Mobile Devices Accelerate Patient Centric Healthcare

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As this web enabled digital age evolves from desktop computers with modems to mobile computing devices and sensors capable of streaming volumes of information into the palm of your hand, so too must healthcare evolve in order to capitalize on the potential benefits for patient care. We are moving beyond the initial quest of simply having access to data on remote systems and controlling systems remotely. Mobile computing offers the capability of capturing and continuously monitoring personal healthcare data and streaming it back to the patient as well as to physicians and care givers, enabling them to provide a higher quality of care and better overall disease management. Capturing data, deriving appropriate signals based on approved health monitor algorithms, and alerting HCPs, care givers, and patients so they can take appropriate action promotes overall wellness and better disease management. Passive monitoring of healthcare data maintained in personal healthcare records (PHRs) is a key component to that strategy that enables a patient to effectively prevent symptomatic episodes that may result in more costly emergency room visits.

Healthcare Goes Mobile

Many healthcare IT systems offer remote access to patient data. Physicians routinely check lab results, view office schedules, and review radiology or pathology images from their private PCs or hand held devices. Advanced imaging devices such as MRI scanners offer remote acquisition control of scan parameters, enabling highly trained specialists to provide advanced care in remotely located imaging centers. Remote access used to be exclusively through desktop and laptop computers accessing remote computer systems through secure land based network connections. Smart phones and tablet computers such as the iPhone/iPad[i] by Apple or Android devices by Motorola extend the paradigm beyond the local network connection to a truly mobile one. Mobility enables a new generation of patient centric devices and mobile applications that bring healthcare into home on a continuous basis rather than pre-scheduled individual visits to the doctor's office.

Benefits of Continuous Monitoring

Aneesh Chopra, Chief Technology Officer of the United States, recently commented at HIMSS11 in Orlando, Florida that "…extending our healthcare system into the home and giving patients access to their data" are key factors in improving our healthcare system. Failure to follow doctor's orders is not an uncommon occurrence. Whether it is deliberate because patients don't like the prescribed treatment or side effects, or simply human nature to be forgetful, the consequences are equally poor. Electronic monitoring provides insight on the potential causes and enables correction through coaching resulting in increased compliance.

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Whether it is monitoring glucose levels for diabetes, medication doses for asthmatics, or orthodontic usage, early detection of gaps in adherence to treatment plans, or physiological parameters that are out of range provide the opportunity for corrective measures that could prevent a more costly visit to an emergency room.

Acquisition Devices

Just as iPads and Android phones are on the cutting edge of mobile computing, many new devices and sensors are coming to market designed to monitor, transmit data, and report on personal health symptoms. Once such device is called a Smartinhaler[2] developed by Nexus6[3]. This device is FDA approved to monitor the number of doses dispensed from an inhaler and automatically transmits the key data via cell phone technology to a remote system where it can be accessed by the patient or a care giver. Viewing dose compliance information helps the patient improve compliance and also provides insight into root causes of symptoms when they occur. This information is also helpful to physicians when considering changes to medication doses. It provides insight as to whether the current dose is being used but is insufficient to achieve the desired results – or, perhaps the medication not being taken and therefore no change is dose is warranted.

Figure 1: Smartinhaler device with on-board cell phone, and mobile application to view personal health data.

The device also helps facilitate compliance by providing reminder ringtones that are programmable by the patient, and on-board graphical display of dose data. When integrated with an enterprise electronic medical records system, it could also be used to conveniently trigger medication refills based on the number of doses delivered and the capacity of the medication canister.

Acquisition devices are often complemented by mobile applications that allow the patient or care giver to view the data or program the mobile device. Figure 1 shows sample data from a SmartInhaler displayed on an iPod using a mobile application downloaded from Apple's App Store.

In addition to gathering data, other benefits of continuous connectivity can be derived by sending information to patients when they don't follow their doctor's orders. For example, providing reminders to patients when it is time to take medication can be helpful in improving the patient adherence; sending those reminders to their care giver or physician may also prove instrumental.

[2] www.smartinhaler.com

[3] Nexus6, Ltd. Auckland, New Zealand (www.nexus6.com)

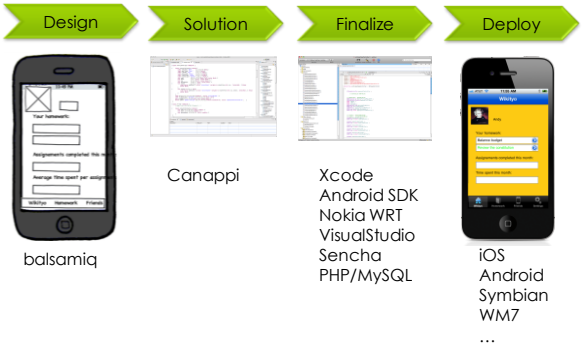
Another example of a digital device capable of continuously monitoring a therapy treatment is provided by TheraMon®[4]. This company based in Austria has built a device that continuously tracks a patient's utilization of removable orthodontic devices. The technology includes a temperature sensor and uses RFID technology to transmit values to an external computer, all hygienically sealed within the braces or dentures.

Figure 2: TheraMon sensor and removable orthodontic device.

Development Platforms

Mobile healthcare is rapidly gaining momentum, largely driven by the explosive growth of mobile applications and the capabilities of mobile devices. Steve Jobs, Apple's CEO, reported at the launch of the iPad2 that more than 350,000 apps were currently available in the App Store. We expect this number to climb to millions within a few years. With such a level of innovation, it is not surprising that device manufacturers such as Apple, Motorola, and Nokia along with mobile operators such as Verizon and AT&T are competing by deploying proprietary platforms that are constantly enhanced and upgraded. This presents two major challenges for innovative companies to establish a presence in that space. First you need to assemble a team with new skills across several platforms. Second, you need to deliver mobile healthcare applications which are device agnostic.

When these challenges are not addressed properly, companies realize that the software development process becomes resource constrained very quickly. This introduces several issues in terms of time-to-market, as well as the maintenance and upgrades necessary to keep up with this level of innovation. Picking platforms or architectures (e.g. Web versus Native Applications) may also be tricky, as we have seen recently with Nokia switching abruptly its platform to Microsoft Windows Mobile 7, putting at risk the large investments made by its customers.



New kinds of development tools are emerging to help address these challenges (resources, skills, architectures, platforms…). Similar to 4th generation programming languages, these new platforms enable development of an application in a technology and architecture that is vendor neutral.

[4] TheraMon, Hargelsberg, Austria (www.thera-mon.com)

As an example, Canappi[5], Development Platform built by Convergence Modeling[6], offers the ability to generate code for iOS, Simbian, Android, and Windows Phone from a single application descriptor across the entire architecture stack (databases, data services and mobile web or native applications). With Canappi, fully functioning prototypes (including the back-end services) can be built in a few hours and multi-platform applications can be produced within weeks.

Figure 13: Convergence Modeling development architecture

Interpreting the Data

Many devices and sensors are available to gather data and make it available through independent systems, but more value can be derived by combining the monitoring data with other information stored in a patient's electronic health record (EHR) or personal health record (PHR). Integrating with hospital information systems will further accelerate the benefits, but this will require more time and effort. Personal health records such as Google Health and Microsoft Health Vault can offer a more near-term solution through their integration capabilities. Smartinhalers, electronic scales, pedometers, and the like can integrate their data into a personal health record that a patient can view using a browser. These portals also offer a market place for new devices, and can be customized to provide disease specific information relevant to the patient's condition.

Regulatory Aspects

The traditional notion of a 'medical device' being an instrument or system that interacts with a patient and is used within a hospital setting or doctor's office no longer applies to this new breed of mobile devices. The boundary line between a medical device and a classic communication system composed of land lines or cell phones is becoming quite blurry. Although complying with HIPAA regulations and securely protecting personal health information (PHI) during transmission is well understood, considering the role of mobile devices with patient monitoring data adds a new dimension to be considered. If a mobile phone receives patient monitoring data, compares it to pre-determined thresholds, and sends an alert signal to a care provider, should it still be considered just a communication device? Or, is it providing clinical decision support that may change the course of treatment and therefore should follow regulations for medical devices with higher risk classification?

Who Benefits? Who Pays?

Ultimately the patient benefits from an improved quality of care derived from real-time availability of data gathered continuously in support of a treatment plan or the attainment of health related goals.

[5] Canappi, (www.canappi.com)

[6] Convergence Modeling, Washington (www.convergencemodeling.com)

However, there is a cost associated with these benefits, and it is unclear who should pay for these capabilities. In some cases, the patient or associated family members may cover the monthly cost of services and data transfer charges. When compared to potential costs of hospital visits and co-pays, the cost of monitoring is easily justified.

Physicians could provide a higher quality of care if accurate monitoring data were available for diagnosis or patient coaching. However, their revenue is based upon reimbursements from insurance companies. Insurance companies have a vested interest in data that could help avoid costly hospital visits. Reimbursements are typically determined by studies that demonstrate improved outcomes for disease management. Although some studies are underway, reimbursement for new devices requires additional work. Finally, self insured companies may offer these innovative devices and services to their employee populations, in support of larger studies focused on outcomes through prevention and reduce healthcare costs.

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[i] iPad and iPhone are registered trademarks of Apple Computer.