an average of 10 minutes and three quarters produced clinically useful information. Users reported a high frequency of tablet use to support patient education. Additional clinical uses included documentation and professional communication.

Our results are consistent with previous work suggesting that earlier generations of hand-held computer devices support

information seeking in clinical practice.^{12,13,22} Little research is available for the current generation of tablets. However, a recent study¹⁴ of physicians equipped with iPod Touches (Apple, Inc), which are smaller but otherwise similar devices to the iPad tablet, showed a lower successful search rate (25%-50%) and shorter average search time (2-5 minutes) compared with our findings. In addition, the rate of all foreground searches, 15% of tablet uses in this study, compares favorably to a pilot study²³ that found medical doctors conducted 0.46 search per month on average (using mobile and desktop computer systems). On the basis of 118 foreground searches, and data representing approximately 35 months of clinical practice, our users averaged a much higher, 3.4 searches per month. This rate is consistent with the designation of “regular searchers” in a large, ongoing implementation trial.²³ Thus, users in our study searched more often, were more successful, and spent more time than previous findings.

The patterns of use identified in this study suggest that tablet computers have the potential to impact the structural, patient, and social components of the practice environment in support of knowledge translation. The following 3 sections explore the potential impact on each area and provide hypotheses and suggestions for future research.

Structural Environment

The most powerful impact of the tablet may be on the structure of the practice environment (ie, physical structure, resources, and supplies). Users accessed the tablets on a daily basis, most often to support information seeking. Over one third of activity in our study was conducted directly on the internet (using the Safari app). Tablet computers gave users instant access to the internet—avoiding the barrier of having to interrupt their workflow to access a stationary (and often shared) computer terminal. Users created single-touch icons to access websites for information seeking using the “add to home screen” feature of the tablets. Table 4 lists the websites that our users selected for single-touch icons—providing insight into websites they prioritized for information seeking. Two thirds of uses involved specialized tablet apps. Apps such as *CORE—Clinical Orthopedic Exam* and *Nerve Whiz* apps provide extensive tablet-specific examination and diagnostic resources only available through mobile computing technology (ie, smart phones and tablets). We hypothesize that the introduction of tablet computers, with appropriate resources

and support, can increase physical therapists' engagement in information seeking, both background and foreground, and reduce the gap between what is known and what is done in patient care.

The use of tablets for documentation was observed as a major category of activity for our users. This type of activity could change the structural environment in 2 ways that promote knowledge translation. First, in combination with electronic health record technology, tablet technology may make accessing patient-specific information seamless with providing patient care. For example, tablet use among neurologists during rounds resulted in time savings for pre- and postround medical record processes and increased bedside time with patients.²⁴ Likewise, emergency physicians using tablets experienced a 38-minute reduction in computer workstation time per shift.²⁵ Whether the therapist is providing care in the rehabilitation gym, walking outdoors, or practicing in a stair well, the tablet could provide instant access to the patient's personal and medical information, enhancing therapists' ability to integrate this information into clinical decision making. Second, mobile clinical decision support tools are emerging as components of electronic health records.²⁶ Thus, in the future therapists may be able to access pertinent, synthesized research evidence and clinical decision support systems within the same mobile app. This would support the critical need to make knowledge access seamless with patient care.

It is important to note that the introduction of tablets into the structural environment of a clinical service could also have important drawbacks. In this study, student users received training, and had a primary person responsible for ensuring that the devices were functioning properly, a supportive information technology department, and funding to supply both tablets and a large number of apps. Many or all of these factors may be missing in a traditional clinical environment. In the absence of additional evidence, clinical managers will need to weigh the potential benefits to the structural environment against the drawback of resources required to provide the hardware, software, training, and support for tablet implementation. In addition, more training and support may be required for a general user population compared with the self-nominated young adults in this study. Finally, the landscape of technology security and risk associated with breaches of patient confidentiality is changing rapidly. Although our users were able to navigate HIPAA compliance concerns without difficulty,

Table 4. Websites Commonly Used for Information Seeking

Title (Author)	Website	Description
Norris Medical Library ^a (University of Southern California)	www.usc.edu/hsc/nml/	Portal for registered USC students to access electronic medical library resources including full-text articles
PT Now ^a (American Physical Therapy Association)	www.ptnow.org	Portal for APTA members to access clinical summaries, patient cases, descriptions of and evidence for tests and measures, clinical practice guidelines, Cochrane reviews, and searchable databases
Rehabilitation Measures Database (Rehabilitation Institute of Chicago)	www.rehabmeasures.org	Evidence-based summaries of evidence for instruments used to collect rehabilitation patient outcomes
Trip (Jon Brassey)	www.tripdatabase.com	Clinically oriented search engine for research evidence to support clinical practice

Abbreviations: APTA, American Physical Therapy Association; USC, University of Southern California.

^aRestricted access.

every user and/or facility will need to assess their own capacity to implement such a technology and provide for responsible protection of patient information and privacy.

Patients

We did not anticipate the extent to which the tablets would be used to support patient education and propose that such use may have a positive impact on knowledge translation efforts. The impact of patients' beliefs, health literacy, and engagement on therapists' success in knowledge translation is not a unique concept to the Ottawa Model of Research Utilization.²⁷ Patients can encourage knowledge translation by asking questions and participating in shared-decision making. We hypothesize that tablet use for patient education, as observed in our study, may increase patients' health literacy and ability to engage in shared decision making. For example, use of an anatomy app to educate a patient about his or her cerebellar stroke may enhance the patient's health literacy and propensity to engage in patient-therapist collaboration and the overall therapeutic process. Although such education does not require a tablet computer, the device and app may make the education process easier and more fruitful. In addition, our data suggest that access to tablet video/camera and movement analysis apps may facilitate movement re-education in ways not previously experienced in physical therapy practice.

It is important to acknowledge that the presence of an electronic device in the patient care environment also has the potential for negative effects. Although users did not report any episodes of patient dissatisfaction associated with the presence of the tablet computers in the clinical environment, there is certainly a need to explore the overall impact of hand-held computers on the patient-therapist relationship. Limited research on this topic among physicians has shown generally positive responses from patients.²⁸ Given the unique circumstances of the physical therapy care environment (longer, more frequent visits in an active setting), we propose that physical therapy or rehabilitation-specific investigations of patient reactions to therapist use of tablets are needed.

Social Environment

In addition to impacting the structural and patient aspects of the practice environment, our findings suggest that the tablet may influence the social environment as well. Users regularly reported sharing the features of their tablets and apps with colleagues. Previous work suggests that space for conversation and collaboration around research evidence is critical to creating a culture of knowledge translation in physical therapy practice.⁵ The ease with which a tablet's resources can be shared, both in conversation and electronically, may promote a culture of sharing and collaboration around knowledge translation.

Apps

Two important issues surfaced regarding apps to support knowledge translation. First, most physical therapy-specific apps commercially available during the study (2011-2012) were geared toward the outpatient orthopedic setting, leaving those in other settings wanting for more robust software options. The authors have compiled a list of

neurology-specific apps (though not endorsed by the authors) available as of May 2015 in Supplemental Digital Content 3 (<http://links.lww.com/JNPT/A129>). Second, there is not a standard for transparency with regard to the validity of the information provided in a given app. Nor, is there a standard method by which users can assess the validity of apps. We compared the content in apps with other knowledge sources, a general assessment of face validity, and rarely encountered errors in the app information. However, conscientious consumers of research evidence will generally find that the app environment leaves much to be desired with regard to transparency of source information. This problem presents an opportunity for advancement in the app industry through collaboration with implementation scientists.

Limitations and Future Research

Important limitations to consider in this cohort study include our small number of self-selected student users and the lack of a comparison group. Practice patterns vary between expert and average performing therapists²⁹ and certainly between students who volunteered for this study and the general population of licensed therapists. Replication of the study with licensed clinicians would likely result in differences related to *what* information users seek (eg, less background information) and *how* they do so (eg, possibly less familiarity with internet and app-based resources). Practicing clinicians as a group might also be less "tech-savvy," and without a comparison group we cannot say how observed activities compare to usual practice without a tablet. We also allowed 2 users to participate using their own tablet rather than the standardized university-owned tablet. These users' patterns of behavior were not recognizably different from their peers; however, complete uniformity would have been ideal. Naturally, a larger sample of users in even more diverse settings would be required for broad generalizability of our findings. There is also limited data to inform how tablets perform in areas such as neurologic and pediatric practice settings.

We relied on users to report their data (uses were not extracted from the devices directly). In addition, users' knowledge and the devices themselves (through new app installation) evolved over the course of the study. Thus, apps installed late in the study could have had a high rate of use but not have acquired sufficient uses overall to be recognized as highly used in our results.

Finally, we did not directly measure users' patient care behaviors or clinical decision making. Therefore, the direct impact of tablets on the implementation of knowledge accessed into practice is yet to be determined. However, our findings inform hypotheses about how tablets might support knowledge translation based on the structure provided by the Ottawa Model for Research Utilization. Future research should include a control group and primary outcome measure associated with evidence-based clinical decision making as the technology in question involves costs that need to be weighed against benefits before widespread implementation.

CONCLUSIONS

Physical therapy students used tablet computers, loaded with commercially available apps to support knowledge

translation, on 70% of their days in clinical practice, averaging 1.3 uses per day. Nearly half of all tablet use involved information seeking. Two thirds of information seeking was for general medical knowledge, and one-third for research evidence from peer-reviewed sources. The other categories of use were patient education, documentation, professional communication, and "other." The preloaded web browser app (*Safari*) accounted for over one third of all uses. Users accessed a total of 59 apps to support clinical practice. Our findings suggest that the tablet computer represents a potentially transformational tool for promoting knowledge translation in the clinical practice environment.

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