
Smartphone technology and apps: rapidly changing health promotion.

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Abstract:

Despite the increased availability of smartphones and health applications (apps), little is known about smartphone technology and apps for implementation in health promotion practice. Smartphones are mobile devices with capabilities for e-mail, text messaging, video viewing, and wireless Internet access. It is essential for health promotion professionals to understand how to use smartphones and apps in health interventions. More people globally are using smartphones and health apps. Additionally, health promotion professionals will be able to reach minority populations who are early adopters of smartphone technology. The purpose of this article was to provide an overview of smartphone technology and health apps for health promotion interventions in 1) healthcare, 2) consumer health/health behavior change, and 3) education as well as considerations for choosing apps. It is recommended that development of new health promotion programs using smartphones and apps include evidencebased guidelines for chronic disease management, improved physician-patient interaction, and improved access to services from a distance.

Key words: Internet, mobile devices, health promotion, technology, smartphones

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Introduction

Smartphone technology and health applications are transforming health promotion. Smartphones are mobile devices with additional capabilities such as email, text messaging, video viewing, and wireless Internet access. (1) Applications, or apps, are downloadable software products that run on mobile devices. (2) The emerging health technologies support the Healthy People 2020 Health Communication and Information Technology goals and objectives which include the increased use of mobile devices to improve health outcomes and health quality and achieve health equity. (3)

Smartphones are small, always on, and carried on the person during the day. (4) Smartphones, with the potential to outnumber personal computers in the near future,⁵ are owned by 40 to 50% of Americans, and their use continues to grow. (6,7) Smartphones run over wireless communication networks and open operating platforms such as iPhone OS, BlackBerry OS, and Android. (6) Interestingly, the 55- to 64-year old age cohort was the fastest-growing age group for smartphone adoption in 2011 with an increase in use from 17% to 30%. (8) Many developing countries have even skipped mainframe computer development and moved directly to mobile broadband and smartphones to meet their computing infrastructure needs. (8)

Data trends show an increased use of smartphones by minority populations. African-Americans use mobile technology for daily Web searches at a 10% higher rate than the national average, (6) and Hispanics (25%) are more likely to search for health information using their mobile phones than non-Hispanics (15%). (9) Access to the Web through stationary computer desktop or laptop or having home broadband connection has been traditionally lower for American minorities and people in developing countries. This disparity decreases, though, with mobile use.

Health apps on smartphones are one of the most highly used apps as nearly 30% of U.S. adults use health apps.¹⁰ It is projected that 500 million people globally by 2015 will be using health apps. (11) Pew Internet research suggested adults ages 30 to 49 (32%) used health apps slightly more often than adults ages 18 to 29 (28%) and 50 and older age (20%) with numbers increasing annually for all adult age groups. (10)

Apps are available covering a range of health topics including healthy lifestyles, fitness, disease management, and public health. (12) Over 17,000 mobile health and medical apps are available across all app stores with over 70% targeted to health professionals. (6) Medical apps are being used by physicians for medical reference, medical alerts, general diagnosis, lab work and digital image delivery, tracking or monitoring patients, and continuing medical education. (2,6) Apps are also being used more by students as a primary way to conveniently access digital information. (13)

Despite the increased availability of smartphones and apps, little is known about smartphone technology and apps for implementation in health promotion practice and health outcomes. Recent studies, though, suggest health apps may have the potential to support interventions for health behavior changes. (1,14) It is important, therefore, for health promotion professionals to understand how to use smartphones in health interventions. The purpose of this article was to provide an overview of smartphone technology and health apps for health promotion interventions in 1) healthcare, 2) consumer health/behavior change, and 3) education as well as considerations for health education specialists when choosing health apps for interventions.

Smartphones and Health Apps for Health Promotion Interventions

Healthcare

The widespread use of mobile technologies will have the potential to move healthcare from episodic to continuous care through constant innovation. (7) Compared to programs in the classrooms or on stationary computers, health education specialists can use mobile health behavior change interventions to be more highly-interactive. The interventions may also include real-time interactions with individuals attempting behavior changes.

Smart phone technologies can impact physician practices and improve patient care. (6) Using mobile health monitoring, studies showed that health professionals or health education specialists can send and receive patient information in real time using smartphones for motivation, behavior modification, patient adherence, or decision support in interventions. (1,14) Some mobile-based technologies include sensor technologies that send measurements back to health care professionals or health education specialists. (6) In one randomized control trial, simple short message service (SMS) text reminders showed promise for behavior modification when type 2 diabetes patients missed taking their diabetes medication. (14) During a six month period, data registered by electronic medication dispensers in real time were received through the Internet by providers. The effectiveness of medication adherence was determined by refill data. Patients who received text reminders and reported real-time medication monitoring improved their diabetes medication adherence compared to the control group with no mobile health monitoring. Motivation for medication adherence is very important in diabetes management. Medication adherence may contribute in good glycemic control as a health outcome for type 2 diabetes patients. (14)

In a mobile phone based physical activity intervention, the use of apps and pedometers was found to influence positive behavior changes among 192 physically inactive women ages 25 to 69 in a randomized control trial. (1) The 3-month intervention was followed by a 6-month active maintenance intervention. Patients set individual weekly goals for physical activity, recorded daily activity in diary, and received daily messages and videos for immediate feedback. Data included total steps each day and physical activity seven-day recall, and validated surveys including self-efficacy, social support, exercise, and depression as outcome measures.

Behavioral health opportunities in clinical practice may include the integration of smartphones and apps as part of treatment. (15) In a two-year longitudinal study, text messaging using smartphones with mood ratings from patients and email prompts from clinicians during routine follow-up showed to be a reliable method for real time data collection. (16) The benefits included real time recall of mood episodes and real time two-way communication. Apps may also be used for patient self-assessments or tracking symptoms. Apps may also be developed with autodetection of any significant distress to provide a contact to a support hotline. (15) In addition, therapeutic skills training for patients such as relaxation may be provided with apps for home practice. (15)

Smartphones and medical apps have become an integral part of medical practice today to help health professionals be more efficient and also be able to work at a distance. (5) This may provide potentially more effective provider-patient relationships and support because the apps allow access to information needed to monitor health. (5) Medical references may be accessed in resource-limited areas in the United States and in other global areas. Smartphones and apps were successfully used by resident physicians at remote locations in Botswana with point-of-care and drug apps, email, and Internet access. (17) Other mobile-based intervention studies in developing countries (18,19) using text messaging showed promise in improving healthcare delivery for HIV and maternal health. There is also strong evidence that a text messaging intervention used by community health workers as lay health educators improved patient care for patient adherence and appointment reminders in Malawi. (20) The intervention showed a cost savings in worker time and operational costs as a cost-effective healthcare model.

Using smartphones, managed care plans can also communicate behavior change information, medication adherence education, and follow-up treatment protocol to members and providers. Health educators or health promotion specialists may help to develop mobile patient health information for new initiatives such as electronic health exchanges, accountable care, and patient-centered medical homes. Health insurers who have already established electronic medical records for their clients are developing mobile apps to assist clients with chronic disease management. (6) By connecting the Web and electronic medical records using a smartphone, patients can more easily navigate the healthcare system.

Consumer Health/Behavior Change

Health consumers are looking for information that will allow them to take immediate action, not particularly in-depth research that takes a lot of time on the Internet to conduct. Smartphones are now used for mobile self-monitoring as well as health behavior maintenance. Because 70% of consumers with chronic diseases own at least a cell phone, there is an opportunity to develop apps directed toward mobile self-monitoring. (21-23) Consumers are using smartphones and health apps for general information and specific information targeting different age groups, too. (24)

Table 1 presents several free Android, Apple iPhone, and Blackberry apps for various health promotion topic areas and self-monitoring. Selection of apps was based on app store ratings and evaluation by two reviewers from the university based on features for content, review of app user ratings, and self-monitoring features such as logs or progress tracking. For example, a free Calorie Counter app for Android phones is interactive for all age groups with daily posting of food consumption with calorie listings, water consumption, goal setting, physical activity, and target weight. Graphs and charts are generated for easy tracking. A free Nexercise app for iPhones uses virtual rewards such as medals and points while tracking exercise progress. Friends may be added

for challenges and motivation. For parents, a free WebMD Baby app for iPhones provides tracking of children's health, video storage capabilities, parenting tips and journaling, and information for emergencies and illnesses.

Education

Teens are one of the fastest growing user groups of mobile technology including cell phones. Pew Internet & American Life Project research showed older teens ages 14 to 17 (87%) have a cell phone compared to younger teens ages 12 and 13 (57%). (25) Differences exist for teen cell phone ownership by income levels. (25) Teens from low income households less than \$30,000 own 18% fewer cell phones. (25) For middle and high school-aged youth, over 60% can use cell phones during school time. (26)

Despite the digital divide for teen cell phone ownership outside the classroom, mobile learning with apps in the classroom is starting to increase access to educational opportunities. Beyond the traditional classroom walls, the connectivity provides instant access to content and learning activities as well as continuous learning. Hundreds of apps provide tools in different student learning style domains. (27) Research on the use of mobile devices in the classroom suggests the usefulness in teaching mathematical actions, enhancing engagement in language, improving vocabulary, and increasing task-oriented behaviors. (28) The use of mobile technologies in education may aid student learning by encouraging out-of-classroom learning, improve opportunities for collaboration from distance, support differentiated instruction, and reach underserved populations. (9) Flexible and convenient, mobile devices can support students' learning everywhere they go, and teachers can use the devices to meet individual learner needs. (27)

Education for healthy lifestyle and physical activity promotion to counter sedentary behaviors can be enhanced using smartphone health and fitness apps. Incorporating this mobile technology in health and fitness education may improve students' health and physical activity levels inside and outside of the classroom. (27)

Pedagogically-sound use of the new mobile technologies, though, requires linking learning outcomes, curricular content, instructional strategies, and learning activities to the appropriate types of technology to support teaching and learning. (29) Successfully linking this learning tool to course objectives and content, some health educators have used calorie tracking and meal planning apps in nutrition lessons and incorporated yoga or dance instruction apps for students to create their own movement education routines. (27) Other possibilities for sound mobile learning activities can include recording and playing audio and video files, downloading web-based content, participating in game-based scenarios, and conducting on-site assessments. (27) There is evidence that a school-based obesity prevention intervention using behavior change strategies and text messaging has the potential to reduce weight gain and increase physical activity. (30) In the randomized control trial, 357 disadvantaged teen girls in eighth grade participated in the school program. The intervention program was developed using the Social Cognitive Theory as a framework for activities to include text messaging, physical activity, self-monitoring using pedometers, and nutrition workshops.

Choosing Apps for Health Promotion Interventions

Because most Americans own smartphones that may be on constantly and allow two-way communication, smartphones are a vehicle that can impact health information dissemination and health promotion. (12) As more apps are developed, consumers, providers, and health educators need assistance to make an informed choice finding a health app for health promotion or healthcare interventions. About one-fourth of apps, however, are downloaded and used once, and three-fourths are dropped after about the 10th use. (31) Some critical considerations when choosing health apps include quality of apps, usability and technical problems, regulation, and data security and privacy.

Quality

Despite the wide distribution of health apps for smartphones, limited research is available addressing content quality of apps which involves health professionals as resources in the content quality development.

Development of smartphone apps has not traditionally included health professional input. In one study, health professional involvement as a resource was found in only 16 (14%) of 111 pain management apps. (21)

No standardized evaluation tools are available for health education specialists or health professionals to review content quality of health apps. Most app reviews on the Internet for evaluation list the price, content description, and user ratings. Only a few studies examined apps for content quality based on criteria or guidelines researchers provided for health topic and best practices. (21,22) Findings in two studies showed low levels of adherence to the guidelines. One study analyzed 47 smoking cessation apps using three categories for content quality. (22) The categories and measures included the Clinical Practice Guideline for Treating Tobacco Use and Dependence by the U.S. Public Health Service, types of approach to smoking cessation based on the National Tobacco Cessation Collaborative guidelines, and popularity by number of downloads of apps. Another study evaluated consumer pain management apps for content quality based on the researchers' criteria for information on types of pain, relaxation training, and self-monitoring with diaries or pain scales. (21)

Multiple research methodologies and evaluation methods also need to be used in order to generate evidence about the technologies. (32) The majority of mobile device interventions for health assessment and patient monitoring were not based on accepted health behavior change theory such as goal setting or reinforcement or evidence-based interventions. (4) More efficacy studies are needed to research smartphone technology used in health promotion interventions. Review tools are being developed (33) and initiatives such as Global mHealth Initiative and the mHealth Evidence Workshop are underway to scientifically review and evaluate mobile health apps. (34) In addition, experts in the technology field reviewed health apps with their evaluation guidelines that were entered into competitions such as the Appy Award (health and fitness category), Healthy App Challenge/Surgeon General's Award, Health and Human Services Innovation Award, Global Mobile Awards (best mobile health innovation), and mHealth Alliance Award. Using their own evaluation guidelines, each group judged entries on criteria they considered important.

Usability Evaluation and Technical Problems

After choosing health apps, health education specialists or health professionals may consider the challenge of usability evaluation. Usability refers to the ease of use such as the use of smartphones based on specific evaluation criteria. (35) Usability evaluation often includes different methods such as think aloud, heuristic evaluation, and cognitive walkthrough to examine technical problems or skill levels of participants. (35) In think aloud evaluation, behaviors and comments of participants such as patients are recorded as they think aloud using apps. In one think aloud usability study, results showed different behavior patterns of younger and older patients for self-monitoring blood glucose data entry and data receipt using apps. (36) Information may be used for training future participants to use smartphones and apps. In heuristic evaluation, compliance criteria of usability principles for the apps design are examined by designers as evaluators. An example is having one-click main pages. In cognitive walkthrough, scenario-based tasks are examined by evaluators for ease of apps that may interfere with completion of tasks. Assessment of the potential technical problems of both the providers and participants is another concern to support smartphone technology interventions. Technical difficulties for accessing the elements of some apps may present barriers to successful uploading of information. Thus, participants may find some apps frustrating and find smartphones difficult to use.

Although it appears that student learning in education can be enhanced through the mobile learning approach, current studies suggest apps may possess some technical problems and limitations. (35) Some noted disadvantages, though, include the potential for distraction and cheating, lack of supportive educational theory, poorly-designed devices, and diversity of proprietary platforms. More research needs to be conducted on how to train teachers to appropriately use the technology in their curricula. (9)

Regulation

Federal initiatives to develop regulatory requirements of healthcare devices involve collaboration between the Food and Drug Administration (FDA) and the Federal Communications Commission (FCC). (6) It is estimated that there are over 17,000 medical apps on the market, and the FDA plans to regulate a small portion. The FDA is determining how to regulate those clinically-active apps that promote disease treatment or cure such as heart monitors or remote-controlled drug release mechanisms.⁶ The FCC will also regulate mobile specific applications such as smartphone remote monitoring apps and diagnostic smartphone apps with videoconferencing devices.

Data Security and Privacy

Data security and protection of data for privacy are paramount for consideration by providers, health education specialists, insurers, and users. The lack of standardization of personal information security in the Health Insurance Portability and Accountability Act (HIPAA) of 1996, our national standards to establish safeguards to protect the privacy and confidentiality of personal health data, is also a concern. (38) Nationally, these concerns are starting to be addressed by the Office of the National Coordinator Chief Privacy Office. As part of a mobile device program to identify best practices in privacy and security, health care education is needed about securing health information to protect patient rights if information is transmitted or shared with providers. New mobile health devices can collect physiological and lifestyle data over the long term, remotely monitor patients using sensor technology, and share large amounts of data with a variety of providers. In addition, participants in research studies should be notified in the consent forms the potential risks for privacy and benefits of smartphone use. (15)

The Health Information Technology for Economic and Clinical Health (HITECH) rules are part of the American Recovery and Reinvestment Act of 2009. (39) The legislation may provide an expansion for electronic protected health information and potential legal liability for non-compliant medical practitioners. As a result, health education specialists need to be aware that HITECH may expand the scope of privacy available under HIPAA. In the future, physicians will use more highly integrated mobile technology in their practices, but privacy and security of electronic health records will be a challenge.

With the growing popularity of smartphone apps, harmful apps created by hackers can extract personal information from the mobile devices when apps are downloaded to the mobile devices. (40) When installing the app, an application "permissions" screen often appears. This is normal. However, if the app asks to extract any personal information from the phone such as address book, reconsider the installation or choose the option to block the request for use of the information. (32) Recommendations are the use of downloadable reputable antivirus software such as McAfee, Symantec, F-Secure, or Kaspersky, the use of official app stores, and researching apps and their sources before installation if apps are not purchased through official app stores. (40) The official app stores are the Apple App Store, Google Android Market, and RIM Blackberry App World. Other recommendations include conducting a Google search for the app name and/or its publisher and examining reviews of the apps. If there is uncertainty about a publisher from an official app store, Android users can block the installation of non-Market applications by un-checking the 'Unknown sources' option in the Android Applications Settings menu on the devices. (40) In addition, smartphone users should protect their privacy by storing devices where they cannot lose them or download software that can track a lost device, and use password protection and data encryption.

Conclusion

As smartphones, networks, and platforms become more powerful, the multimedia experience delivered will be more robust with health apps. More and more people globally are using health, medical, and education apps. Therefore, health education and health promotion specialists need to understand how to incorporate smartphones and apps for motivation as patient reminders, patient education, behavior modification, patient adherence, or decision support. The focus of smartphones and health apps will be on chronic disease management, health promotion, improved physician-patient interaction, medical references, and improved

access to services from a distance. In addition, integration of smartphones and health apps will allow health educators and health promotion specialists to reach minority populations who are increasingly using smartphone technology.

Smartphones and apps provide an opportunity to collect and deliver individualized health information and interventions to improve self-management and health behavior change over time. Many apps possess poorly-designed structure and navigation, there can be technical difficulties with the functionality and interactivity of this technology, and some apps may be federally regulated in the future. The health promotion professional, though, should always evaluate the quality and usability of any technology including smartphones and apps.

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Table 1. Examples of Free Health Apps for Selected Health Topics

| Topics | Health Apps | Information and Links |
|-------------------------------|-------------------|--|
| Health and Fitness (Exercise) | iPhone | Nike Training Club: Drills, audio guidance, exercise regimens and more. http://itunes.apple.com/us/app/nike-training-club/id301521403?mt=8 |
| | iPhone | Nexercise: Virtual rewards such as medals and points are available for your progress. Exercise is grouped in categories. Add your friends to your account. http://itunes.apple.com/us/app/nexercise-fun-fitness-exercise/id417348701?mt=8 |
| | iPhone Android | Runkeeper: Motivation and tracking progress are features with this app for tracking your runs with GPS. You may see your fastest mile at your fingertips. http://itunes.apple.com/us/app/runkeeper/id300235330?mt=8 https://play-google-com.proxy.lib.pdx.edu/store/apps/details?id=com.fitnesskeeper.runkeeper.pro&hl=en |
| | Android | Jog Tracker: Your distance running and calories burned are tracked. Other features include voice prompts for |

motivation. <https://play-google-com.proxy.lib.pdx.edu/store/apps/details?id=com.highwaynorth.jogtracker>

| | | |
|--------------------------------|---|---|
| | Blackberry | Runtastic: You can track distance, speed, and calories burned. Voice feedback in different languages is a plus. http://appworld.blackberry.com/webstore/content/18053/?lang=en |
| Health and Fitness (Nutrition) | iPhone | Fooducate: Barcodes can be scanned while you shop to find nutritional information or find healthy alternatives. http://itunes.apple.com/us/app/fooducate/id398436747?mt=8 |
| | iPhone | Restaurant Nutrition: 250 restaurants are listed with many food items and caloric information to help you make smart choices. http://itunes.apple.com/us/app/restaurant-nutrition/id285180322?mt=8 |
| | Android | Calorie Counter by FatSecret: Tools to help you lose or maintain weight are food diaries, exercise diaries, and calorie counters. https://play.google.com/store/apps/details?id=com.fatsecret.android&feature=related_apps#?t=W251bGwsMSwxLDEwOSwiY29tLmZhdHNlY3JldC5hbmRyb2lkI10 |
| | Android | Calorie Counter - MyFitnessPal: Largest database is available with over 1 million foods. Your computer or phone can be used to sync food entries. https://play-google-com.proxy.lib.pdx.edu/store/apps/details?id=com.myfitnesspal.android&hl=en |
| | Blackberry | Recipe Box: Over 700 recipes are easy to fix. Create your shopping list too. http://appworld.blackberry.com/webstore/content/41339/?lang=en |
| Health and Fitness (Family) | iPhone Android version set for 2012 | WebMD Baby: Wealth of information for baby's development include videos, articles, and tips for office visits. Videos can be stored here too. http://itunes.apple.com/us/app/webmd-baby/id489673347?mt=8 |

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Disclaimer: *This information is not a tool for self-diagnosis or a substitute for professional care.*
