

Smartphone Use at a University Health Science Center

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ABSTRACT. This paper describes the results of a survey of library patrons conducted by librarians and IT specialists at the Health Science Center Libraries at the University of Florida. The purpose of the survey was to learn if and how library patrons were using smartphones to perform their work-related tasks and how patrons felt the library could support smartphone use at the Health Science Center.

KEYWORDS. Academic health sciences libraries, mobile devices, PDAs, smartphones

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INTRODUCTION

Smartphones have changed the way people communicate, as well as exchange and store data and images. In health sciences education and practice, smartphones have a unique set of uses and purposes. To understand current use, preferences, and future needs for smartphone support in an academic health science environment, the librarians and information technology (IT) specialists at the University of Florida's Health Science Center Libraries (HSCL) conducted a survey of faculty, students, and staff of the six Health Science Center (HSC) colleges. Two events in 2009 provided the impetus for this project. First, an emerging technology mini-grant focused on designing a website that contained vetted medical applications for smartphones was awarded to a librarian at the HSCL's Borland Library in Jacksonville, Florida. Second, the university's College of Pharmacy began requiring incoming first-year students to purchase either an iPhone or iPod Touch (iTouch) device to use throughout the curriculum. These events led to an examination of how the library could meet patrons' mobile application information needs. It is expected that the lessons learned from this study could apply to smartphone use and support at most other academic health center libraries.

LITERATURE REVIEW

A literature review was conducted to identify reported uses of smartphones in academic and medical settings for clinical, education, and research activities and to identify how librarians have supported patrons in the effective use of these devices. Personal Digital Assistants (PDAs) were included in the literature review because they are the forerunner to the smartphone.

However, PDAs do not have the operating systems of a smartphone and, therefore, are not capable of multitasking as smartphones do. Tablets were not included in the literature review because they made their debut in April 2010, which was after the initial research for this study was underway.

Clinical Use of Smartphones

The use of smartphones within the clinical setting is common among physicians, nurses, and other clinical staff. Blake noted that mobile phones have found a place not only in the academic setting, but as a tool for exchanging information and health promotion.¹ For many, the smartphone has become a multipurpose tool, replacing the need for a pager, cell phone, and personal digital assistant.²

Smartphones have a role in improving communication between clinical team members through their use as paging systems and in the transmission of patient information. Knobloch and colleagues studied the use of a multimedia messaging service (MMS) allowing the resident burn consultant to receive a real-time image regardless of location.³ These researchers found MMS transmission of JPEG images beneficial in terms of immediacy and efficiency, reducing the need for the burn consultant to call the on-site team back for further information, but also dependent on the quality of the cell phone network in use. Dala-Ali and colleagues demonstrated a success rate of 80% in recognizing gangrene in extremity wounds using both a camera phone and online communication.⁴ In this emergency setting, images were used to document injuries or lesions before applying the relevant dressing, thus preventing unnecessary dressing changes and providing the surgeon with visual evidence of the extent of the injury.⁴ Non-photographic images

are being conveyed for diagnostic use. CT scans are being sent for some oral and maxillofacial consultations, as the smartphone allows for instant access.⁵ Software designed for the iPhone (OsiriX and others) is used in radiology for viewing not only CT scans, but also MRIs, ultrasounds, fluoroscopy, and angiography studies. Although not yet approved by the FDA, the literature suggests that OsiriX may be an important step towards mobile medical diagnostic imaging.⁶

In addition to improving the speed and quality of communication, clinicians use smartphones to consult clinical information resources. As Leon and colleagues at the National Library of Medicine observe, “The most effective practice of evidence-based medicine occurs in real-time at the point of patient care since physicians rarely seek answers to clinical questions once the clinical session ends.” In their pilot study, 16 out of 31 physicians reported that the information obtained in real-time “frequently” had an impact on the diagnoses of patients.⁷ At Children’s Hospital Boston, smartphones are being used to access drug information and to communicate with colleagues on the hospital’s intranet.⁸ Applications and web browsing, both features of the smartphone, facilitate immediate access to evidence-based and reference resources. Applications range from drug databases such as Epocrates to diagnostic tools like EyePhone, an iPhone application which is a visual acuity test used in neurology.⁹

Despite positive innovations in smartphone technology, concerns relating to privacy remain when using smartphones in clinical practice. Can data such as personal health information (PHI) be kept safe in the event of theft or loss of a device? Busis notes that security-based applications and built-in security functionality are available across device platforms (e.g. Remote Wipe application for Microsoft Exchange-based systems and Apple’s MobileMe security features); however, malicious circumvention of these safeguards is always a possibility.

Sensitive patient data could also fall into the wrong hands during the transmission of data, patient or physician location via the global position system (GPS), phone calls made, or other functions, which may allow data leaks and the potential for patient identification.⁹

Beyond privacy, another concern is whether mobile phones are an emerging threat to infection control. As more smartphones are used in medical settings, the devices are exposed to more patients and can spread infection. In a 2011 study by Srikanth and colleagues, 94% of 87 mobile phones owned by healthcare workers or corporate workers contained bacterial growth. Of these, 74% had multiple types of bacterial growth and this was more likely on the phones owned by healthcare workers. A greater percentage of strains were found to be pathogenic on the corporate phones (29%) than those of the healthcare workers (17%).¹⁰

While the literature reports positive educational and productivity experiences with mobile devices, the blurring of work and personal responsibilities that comes with ownership of a smartphone is an issue that bears consideration. As health care providers are contacted beyond regular working hours, are they duty bound to respond to “urgent” messages when they are not on call? There are no clear guidelines, but Miller and colleagues suggest that most physicians do respond.¹¹

Use of Smartphones in Biomedical Research

Researchers are utilizing smartphones and PDAs in both their basic science and clinical research projects. In the laboratory setting, a variety of smartphone applications are available to perform such tasks as scientific graphing, examining 3D images of chemical compounds, assisting in the preparation of laboratory solutions, and viewing lab video tutorials.¹² Web-based tools designed

to perform DNA sequence analysis and visualization are also being made available on mobile platforms.¹³

In clinical and epidemiological settings, smartphones are proving their utility in the collection of research data. Smartphones are particularly useful in remotely collecting self-reported data from research participants at frequent time intervals; such real-time reporting can improve accuracy and specificity over retrospective reporting. For example, Henry and colleagues used Palm Pilots to survey individuals with the hearing disorder tinnitus several times per day over a two week period. The PDA sent an audible alert to participants, who were then asked a variety of questions about the severity of their condition as well as what they were doing at that particular time.¹⁴ Similar data collection methods have also been used to study children's physical activity and teenagers' substance use and sexual activity.^{15,16} Beyond the timing advantages to using smartphones for data collection, smartphones' built-in GPS features facilitate simultaneous collection of location data along with other survey-based data (e.g., to show the geographic distribution of bacterial pathogens).¹⁷

Use of Smartphones in Instruction and Education

Smartphones and PDAs are being used in health science education, particularly when students are in the clinical realm. In clinical settings, students' uses of smartphones often mirror those of their clinician counterparts, ranging from searching for information to taking notes and recording data to communicating with colleagues. At Utrecht University, for example, medical interns most frequently used their PDAs to search for information within guidelines, protocols, rules of thumb, or reference books and to take note of to-do items, questions from colleagues and

patients, and personal reflections.¹⁸ Similarly, Tempelhof's 2009 systematic review on PDA use among medical residents indicated that 90% of residents with PDAs used them to access drug information resources daily, 50% accessed electronic medical textbooks and clinical decision support systems daily, and 20-30% used them daily for patient care tasks such as retrieving laboratory values and tracking patients.¹⁹

Smartphones and PDAs may also be used in more formal educational contexts within the clinical realm. For instance, Ho and colleagues at the University of British Columbia studied the use of PDAs to record case logs, medical students' mechanism for keeping track of the clinical cases they see within their clerkship experience and communicating their learning portfolios to faculty. In comparing the use of paper-based case logs to PDA case logs, these researchers found that students using PDA case logs made 11 times more entries and were more likely to report that keeping a case log helped them learn. Reported reasons for this increased level of entry logging included the convenience of portable electronic data entry and the ease with which reflections and data could then be sent to faculty or referred to later by the student.²⁰ In a Duke University study, residents were invited to attend five midday educational conferences either in person or by watching a video podcast using an iPod. Both sets of residents were quizzed on the content of the educational conferences and the two groups received equivalent scores. Given equivalent levels of content retention for remote attendees, it was concluded that the podcast offered a viable alternative for residents wishing to maximize their educational conference attendance without violating resident work-hour mandates. The study also indicated a potential increase in resident participation in self-directed education.²¹ Nursing students have reported using PDAs and smartphones in various settings, including clinical areas, during class, and while

studying as well as for different purposes, including looking up information for families and for patients.²²

The Library's Role in Supporting Mobile Devices

Library literature reports on how libraries support the use of smartphones in the academic setting. Murphy observes that librarians have already moved into the mobile-ready communication arena with the adoption of text-messaging, also known as short-messaging service (SMS).²³ The “Ask-A-Librarian” chat service that many libraries utilize is an example of librarians and patrons communicating about a library’s collection or resolving a reference query via SMS. Cummings and colleagues conducted a survey with a dual purpose: to determine if their patrons wished to access the Washington State University librarians catalog via their mobile device and to discern what impact mobile computing was having on academic libraries. Over 50% of their respondents said they would utilize a small screen device to access the library’s resources.²⁴ Library support for smartphone users has been on the increase as users request mobile access to information that has been available through library databases and computers. Responses to these requests have implications for budgets and use of library staff time. Terry provides an overview of the medical apps market, describing their different features and costs. Apps like Diagnosarus, Epocrates, and Skyscape offer ease of use, low cost, and diverse content.²⁵ Cuddy discusses the iPhone in terms of its use in medical libraries and concludes that “it is inevitable the iPhone will have an impact on the way medical libraries deliver services to their users.”²⁶ Gebb²⁷ suggests that libraries could support patrons’ use of smartphones with the

creation of online tools that offer instruction and guidelines about using different devices, and applications designed for specific smartphone platforms.²⁷

It is clear from these studies that smartphone use is revolutionizing how medical personnel conduct the practice of health care and that smartphones have a role in medical education and research. The goals of this study were to determine how the diverse population of the University of Florida's academic health center currently use their smartphones, what these clients see as potential uses for such technology, and then determine how librarians can support smartphone use.

METHODOLOGY

A survey was developed to capture information on respondent demographics (college, department, patron status), current and future planned smartphone ownership, applications used in their work (clinical, research, instructional), future needs, and the library's role (see the Appendix). The first widely used tablet, the iPad, made its debut in April 2010 which was after the initial research for this study was underway; therefore, tablets were not included in the survey. The survey was built in SurveyMonkey™ and administered over e-mail in November 2010. The survey was also linked to the HSCL's homepage. Because the initial survey did not include skip logic, a second iteration of the survey with the same content with the addition of skip logic was released in December 2010. Between the two releases the survey was sent to approximately 9,410 faculty, students, staff, residents and post-docs of the six colleges (Dentistry, Medicine, Nursing, Pharmacy, Public Health and Health Professions, and Veterinary Medicine) of the Health Science Center.

A total of 432 patrons participated in the 13-question survey for a response rate of 4.49% (see Figure 1). Objective survey responses were subjected to basic summary statistics. The open-ended responses were categorized by whether smartphones were used for administrative functions, teaching, library services and resources, clinical functions, research functions, named products, or named platforms. Connectivity and policy concerns were also noted.

[PLACE FIGURE 1 HERE]

Legend: FIGURE 1. Respondent Demographics by College

RESULTS

Responses from the 432 survey participants represented all six health science colleges: 61 (14.0%) were from Dentistry, 134 (30.8%) from Medicine, 43 (9.9%) from Nursing, 103 (23.7%) from Pharmacy, 47 (10.8%) from Public Health and Health Professions, 34 (7.8%) from Veterinary Medicine and 10 (2.3%) from other non-health science colleges. Of the 428 respondents who answered the question about their status at the HSC, 218 (50.9%) were students, 132 (30.8%) were faculty, 54 (12.6%) were staff, 13 (3.0%) were residents and 11 (2.5%) were post-doctoral associates (see Figure 2).

[PLACE FIGURE 2 HERE]

Legend: FIGURE 2. Respondent Demographics by Status

Of the 367 who responded to the question about the kind of phone they own, 194 (51.5%) have an iPhone or iTouch device, 90 (46.3%) an Android, 60 (30.9%) a Blackberry, 14 (7.2%) a Palm, and 17 (8.7%) other devices (see Figure 3). Four faculty members, one resident, and four students each reported having two devices. Out of the 194 iPhone or iTouch users, 115 (59.3%) were students. The largest group of students using an iPhone or iTouch device was pharmacy students at 79 (69.0%).

[PLACE FIGURE 3 HERE]

Legend: FIGURE 3. Respondent Demographics by Platform

Current Smartphone Use

Three hundred thirty-eight respondents answered Question 8 “If you currently own a smartphone, do you have mobile apps on your phone to assist you in your clinical duties?” One hundred forty-one (41.7%) indicated they do and 139 identified specific applications. Apps mentioned ten or more times included Epocrates, Medscape, Lexi-Comp, Clinical Pharmacology, and Micromedex. Additional responses to this question are included in Table 1. Responses to this question came primarily from the Colleges of Pharmacy (38.9%), Medicine (25.2%), and Nursing (15.1%).

[PLACE TABLE 1 HERE]

Legend: TABLE 1. Mobile Applications Most Frequently Used to Assist in Work-Related Duties

When asked “If you currently own a smartphone, do you have mobile apps on your phone to assist you in your research duties?” 328 responded to the question. Of these, 105 (32.3%) respondents answered “yes” and 86 of them identified specific applications. Apps mentioned ten or more times included Epocrates, Medscape, and PubMed. Additional responses to this question are included in Table 1. Some responses identified laboratory tools, appliances or sources for scientific literature (e.g., “Sound level meter,” “timer,” “measurement unit converter,” “Pubmed,” “vaccines,” “biogene,” “plos”). These responses indicate patrons want apps for handheld converters and registers, as well as tools for communication and to organize the references they have already located. Attempting to locate apps that accomplish one or more of these services together is just one of the challenges facing librarians.

Three hundred twenty-five respondents answered Question 10, “If you currently own a smartphone, do you have mobile apps on your phone to assist you in your instructional duties?” Of these 50 (15.3%) answered “yes” and 32 of them identified specific applications. As with Question 9, there was a low response rate when asked to name specific apps used for instructional duties. No single named product was mentioned ten or more times; the most frequently mentioned app was Epocrates. Additional responses to this question are included in Table 1. Since this question was about instruction, there may have been confusion by the respondents regarding what was considered “instruction.” The term could have been interpreted to mean to teach or instruct individuals in a certain subject or task or to be instructed or taught. The types of responses referred to both meanings. For example, one faculty member listed “Responseware” referring to an application that allows an audience (most often students) to

respond in real time to a question posed by the instructor. An answer from a student was “listen to lectures,” suggesting more focus on accessing and learning class content.

Customized Menu of Evaluated Mobile Apps

When patrons were asked in Question 11, “Would you find a customized menu of evaluated mobile apps useful?” a total of 351 patrons responded. Of these, 334 (95.1%) indicated “yes,” affirming that a customized menu would be useful.

Future Smartphone Use and Library Support for Smartphones

One hundred and eighty-three participants responded to Question 12, the open-ended question, “What work-related tasks would you like to be able to perform with your smartphone?”

Responses were grouped into 78 narrow categories related to specific uses, named products, or named platforms. The specific tasks most frequently reported included: accessing drug information resources (16.9%), using literature databases (15.3%), accessing e-mail (12.6%), accessing full-text of journal articles (12.0%), performing miscellaneous clinical tasks (8.7%), accessing patients’ electronic health records (6.6%), calculating lab values (6.6%), finding information on particular diseases or diagnoses (6.0%), and performing miscellaneous administrative tasks (5.5%).

For the purposes of broader analysis, narrow categories were grouped into functional themes: administration (e.g., e-mail, access work files), teaching (e.g., student assessment, access course information), library (e.g., journal access, citation managers), clinical (e.g., drug

information, decision support), research (e.g., access lab databases, statistical packages), connectivity (e.g., network login, wireless access), and policy (e.g., departmental or university requirements regarding device selection), as well as named products and named platforms. Any one response may have been assigned to multiple categories, depending on its content. Results of this analysis are presented in Figure 4. The most common themes were clinical tasks (35.3%), administrative tasks (32.6%), and library-related tasks (27.2%).

[PLACE FIGURE 4 HERE]

Legend: FIGURE 4. Work-Related Tasks Respondents Would Like to be Able to Perform and Suggested HSC Library Support

There were 143 responses to Question 13, the open-ended question, “How might the Health Science Center Libraries support you in the use of your smartphone?” Responses were assigned to the same categories as were used in Question 12. The specific ways respondents most frequently mentioned the HSCL supporting them in use of their smartphones included: providing access to literature databases (15.4%), developing a mobile-friendly version of the HSCL’s website (14.7%), recommending or sending notification of relevant apps (10.5%), improving connectivity (10.4%), providing access to full-text electronic journals (9.1%), and providing a mobile version of PubMed (7.7%).

The responses were also analyzed using the same functional themes as were used in Question 12, and the results of this analysis are presented in Figure 4. The most common themes were library-related tasks (57.2%), named products (16.6%), and “don’t know” (13.1%). Two of the most common themes from Question 12, clinical tasks and administrative tasks, were far less

common in response to this question only 7.6% of responses addressed clinical tasks and 6.9% addressed administrative tasks.

DISCUSSION

The results illustrate the perceptions of a cross section of the HSC colleges, with representation from clinical, instructional and research realms. The survey included information about respondents' academic status (student, faculty member, staff member, post-doctoral associate, or resident) to determine if there were patterns in smartphone use by different types of users. Students were the largest group of respondents, followed by faculty, mirroring their respective population sizes. Fewer responses came from staff, post-doctoral associates, and residents, possibly because they are not included on departmental distribution lists and library outreach has traditionally focused less on these groups.

iPhones and iTouch devices were particularly prevalent among the respondents, more so than in the wider smartphone market. 51.5% of respondents owned these devices as compared to Apple's 25.3% market share during this time period.²⁸ This discrepancy likely reflects the College of Pharmacy's 2009 requirement for its students to use an iPhone or iTouch device, coupled with the relatively high response rate from that college (23.7%). At present, no other Health Science Center college requires students to have a mobile device.

Basic science researchers and students were identified through departmental and program affiliations, a cohort that numbered 75 individuals (17.4% of total respondents). Unsurprisingly, this basic science group had little use for resources considered clinical, with only four individuals naming such products (Micromedex, Epocrates, Medscape, MedRef) in response to

any of the questions. Overall, responses from the basic science population tended to be very individualized, with few named products (aside from PubMed) shared among respondents. One such site, Qiagen (two respondents), provides information on molecular sample and assay technologies such as polymerase chain reaction, gene expression analysis and genotyping and is typical of the very specific nature of basic science information needs. Tasks and applications related to bioinformatics, data sharing, and collaboration were noted only by those individuals identified as basic scientists.

PubMed was the one named product listed by multiple members of the basic science cohort. Of the 26 basic science respondents to Question 9 (apps currently used for research), six (23.1%) reported using a PubMed mobile app for research. Of the 59 non-basic science respondents who answered the question, eight (13.6%) indicated they use such an app. Although the sample sizes are much smaller, similar results were seen for Question 10, in which two of 10 (20.0%) basic science respondents reported using a PubMed app for their educational work, with one of 21 non-basic scientists (4.8%) reporting the same. Finally, Question 11 yielded a similar response pattern, with four of 31 (12.9%) basic scientists wanting to be able to use a PubMed app for their work and seven of 138 (5.1%) non-basic scientists responding in kind. These numbers suggest a strong difference between basic scientists and clinicians/clinical students in either the way they use their mobile devices or their level of reliance on PubMed. Given the small sample sizes, it is not possible to conclusively demonstrate these differences; however, this area of inquiry remains an interesting topic for future research.

As described in the Results section, 38.8% of respondents who reported using apps for clinical duties were from the College of Pharmacy. This could be a potential explanation of why drug information and drug-related products were so frequently mentioned. In addition, the high

number of respondents to this question who have Epocrates (n=97) may be a result of the free version that is available and also a student version of Epocrates, which is provided by the College of Medicine to its faculty, third- and fourth-year students, and residents. Apps from trusted sources such as the National Library of Medicine (PubMed for Handhelds) were among the most downloaded and used. Some results from survey questions 8 through 10 are consistent with the current literature detailing the types of available applications and their use within the academic health sciences environment. Many respondents alluded to using their smartphones to find drug information, especially using the application Epocrates; reference to drug information on mobile devices has been discussed frequently in the literature.^{4, 7, 9, 25}

Of interest are some of the applications that are little mentioned or absent within the survey results, yet are mentioned throughout the literature, such as imaging tools used for transferring patient information.^{3, 5, 6} It is possible that imaging tools were not mentioned due to problems accessing images connected to patient records in the electronic health records (EHR) on various devices, and also possibly because of the limitations common to smaller handheld devices. At present, the size of the average smartphone display window is roughly 3.5-4.5 inches.²⁹ This is a small size to accurately view an image such as a radiograph or dissection. With the popular use of iPad and tablets the issue of image clarity may be solved.

Numerous administrative tasks were listed as work-related tasks in responses to Questions 12 and 13. While the HSCL librarians expected responses that were primarily clinical, educational, or research-related in nature, many respondents listed apps related to e-mail, calendars, schedule alerts, and the classroom reservation system, demonstrating that respondents are using their smartphones for managing their overall work environment. These responses suggest that administrative uses to accomplish or augment work-related tasks are important to

health sciences patrons. This broader range of smartphone uses must be taken into consideration when developing a library-based support system for HSC smartphone users.

A possible role that emerged from the survey responses is for the HSCL to serve as a clearinghouse of vetted smartphone applications and services. The high percentage of affirmative responses 334 (95.1%) to Question 11 indicates that the development of a menu of evaluated mobile apps is desired by users and suggests a starting point for the HSCL: the development of a list of evaluated apps available by type of device, apps that are free or highlighting apps that are already available through the libraries' paid subscriptions to resources such as MDConsult's mobile version. Respondents' interest in this kind of input from the library is further evidenced by comments in Question 13 regarding ways the HSCL could help support smartphone use, such as:

- “An evaluation of the different apps available would be nice.”
- “Help us get apps to the databases you have.”
- “First, educate us as to what's available. We all know bits and pieces.”

In order to move in this direction, Gebb identified three aspects to consider when evaluating mobile apps: content, platform, and usability.²⁷ “Content” refers to coverage, authority, and ability to be accessed and utilized at the point of care; “platform” addresses the operating system of the smartphone in question; and “usability” means the application must be intuitive and user-friendly.²⁷ The issues relating to mobile applications that the HSCL's patrons have identified as of immediate concern mirror those identified by Gebb: content, which addresses the veracity of an app and the type of content offered; platforms, assistance with basic understanding of the many smartphones operating systems available and what apps will operate effectively on their device; and, finally, usability, which at its most basic is instructing the user

how to operate specific functions on their chosen device, as well as directing them to resources that provide additional information on the more “high level” device functionality.

Instruction was also mentioned by Gebb as a final aspect librarians must consider when planning to support their patrons’ use of mobile devices. The HSCL librarians are using the information gathered by this survey as a way to outline an instructional workshop or program that would provide reliable and authoritative information on the use of smartphones.

Another instructive set of results involved the discrepancies between the types of tasks respondents wanted to be able to perform on their smartphones (as indicated by responses to Question 12) and the ways respondents envisioned the library supporting their smartphone use (as indicated by responses to Question 13. For many respondents (32.6%), performing administrative tasks was an important aspect of using their smartphones, but relatively few (6.9%) saw a role for library assistance in this kind of task. This is not necessarily unexpected as the library currently has little role in helping patrons with their general administrative needs such as e-mail and scheduling; these are generally supported at the college or department level. Inversely, while a number of respondents (27.2%) initially identified library-related tasks that they would like to be able to perform on their smartphones, far more (57.2%) saw a role for the library in providing support for these types of tasks. This is also understandable; when specifically asked how the library can help them with their smartphones, patrons were prompted to think about traditional library service areas such as access to literature databases and information evaluation. Finally, many respondents (35.3%) highlighted the importance of being able to perform clinical tasks on their smartphones, but few (7.6%) saw a role for the library in supporting this kind of work. This may be explained in part by the fact that the HSCL historically did not provide direct support for clinical clients. Recently, however, the library has

been developing stronger partnerships with clinicians, particularly through the introduction of two new positions: Clinical Research Librarian and Consumer Health and Community Engagement Librarian. The HSCL clearly has work to do in communicating new clinician-focused services to patrons and changing their perceptions of how the library can be involved in supporting their clinical work.³⁰

For both Questions 12 and 13, a common request was for an application for searching all the library's electronic resources (i.e., "Create an app to search library"). Patrons believe this is something the library can create internally, but a single federated search application would be difficult to develop, given the variation in the current interfaces of subscription databases. The HSCL IT staff point out that the inconsistency of internal database field names for such things as title, year, quarter, edition, etc., and the frequency at which these field names may change for the same search tool would dictate that such an application must be updated very frequently. For a project such as this to be possible and effective, an official and well-defined relationship between the HSCL and the vendor must exist such that the vendor provides for constant communication and disclosure of their search engine inner-workings. However, there are other opportunities for IT staff involvement.

The Health Science Center Libraries' IT staff is experienced with troubleshooting problems that arise with patrons' mobile devices. These specialists could also serve as technical advisors to the librarians and as liaisons to the wireless infrastructure providers. In addition, their expertise and perspective would be advantageous on an HSC committee seeking to identify recurring connectivity issues and potential solutions.

As the HSCL moves forward in responding to the needs and preferences of smartphone and other mobile device users, HSCL librarians and IT staff will also look to the current

experiences of colleagues at other libraries. A number of health sciences libraries have developed a mobile presence, ranging from creating a mobile website,³¹ to highlight mobile versions of common databases and resources,³² to recommending specific mobile applications by platform and subject area.^{33,34} Another major thrust for health sciences libraries currently engaging with mobile technology is the use of tablets for a wide variety of educational and outreach purposes. Institutions like the University of Southern California are lending iPads and other tablets to faculty in clinical settings and learning how they use them.³⁵ Others, like the University of Central Florida, are involved in initiatives to give tablets to medical students and are evaluating the impact of these devices on the students' use of library resources.³⁶ Librarians are also using tablets to reach out to users in more remote locations; for example, outreach librarians in Maryland used iPads to demonstrate dental consumer health resources at fairs,³⁷ and SUNY Upstate Medical University used iPads and mobile applications to engage with members of a wide-ranging Emergency Preparedness Regional Partnership.³⁸ Librarians at the University of Utah's Spencer S. Eccles Health Sciences Library developed a technology-based course for the students in their pediatric clinical rotation focusing on the students' use of mobile devices during their rotations.³⁹ These examples can certainly help guide the HSCL's future efforts in supporting the UF community's use of mobile technology.

RESPONSE AND FUTURE PLANS

There are several new roles and new possibilities for librarians and IT specialists suggested by the survey responses. These include developing and marketing new and existing resources, such as the librarians providing workshops on specific devices and the apps that work best for a

particular device or offering a class on the mobile counterparts of existing databases, such as PubMed Handheld and MDConsult to examine and learn how much can be accomplished with these resources. Other possibilities include providing up-to-date information, links or RSS feeds for medical specialties or procedures, technical support for smartphones, advocacy for patrons (particularly related to connectivity and accessibility, and with vendors), evaluation of relevant apps, and patron education with workshops or programs to learn or expand their knowledge about the devices they have and use. The survey provided HSCL librarians with a rich source of data, not only about the patrons themselves, but how they use their smartphones on a daily basis. It is clear that the HSCL's patrons see a role for the library in furthering this endeavor. In addition, it is possible that the role of librarians may be broader and more varied than the one they envisioned. As mentioned earlier, librarians and library IT professionals can provide guidance, instruction to patrons on resources intended for clinical and administrative functions, and also advocate for patron interests with campus IT departments and content providers.

This survey and the responses it garnered reflect HSCL patrons' desire for more smartphone support in selecting vetted applications and training on the device. The HSCL librarians have a basic knowledge regarding smartphones because each librarian has one of the devices operating on different platforms. The next steps will be for HSCL librarians and IT staff to develop a plan to address the patrons' identified needs including workshops, marketing the library's existing mobile friendly resources and continued monitoring of the use of devices in the academic health center.

In light of the useful information provided by survey respondents, the HSCL has formed a Mobile Technology Team that will work on implementing many of their suggestions, as well as anticipating current and future roles the library can play in supporting their use of mobile

technology. This team includes some members of the group who developed and analyzed the responses from the 2010 survey reported on in this paper, as well as new team members from various departments—including librarians, library IT experts, and paraprofessionals—to provide a fresh perspective as this project moves forward. Liaison librarians have already started to add information to subject and course guides about mobile versions available for some resources; the Mobile Technology Team is also developing a general guide or webpage to collect these resources in one place, since the overwhelming majority of responses to the survey question about a customized menu of mobile apps indicated this would be a useful resource. The team is surveying HSCL patrons again in fall 2012, with a focus on use of tablets and other mobile technologies. The IT experts in the HSCL Systems department are also currently working to update the library's website. Included in these plans are a library website designed to function on smartphones, which will directly address the concerns of survey respondents to Question 13 who requested a mobile-friendly version of the HSCL's website.

CONCLUSION

Other health science libraries are facing the same rapidly changing technological environment and are responding in a variety of ways including creating mobile-friendly websites, offering training on mobile apps and devices, developing guides of evaluated apps, lending mobile devices, and creating library apps. While the data collected from this survey represents the characteristics of the University of Florida HSCL's unique patron population, their current use of and predicted needs for mobile resources and support also reflect wider trends. The widespread use of smartphones among all groups in the academic health sciences population, openness

among these user groups to librarians and library IT professionals in a supportive role, and the opportunity to provide support and services not currently envisioned by library patrons may be reflected at other institutions. Given the changing technological environment and evolving user needs, it is vital that libraries engage in an ongoing process of eliciting user feedback. Using a similar method to elicit feedback across a wide spectrum of potential library users may provide librarians elsewhere with a more nuanced understanding of their own patron population's needs.

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REFERENCES

1. Blake, H. "Innovation in Practice: Mobile Phone Technology in Patient Care." *British Journal of Community Nursing* 13 (2008): 160-165.
2. Burdette, S.D., T.E. Herchline, and R. Oehler. "Surfing the Web: Practicing Medicine in a Technological Age: Using Smartphones in Clinical Practice." *Clinical of Infectious Diseases* 47 (July 1, 2008): 117-122.
3. Knobloch, K., H. Rennekampff, and P.M. Vogt. "Cell-phone Based Multimedia Messaging Service (MMS) and Burn Injuries." *Burns* 35 (December 2009): 1191-1193.
4. Dala-Ali, B.M., M.A. Lloyd, and Y. Al-Abed. "The Uses of the iPhone for Surgeons." *Surgeon* 9 (February 2011): 44-48.

5. Aziz, S.R., and V.B. Ziccardi. "Telemedicine Using Smartphones for Oral and Maxillofacial Surgery Consultation, Communication, and Treatment Planning." *Journal of Oral and Maxillofacial Surgery* 11, no. 67 (2009): 2505-2509.
6. Choudhri, A., and M. Radvany. "Initial Experience with a Handheld Device Digital Imaging and Communications in Medicine Viewer: OsiriX Mobile on the iPhone." *Journal of Digital Imaging* 24, no.2 (2011): 184-189.
7. Leon, S.A., P. Fontelo, L. Green, M. Ackerman, and F. Liu. "Evidence-based Medicine among Internal Medicine Residents in a Community Hospital Program Using Smartphones." *BMC Medical Informatics and Decision Making* 21, no. 7 (February 2007): 1-11.
8. Gamble, K.H. "Trend: Smartphones." *Healthcare Informatics* 24, no. 2. (February 2010): 24-27.
9. Busis, N. "Mobile Phones to Improve the Practice of Neurology." *Neurologic Clinics* 28, no. 2 (May 2010): 395-410.
10. Srikanth, P., E. Rajaram, S. Sudharsanam, A. Lakshmanan, U. Mariappan, and K. Jagannathan. "Mobile Phones: Emerging Threat for Infection Control." *Journal of Infection Prevention* 11, no. 3 (2010): 87-90.
11. Miller, R.E., S. Boyce, and J.S. Whelan. "Mobile Phone Use Within an Oncology Department." *Clinical Oncology (Royal College of Radiologists)* 22, no. 1 (February 2010): 86-87.
12. Baumgart, D.C. "Smartphones in Clinical Practice, Medical Education, and Research." *Archives of Internal Medicine* 171, no. 14 (2011): 1294-1296.
13. Singer, G.A.C., and M. Hajibabaei. "Web-based Molecular Biodiversity Analysis." *BMC Bioinformatics* 10, Supplement 6 (2009): S6-S14.

14. Henry, J.A., G. Galvez, M.B. Turbin, E.J. Thielman, G.P. McMillan, and J.A. Istvan. "Pilot Study to Evaluate Ecological Momentary Assessment of Tinnitus." *Ear and Hearing* 32, no. 2 (March-April 2012): 279-290.
15. Dunton, G.F., Y. Liao, S.S. Intille, D. Spruijt-Metz, and M. Pentz. "Investigating Children's Physical Activity and Sedentary Behavior using Ecological Momentary Assessment with Mobile Phones." *Obesity* 19, no. 6 (June 2011): 1205-1212.
16. Shrier, L.A., C. Walls, C. Lops, A.D. Kendall, and E.A. Blood. "Substance Use, Sexual Intercourse, and Condom Nonuse Among Depressed Adolescents and Young Adults." *The Journal of Adolescent Health* 50, no. 3 (March 2012): 264-270.
17. Aanensen, D.M., D.M. Huntley, E.J. Feil, F. al-Own, and B.G. Spratt. "EpiCollect: Linking Smartphones to Web Applications for Epidemiology, Ecology and Community Data Collection." *PLoS One* 4, no. 9 (September 2009): e6968.
18. Akkerman, S., and R. Filius. "The Use of Personal Digital Assistants as Tools for Work-based Learning in Clinical Internships." *Journal of Research on Technology in Education* 43, no. 4 (2011): 325-341.
19. Tempelhof, M.W. "Personal Digital Assistants: A Review of Current and Potential Utilization Among Medical Residents." *Teaching and Learning in Medicine* 21, no. 2 (2009): 100-104.
20. Ho, K., H.N. Lauscher, M. Broudo et al. "The Impact of a Personal Digital Assistant (PDA) Case Log in a Medical Student Clerkship." *Teaching and Learning in Medicine* 21, no. 4 (2009): 318-326.

21. Tempelhof, M.W., K.S. Garman, M.K. Langman, and M.B. Adams. "Leveraging Time and Learning Style, iPod vs. Realtime Attendance at a Series of Medicine Residents Conferences: A Randomized Controlled Trial." *Informatics in Primary Care* 17, no. 2 (2009): 87-94.
22. Beard, K.V., S. Greenfield, E.S. Morote, and R. Walter. "Mobile Technology: Lessons Learned Along the Way." *Nurse Educator* 36, no. 3 (2011): 103-106.
23. Murphy, J. "Using Mobile Devices for Research: Smartphones, Databases and Libraries." *Online* 34 no. 3 (2010): 14-18.
24. Cummings, J., A. Merrill, and S. Borrelli. "The Use of Handheld Mobile Devices: Their Impact and Implications for Library Services." *Library Hi Tech* 28, no. 1 (2010): 22-40.
25. Terry, M. "Medical Apps for Smartphones." *Telemedicine and e-Health* 16, no. 1 (January/February 2010): 17-22.
26. Cuddy, C. "The iPhone in Medical Libraries." *Journal of Electronic Resources in Medical Libraries* 5, no. 3 (2008): 287-292.
27. Gebb, B.A. "Library Support for Mobile Device Projects." *Journal of Electronic Resources in Medical Libraries* 7, no. 2 (2010): 165-170.
28. "Mobile Phones – US." Mintel Reports Database (February 2011). <http://oxygen.mintel.com>.
29. Seshan, B. "Top 10 Smartphones with Large Screen Size." *International Business Times* (November 25, 2011). <http://www.ibtimes.com/top-10-smartphones-large-screen-size-374664>.
30. Tennant, M.R.; Auten, B.; Botero, C.E. et al. "Changing the Face of Reference: Adapting Biomedical and Health Information Services for the Classroom, Clinic, and Beyond." *Medical Reference Services Quarterly* 31, no. 3 (July-September 2012): 280-301.
31. The Spencer S. Eccles Health Sciences Library. "EHSL Mobile Home Page." Accessed August 23, 2012. <http://m.library.med.utah.edu/index.php>.

32. University of Pittsburgh Health Sciences Library System. "Mobile Apps." Accessed August 23, 2012. <http://www.hsls.pitt.edu/clinical/mobile>.
33. Himmelfarb Health Sciences Library. "Mobile/Handheld Resources." Accessed August 23, 2012. <http://libguides.gwumc.edu/mobile>.
34. University of Michigan Library. "Health Sciences Mobile Devices Resources." Accessed August 23, 2012. <http://guides.lib.umich.edu/content.php?pid=116930&sid=1170352>.
35. Brennan, M., and E. Eandi. "Keeping Score: Use of iPads by Clinical Faculty." Contributed paper presented at the Annual Meeting of the Medical Library Association, Seattle, WA, May 20, 2012.
36. Dexter, N., S. Gillum, M. Garner, and D.J. Walton. "The iPad: A Game-Changer for Accessing Library e-Resources." Poster presented at the Annual Meeting of the Medical Library Association, Seattle, WA, May 21, 2012.
37. Solomon, M.I., and A.L. Tatro. "Putting the Teeth in Outreach: Patient Education at Free Rural Dental Clinic Using Mobile Devices." Poster presented at the Annual Meeting of the Medical Library Association, Minneapolis, MN, May 17, 2011.
38. Pope, C.A., and D.K. Sowles. "Emergency Preparedness Resource." Contributed paper presented at the Annual Meeting of the Medical Library Association, Seattle, WA, May 20, 2012.
39. Le Ber, J.M., and N.T. Lombardo. "Evolving Technologies Support Mobile and Collaborative Curriculum: A Case Study." *Medical Reference Services Quarterly* 31, no. 2 (April-June 2012): 150-158.

Appendix

HSCL Smartphone Survey

1. What is your College?

- Dentistry
- Medicine
- Nursing
- Pharmacy
- Public Health and Health Professions
- Veterinary Medicine
- Other

2. What Department? (open-ended)

3. What is your status?

- Faculty
- Resident
- Post-Doctoral Associate
- Staff
- Student

4. Do you currently own a smartphone? If No, skip to #6

- Yes
- No

5. If yes, what kind?

- Android

- Blackberry
- iPhone/iTouch
- Palm
- Other

6. Do you plan on buying a smartphone within the next 6 months? If No, thank you for participating in our survey.

- Yes
- No

7. If yes, what kind?

- Android
- Blackberry
- iPhone/iTouch
- Palm
- Other

8. If you currently own a smartphone, do you have mobile apps on your phone to assist you in your clinical duties? (open-ended)

9. If you currently own a smartphone, do you have mobile apps on your phone to assist you in your research duties? (open-ended)

10. If you currently own a smartphone, do you have mobile apps on your phone to assist you in your clinical duties? (open-ended)

11. Would you find a customized menu of evaluated mobile apps useful?

- Yes
- No

12. What work-related tasks would you like to be able to perform with your smartphone? (open-ended)

13. How might the Health Science Center Libraries support you in the use of your smartphone? (open-ended)