Phones have evolved from a two-way analog form of communication to palm sized computers called smartphones. Smartphones support audio, video, text, email communication, calendars, lists, contacts, journals, calculators, pictures, weather updates, medical applications and more. One of the greatest advantages of using healthcare applications on smartphones is convenience. The portability supports quick access to references and tools that have not been easily accessible until now. Smartphones even assist healthcare workers with completing their daily tasks. For example, nurses may teach patients about monitoring their health, such as tracking their blood pressure by using tools on smartphones. A variety of applications are available for managing chronic disease, diet, exercise and lifestyle choices. While smartphones have many useful features, like any other technology, smartphones are ever changing with more advanced features. This creates a challenge for nurses to keep up with the latest but there are helpful guides and websites dedicated to this topic. This paper will briefly review smartphone adoption, various operating systems for smartphones, and highlight more commonly used applications and websites.

**Keywords:** smartphones, nursing practice, eHealth, medical applications, handheld computing

No doubt, Alexander Graham Bell, the inventor of the telephone, would be amazed at the phone’s transformation. Not so long ago, the telephone was a simple two-way communication device. Today, the phone is a sophisticated tool that connects people to a world of information. Smartphones affect all aspects of our lives. People maintain social connections through the traditional phone, chat via text messaging, and use Web 2.0 tools such as Facebook and Skype. Additional phone functions include business tools that manage emails, calendars, and for those in healthcare, reference and data management tools. This paper will briefly review smartphone adoption, various operating systems for smartphones, and highlight more commonly used applications by nurses.

**Adoption of Smartphones**

Smartphone use by healthcare workers is a growing market. It is estimated that 72%, of 661,000 US physicians (Bureau of Labor Statistics, 2010, p. 2) use smartphones in their practice (Dolan, 2010, para. 1). According to Physicians Money Digest (May, 2011), the iPhone is the most popular smartphone used by US physicians with 75% of those physicians polled have at least one Apple device.

Little is known about the number of nurses who use smartphones. This limitation may be, in part, due to the vast number of nurses in the US, approximately 2.6 million (Bureau of Labor Statistics, 2010, p.1), or the unreliable self-reported techniques to gather this information. A search on CINAHL using key terms “nurse” and “adoption” revealed approximately 50 research or review articles about smartphones but only one focused on smartphone adoption by nurses. The same search in Pub Med resulted in 10 articles with only one about nurse adoption, which was the same article identified in CINAHL. Not surprising, in their study of 200 nurses employed in community hospitals Putzer and Park (2010, p. 7) found several factors influenced nurses’ use of smartphones: 1) observing others using a smartphone (t=2.47, p=.01), 2) their perceived compatibility of the smartphone to other technology in the work setting (t=11.22, p=.00), and 3) the internal environment of the work setting including size, resources,
and support from management ($t=5.06$, $p=.00$).

These findings indicate that a supportive environment with technical assistance, an environment that is compatible with smartphones and co-workers that use smartphones leads to use of smartphones by nurses in hospital settings. Springer Publishing administered a survey and reported that 75% (N=821) of nurse respondents owned a smartphone or tablet. And of these nurses, 66% (N=541) owned iPhone or iPad devices. It should be noted, however, that 75% (N=821) of the respondents either held graduate degrees or were employed by a university or college (Springer Publishing, 2011, para. 1-2). In January 2010 alone, there were approximately 1700 medical applications downloaded by 1 million users in the US for their smartphones (Byrne, 2010, para. 1). Smartphone use is expected to rise due to the increasing number of available medical applications making smartphone use more popular. Medical applications are no longer limited to traditional reference and data management tools. Applications have now expanded to healthcare ancillary services, fitness, and lifestyle applications that can be used for patient education.

**Smartphone Operating Systems**

Not all smartphones use the same operating system (OS). Overall, there are six: Palm®, Windows Mobile®, Apple iPhone®, Symbian®, Google Android, and Blackberry®. The most common operating system globally is the Symbian® OS, now owned by Nokia (Nokia, 2011), holding 53% of the market share. But despite this large share, Symbian® OS has fewer medical applications than any other operating system. The iPhone® OS with 43% of the market share has more medical applications than any other system (Dignan, 2009, Table 1) but Palm®, Windows Mobile®, Blackberry® and Google Android are rapidly increasing their medical applications. When choosing a new smartphone, it is imperative to determine the operating system that best suits one’s needs and supports the applications one will use. The variety and number of applications available on an operating system may determine the best option. For a comparison of the most common US smartphone operating systems visit Popular Mechanics field guide (see reference for URL).

**Table 1: Websites for Smartphone Applications**

**Smartphone Applications for Nurses and their Patients**

Medical and healthcare applications for smartphones are abundant and include drug references, medical calculators, reference guides and personal health and lifestyle applications. It is important to note that for many of these applications to be fully functional, robust cellular connectivity and data plans may be required. When a small number of US healthcare students, administrators, providers, and nurses (N=71) were surveyed by a software company, they reported using their smartphones to access email (83%, n=59), write notes and memos (72%, n=51), use drug references (50%, n=36), access clinical decision support tools, (28%, n=20), view medical images (13%, n=9), access lab orders and results (10%, n=7) and access patient records (6%, n=4) (Thorman, 2009).

Drug references or databases are the most commonly used medical applications on smartphones. These applications are helpful because they provide drug, disease, lab and safety information in addition to interactions between medications at the point of care. Some of the drug databases include features for identifying unknown medications based on pill characteristics and formularies to help select therapies based on insurance coverage. Most recently, applications are available that help patients identify their own medications based on pill characteristics such as color, shape, scoring, and any identifying letters or numbers.
Highly rated by healthcare providers, several applications, including ePocrates©, Skyscape© and Lexi-Drugs©, contain free or trial versions of drug databases (Einerson, 2010). These also include medical calculators and reference guides when additional features are purchased and are available for most of the operating systems, except Symbian© OS. Skyscape© is the only application that will operate on Symbian© OS.

Medical calculators are helpful because they include a variety of medical algorithms commonly used by practicing nurses. Examples include BMI calculations, OB wheel, Braden scale, glomerular filtration rate, creatinine clearance, body surface area, pediatric dosage calculations, and peak flow predictions. MedCalc©, a popular medical calculator, is available free for Palm©, Window Mobile©, and iPhone© and available on the Google Android OS for a nominal fee. A similar medical calculator, known as UIQ MedCalc, is available for the Symbian© OS (Husain, Alkadhi & Misra, 2010).

One of the greatest advantages of using medical applications on smartphones is the convenient and quick access to medical references that have not been easily accessible until now. Outlines in clinical medicine© (OCM©), a comprehensive resource that relates the latest research and evidenced based clinical practice information is a Skyscape© product and available on all operating systems.

The US National Library of Medicine offers PubMed on Tap, available for all operating systems, which allows one to access pertinent and up-to-date research and clinical information at the bedside. This application functions much like a knowledge base where one can retrieve information on a topic by simply typing in a single key word. A free version of this application, PubMed on Tap Lite, includes all the features of the full version except it limits the number of retrieved articles to ten. Because PubMed on Tap Lite is free, advertisements may appear on the bottom of the smartphone screen while using the application.

Healthcare is complex and often requires specialty knowledge and expertise. Locating resources to assist with complex medical problems is often challenging. Smartphone applications support healthcare workers because smartphones allow convenient access to specialty information in areas such as radiology, neurology, pediatrics, neonatology, and continuing education activities (Husain et al., 2010). Lieberman’s iRadiology Classics, a free application for iPhone OS, © offers full featured radiology images with labels and a description of the findings. The images can be enlarged on the iPhone without degradation but the application is an educational resource and not intended for diagnostic purposes. There are approximately a dozen radiology applications on the Google Android OS with a price range of free to $100.00 US. Each application is rated on a 5-point star scale and users assign the ratings. Few of these radiology applications, however, have fully scalable images.

QuantiaMD® and Pri-Med Mobile© offer continuing education credit on the iPhone®, Blackberry® and Google Android OS. Both applications include relevant and timely topics and allow users to connect with other users, browse graphics and multimedia, and complete interactive media rich case studies.

Smartphone users can also search their specialty area on the smartphone to reveal applications specific to their area of interest. For example, the Google Android OS has over 130 pediatric applications including calculators, reference texts that are available via the smartphone, and specialty topics including anesthesia, medications, nephrology and emergency medical systems. Blackberry© OS has far fewer applications, less than 20, for pediatric healthcare. One of the most popular pediatric applications is the 5 Minute Clinical Consult© available on Google Android, Blackberry® and iPhone OS®. Some websites are dedicated to sharing pediatric applications for smartphones (see Table 1). At this time, Blackberry OS® has fewer pediatric applications and Symbian© OS has none.

Gazelle™ and Capzule PHR©, two iPhone© applications, and ZipHealth by Microsoft Health Vault®
designed for iPhone©, Google Android© and Blackberry OS© offer innovative healthcare approaches with personal health records. Individuals may record their personal health histories, access information while receiving healthcare and share with their providers; however, these applications do not seamlessly interface with electronic health records (Wodajo, 2010).

Nurses may play a vital role in advising patients about tools that can promote health and wellness. A variety of applications are available for managing chronic disease, diet, exercise and lifestyle choices. For example, most of the mobile operating systems have an application for managing exercise and diet: iFitness™ and My Fitness Pal are applications specific to iPhone OS© and Cardio Trainer + Racing requires Google Android OS. Ascendo Fitness™ and Total Fitness operate on Blackberry while Mobile Personal Trainer and Personal Trainer for Activity work on Symbian© OS.

Selecting the best smartphone and locating healthcare applications for smartphones may not be as daunting as it seems. There are websites that have selected applications available for download in one convenient location. Often, the websites score applications based on peer review and include a brief summary and pricing information. Sometimes, these sites recommend the target users (e.g. student, patient or provider). See Table 1 for a list of websites that host information about smartphone applications.

Applications and websites listed here may be beneficial to nurses but it is the responsibility of every healthcare provider to ensure the applications meet the standards necessary for providing quality healthcare. Since healthcare, the evidence on which healthcare is based, and technology is ever changing, it is crucial that nurses ensure the information they are accessing is not only accurate, but relevant and current (Phillippi & Wyatt, 2011). Technology is never static. A new wave of mobile devices has already been launched but has yet to deeply penetrate the healthcare industry. It is expected that tablets such as the Apple iPad©, and the Blackberry Playbook©, will transform the work of nurses and other healthcare workers including access to patient information, data retrieval, data entry, and reference materials and applications currently used on smartphones.

References


Dr. Wyatt has fifteen years of experience in nursing education and ten years experience in instructional design. She has expertise in online learning and ways to enhance traditional education using instructional technology. Dr. Wyatt has used both synchronous and asynchronous learning methods in online environments through course management tools, teleconferencing technology, chat rooms, digital stories, and self-directed web-based modules. Her research is focused on ways to enhance consumer and professional health education through instructional technology.

Dr. Krauskopf has been a certified family nurse practitioner since 1983 providing health care in a variety of primary care settings and began a nursing faculty career in 1998. Dr. Krauskopf has participated in funded research utilizing technology to enhance education, assessing nurse practitioners’ use of handheld technology in clinical practice, developing bioterrorism curriculum incorporating technology and developing and implementing educational strategies to increase access to advanced practice nurses in rural Virginia.