SMARTPHONE USE AND PERCEPTIONS AMONG MEDICAL STUDENTS AND PRACTICING PHYSICIANS

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Background: Smartphones have become mainstream, including in the healthcare setting. However, little formal research has been performed to examine mobile medical technology.

Aims: To examine smartphone use and perceptions among medical students and physicians in a statewide medical university.

Methodology: An IRB approved 23-item survey eliciting smartphone use and perceptions was developed by the research team and an e-mail invitation for participation was sent to all medical students, resident and attending physicians in three medical schools.

Results: A total of 544 surveys were submitted; 347 were completed and analyzed. 93.9% of respondents had smartphones, with no significant difference between students and physicians. Of those with the technology, 82.9% stated they have used it at least once in a clinical setting. Respondents perceived fast access to information to be the greatest benefit to mobile medical technology (96.6%), as well as simplified access (75.5%). Greatest perceived barriers to using this technology were uncertainty about available applications (39.4%) and inexperience (23.4%). There was no significant difference between students and physicians with regard to either category. Concerning patient-centered applications, assistance with lifestyle modification (78.8%) and increased adherence to treatment plans (73.8%) were agreed upon as potential benefits. Greatest perceived barriers to recommending this technology were added cost to the patient (52.6%) and concerns about patient self-diagnosis (47.7%), with no significant difference found between students and physicians.

Conclusion: These data demonstrate smartphone usage is prominent in the healthcare setting and indicates strong agreement regarding its benefits and barriers. Implementing smartphone education into medical curricula may be beneficial to healthcare providers.

Background

As folks from the 1920s brought into existence words like "flapper" to describe the world around them, so have we in the 21st Century. Today cellular phones define our generation and allow us to add a new word to our vocabulary. The word *nomophobia*, the fear of being without one's mobile phone, should be particularly exciting to health practitioners as it

may be used to our advantage to decrease morbidity and mortality of disease.[1] While some interventions using mobile phones and other handheld devices have already proven successful, the use of such technology in healthcare is still in its infancy.[2–5] Since few studies have explored such technology in American medical practice, this study aimed to examine not only its usage among osteopathic and allopathic physicians and students, but also perceptions of its use.

While mobile software applications run the gamut from gaming to personal organization, there are a number of applications that pertain to health and medicine. Directed at both physician and patient, a variety of applications exist to aid people with everything from brushing up on a procedure to tracking and managing chronic disease. Presently, there are approximately 7,136 health and medicine applications for Apple's iOS operating system, 1,296 for Google's Android operating system, and 338 for Research in Motion's BlackBerry operating system.[6]

Medical applications may prove rather helpful to physician and patient alike, in a variety of ways:

- *Storage*. Since many individuals keep their phone with them at all times, they can serve as hard-to-lose repositories of personal health information, including glucometer readings, blood pressure tracking, and beyond.[1] With wireless Internet capabilities, data can be seamlessly stored and retrieved on personal hard drives or be sent to wherever they are required.[7]
- *Consultation*. Physicians can use application software to consult with other distant health professionals using video and picture messaging on their smartphones, as described in the medical literature.[2]
- *Reference*. Medical students and residents have the opportunity to learn about new topics while rotating on hospital wards; and experienced physicians may find particular applications helpful if they encounter an unfamiliar condition or procedure.[8,9]
- *Billing*. Applications such as ICD-9 can allow physicians to speed through the inevitable paperwork portion of medicine, reducing both patient wait times and medical waste.[8]

However, with these perceived benefits come equally perceived barriers to medical smartphone implementation. Among these perceived barriers are:

- *Cost*. A study showed that 83% of smartphones cost over $250.00, and almost half of all Americans spend $100.00 monthly on their Internet/Data plans. While many free applications exist, some may cost well over $50.00.[10–12] Additionally, many medical applications require costly annual subscriptions that may be out of the budget of subscribers.
- *Education*. While smartphones have been designed with simplicity in mind, users may still require training with the device and its applications to become proficient in the technology. Using the devices may actually become a time-wasting endeavor that becomes a hindrance rather than helpful.[9]
- *Choice*. With the aforementioned number of medical applications available on mobile devices, physicians and patients may become overwhelmed with the sheer volume of options to choose from when deciding on what applications to download.[13]
- *Erroneous information*. Anyone may create an application for sale or distribution, allowing people to choose an application that has false or intentionally misleading information, as has been demonstrated on various Internet sites.[13–15]
- *Reliability*. Some authors have tested the reliability of mobile medical applications and have found significant flaws with particular applications due to lack of evidence-based information and peer review. This was demonstrated by a review of applications for opioid conversion,[16] cancer information for healthcare workers,[17] and asthma management.[18]
- *Accessibility*. A Pew Institute survey reports that only 54% of Americans with chronic illness or disability use the Internet compared to the 81% of healthy Americans who do.[19] Though no data exist for smartphone usage among those with disabilities or specific diseases, this information suggests that disability may create a barrier to adoption of such technology.
- *Misconception*. Some physicians may find smartphone usage by students in a clinical setting disrespectful. Similarly, physicians and students may feel uncomfortable using the device in front of patients.[9]

Although the use of medical smartphone technology is growing anecdotally, peer-reviewed studies

examining this technology and its benefits and barriers in healthcare are still in their infancy.[20] The purpose of this study was to gauge physician and medical student awareness and usage of mobile medical applications, evaluate their attitudes towards implementation and utilization of these applications in a clinical setting, and to identify the barriers and benefits of recommending this technology to patients. The investigators hypothesized that there would be more frequent usage and recommendation of applications by medical students and young physicians in comparison to older physicians. The ultimate goal of this study was to surface these discrepancies and to utilize the gathered perceptions of participants as a foundation for future projects that will seek to better implement this technology in clinical settings.

Methodology and Setting

Research data was derived from an approved University of Medicine and Dentistry of New Jersey (UMDNJ) IRB protocol. An observational, cross-sectional study utilizing an IRB-approved, 23-item survey developed by the researchers was initiated through the Department of Family Medicine at the Rowan University School of Osteopathic Medicine (Formerly part of UMDNJ). All attending physicians, residents, and medical students affiliated with one of the three UMDNJ medical schools (School of Osteopathic Medicine, New Jersey Medical School, and Robert Wood Johnson Medical School) were invited via e-mail to participate in the study by completing an anonymous survey. The survey link was available to invited participants over the course of one month. There were no exclusion criteria; however, the study was limited to participants with Internet access. The survey was administered and all data was collected online through SurveyGizmo©. An introduction informed participants that completion of the survey was voluntary and no inducements were offered for participating in the study. The questionnaire elicited information about the participant's age, degree, specialty, patient volume, mobile device preferences and reasons for usage, and their perceived benefits and barriers to using these devices in a healthcare setting. Responses were evaluated using SurveyGizmo and analyzed using Microsoft Excel (Microsoft, Inc.) and SPSS v15.0 (IBM, Inc.), performing descriptive statistics and Chi-Square testing to compare responses between the two major groups (medical students and established physicians). The hypotheses tested with these data were:

(1) That medical students would be more likely to have and use smartphones for medical applications than established physicians.
(2) That medical students would be more likely to have recommended smartphone medical applications to their patients than established physicians.
(3) That medical students would perceive fewer barriers to implementation of smartphone medical applications for both themselves and for their patients than established physicians.

Results

Approximately 2000 participants were eligible for participation and 544 surveys were submitted through SurveyGizmo; 347 completed surveys were analyzed. The average age of respondents was 31.2 years, and four physician respondents were greater than 70 years old. The study revealed that 63.4% of respondents had or were working toward an MD degree, and 36.6% had or were working toward a DO degree. One-hundred thirty-two (38.0%) of the respondents were medical students and the rest were resident or attending physicians.

No significant difference between students and physicians was observed concerning smartphone ownership, with 94% of respondents reporting having a smartphone. (95.2% students vs. 92.5% physicians, $p = .356$). Of those with the technology, 82.9% stated they have used it at least once in a clinical setting. Respondents perceived fast access to information to be the greatest benefit to mobile medical technology (96.6%), as well as simplified access (75.5%) and easier medical calculations (70.8%). Primary perceived barriers to using this technology included uncertainty about available medical applications (39.4%), and inexperience (23.4%). There was no significant difference between medical students and physicians with regard to inexperience (21.2% vs. 21.9%, $p = .887$) or uncertainty (37.1% vs. 35.8%, $p = .806$).

Concerning patient-centered applications, only 24.5% of respondents have recommended smartphone health applications to their patients, with fewer students having done so compared to physicians (16.4% vs. 29.6%, $p < .0001$). However, assistance with lifestyle modification (78.8%), increased adherence to treatment plans (73.8%), and strengthening patient self-efficacy and confidence (57.0%) were agreed upon as potential benefits. Perceived barriers to recommending this technology

were added cost to the patient (52.6%), concerns about patient self-diagnosis (47.7%), and patient lack of training with this technology (34.9%). No significant difference was found between students and physicians ($p > .05$ for all barriers).

Discussion

This is among one of the first studies that examined mobile medical technology usage among medical students and physicians in the United States. While the body of knowledge regarding such utilization in the healthcare setting is growing in many parts of the world, as shown by the literature,[20,21] such examination needs to continue to grow in the United States. A study performed in Victoria, Australia examining smartphone use in the clinical setting indicates 87% of health care providers use a mobile phone during clinical practice.[21] This closely mirrors the results from our study.

The medical students and practicing physicians who participated in this study corroborated what has been observed anecdotally as well as in marketing research – smartphone usage both in daily life and in the clinical setting is ubiquitous and has the potential to become more so as technology and training advance. Contrary to our originally stated hypothesis, there was little difference between age of the physician or physician-in-training and the amount of usage of the mobile medical technology. Though the hypothesis was found to be incorrect, the authors are excited by this result as mobile medical technology has the potential to positively affect clinical outcomes. As such, we believe that it is important to encourage and educate physicians at all levels of training to effectively and efficiently utilize smartphones in the clinical encounter.

Furthermore, the authors were surprised to find that there was no significant difference between the perceptions of barriers and benefits to the clinical utilization of this technology. Among the top benefits that all participants noted were: fast access to information, simplified access to information, and ability to easily perform medical calculations. Many other smartphone benefits have been anecdotally documented in the literature and suggested by the media to have a positive impact on healthcare. A recent literature review reported applications capable of locating wandering patients with dementia via GPS and even applications capable of cardiac monitoring by way of EKGs, echocardiograms, and Doppler ultrasound. The latter has recently received news coverage because of its ability to change the

way physicians practice and possibly decrease healthcare costs.[22] Since this technology provides a wealth of knowledge and abilities to translate directly to a higher quality of patient care, the authors believe that it should be integrated at the beginning of undergraduate medical education – providing training and encouragement to medical students from the very first year. Additionally, continuing medical education (CME) would be beneficial to accomplish the same goal in physicians already in practice.

As it pertains to perceived barriers to clinical usage, both students and physicians noted that uncertainty about current applications on the market and general inexperience with the technology were amongst biggest concerns. No study participant cited concern for confidentiality or breach of patient health information, although this was a significant concern raised in the study conducted by Koehler, et al.[21] While pricing is beyond the medical community, medical education programs have the ability to affect change in the other perceived barriers that physicians and physicians-in-training have, most notably accuracy of information retrieved. With the aid of university librarians and information technology departments, and in collaboration with medical educators, applications can be "vetted" for usage by students, residents, and attending physicians for their accuracy and validity in the clinical setting. This would be an interim solution until guidelines are created for these application developers; a notion that has been called for by other investigators researching medical smartphone use.[13,21] In the future, physicians and students may begin to take part in the development of applications to cater to their own clinical and patient needs, as well as test for the validity and reliability of these advancements.

The authors did find that practicing physicians were likely to promote patient-centric applications to their patient population in comparison to medical students. However, this may simply be due to the vastly larger number of patients they have seen in their clinical practice. This provides an opportunity for skilled physicians to teach students about available software; thus allowing for further recommendations of this technology to patients. Familiarity and usage of mobile applications may aid in treatment compliance, lifestyle modification, and strengthening of patient self-efficacy – which both students and physicians recognized as the top benefits. A recent randomized controlled trial by

Carter, et al. showed better adherence to weight loss regimens with use of a smartphone application in comparison to paper diaries and websites.[23] As with all other perceived barriers and benefits, students and physicians agreed on the potential problems with promoting medical smartphone usage among patients, with the greatest concerns being: 1) added cost of this technology to patients, 2) self-diagnosis by patients, and 3) misuse of the applications secondary to lack of training. Although some of these barriers currently exist, with appropriate training and advanced use these barriers may be overcome and allow for some of potential benefits described to be actualized.

Though our brief survey was confirmatory to anecdotal evidence and telling in many ways, there were significant limitations to our study. These included response bias, a common problem in all survey-based studies, and selection bias, as our study population included medical students, residents, and physician-educators, all of whom are connected to a university medical center and have access to significantly more technological resources than a solo practitioner may have. In addition, the study population was small and yielded a relatively low response rate. As such, we may not have captured the actual usage and perception we had hoped to. Lastly, the study population was limited to medical students, residents, and physicians training and practicing in the state of New Jersey and, therefore, it cannot be concluded that such findings pertain to physicians in the United States as a whole.

We also recognize that the benefits and barriers to clinical encounter utilization and to recommendations of such technology were simply *perceived.* Future randomized controlled trials among these populations, both clinician and patient, should be conducted to determine if such usage truly improves patient care and healthcare outcomes.

Conclusion

The data from this study give evidence to the assertion that smartphone usage is very prominent in the healthcare setting. Contrary to the hypothesis, there was no observed difference between medical students and practicing physicians with regard to both usage and perceptions. This finding is encouraging as it demonstrates that current and future physicians are adopting a technology that has significant potential benefit to both their practices and the patient populations they serve. Thus, if barriers and benefits to implementing and recommending this technology remain constant among students and physicians, the early addition of smartphone education to the medical curriculum and in continuing medical education would be beneficial to current and future healthcare providers.

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