Tablet PCs in pharmacy practice

Why pharmacists need to consider the tablet PC.
Let's face it, pharmacists spend a lot of time collecting and analyzing data to provide safe and effective medication use for patients. They dig up information in all sorts of places, such as online drug information resources, medication records, laboratory systems and various nursing "flow sheets". Unfortunately, pharmacists often have to go to several different systems to collect all this data. Creating further complexity is the lack of a standardized collection method among pharmacists. The combination of multiple systems and collection methods results in redundancy and decreased efficiency. Opportunity for errors also exits as many of these systems are manual, including good old pen and paper. As technology advances, it becomes important for us as a profession to move away from inefficient, error prone practices and evaluate newer options for accessing and collecting data. Electronic medical records (EMR), computerized provider order entry (CPOE) systems, computer based monitoring and decision support systems are becoming more and more common place in hospitals across the globe. While not every hospital uses each of these systems, a recent ASHP survey showed that a majority of hospitals are using at least some of these technologies.[1] In addition to these information systems, pharmacists can frequently be found using various software programs to perform pharmacokinetic calculations and track clinical interventions.

The increasing reliance on technology in healthcare, not surprisingly, equates to pharmacists spending much of their time accessing information via computer. Incorporation of computers into the pharmacists' daily routine is commonplace. Walk into nearly any hospital pharmacy today, and you'll see a host of desktop computers (desktop PCs) lining the countertops. While desktop PCs work well in a centralized pharmacy model, they present several challenges for pharmacists at the patient's bedside.

Lack of access to desktop PCs at the point-of-care coupled with the growing need for real time access to information has led to the introduction and rapid growth of small, portable devices such as "personal digital assistants" (PDAs), and to a lesser degree mobile phones, in pharmacy practice. The popularity of mobile devices is evident by the volume of information in the medical literature supporting their use. Widespread use has led to significant advances in mobile computing within healthcare as well as acceptance into mainstream pharmacy practice.

Common uses for PDAs and mobile phones include documenting clinical interventions[2-5], carrying individually created documents and "peripheral brains"[6,7], performing pharmacokinetic calculations, accessing drug information and performing drug interaction checking.[8-13] PDAs and mobile phones offer this functionality in a surprisingly small form factor for easy use at the bed side. However, the portability of these devices comes with a price. Today's PDAs and mobile phones do not posses the processing power or the screen real estate necessary to manage complex pharmacy software. Systems such as the Apple iPhone have made tremendous strides in handling graphics and providing real time access to many web based drug information and decision support resources, but screen size remains problematic. PDA and mobile phone screens are often times several orders of magnitude smaller than that of a full size desktop PC.

The complexities of pharmacy systems and information resources have not made PDAs and mobile phones obsolete per se, in fact their use in healthcare continues to grow. There is, however a void between these mobile devices and desktop PCs. While it is true that desktop PCs lack portability, they offer significantly more processing power, memory, screen size, improved back-up solutions for data integrity, improved views of complex healthcare records, better integration with hospital systems and limitless access to drug information. Despite their lack of mobility, desktop PCs have been shown preference over PDAs in certain clinical situations[14] and mobile drug information databases have never been shown to be superior to their online counterpart.[15] While tremendous advances in technology have been made over the past several years, there remains a gap between the lack of mobility from desktop PCs and the limitations of a PDA or mobile phone. Anecdotal information is available for possible solutions for this gap, but the literature within healthcare and pharmacy in particular, is lacking. What we need is a device small enough to be portable, but powerful enough to handle the needs of today's technologically advanced pharmacy; I present to you the tablet PC.

Mobile PC options for pharmacists
New technology is providing unparalleled opportunity for pharmacists desiring mobile computing solutions. Mobile phone platforms such as the iPhone are offering ever increasing access to patient information, while Ultra-Mobile PCs (UMPCs) remain a viable alternative as a highly mobile computing solution with hardware configurations and software rivaling some desktop PCs. UMPCs offer an attractive alternative to PDAs and mobile phones, but their limited screen size may ultimately make them unsuitable for pharmacist use. I could find no literature evaluating the use of UMPCs in healthcare.

Other options include:

Laptop computers (laptops) - Laptops provide many desirable qualities such as large monitors, keyboards, a built-in pointing device (mouse, a touchpad, also known as a trackpad, and/or a pointing stick), ample processing power and memory. The obvious negative to a laptop is their awkward shape making them difficult to hold while accessing patient information. Their portability is designed around access to a surface on which to work. Without sufficient real estate to place the laptop, their use as a mobile platform is significantly reduced.

Netbooks - Primarily designed for web browsing and e-mailing, netbooks are popular for accessing the internet and for remote access to web-based applications. Netbooks are similar to laptops in almost every way with one major exception; they are typically smaller with screen sizes in the 8 to 10 inch range. Newer netbooks like the Eee PC T91 even offer a convertible tablet pc form factor and touch screen interface. While these devices offer an attractively low price and are a valid alternative to laptops, their limited screen size and limited processing power remain a question mark.

Tablet PCs (tablets) – Tablet PCs are portable computers similar to laptops in many ways. They offer large color displays, processing power similar if not identical to that of a laptop, large amounts of storage and are much smaller and lighter than a desktop PC. The difference between a tablet and a laptop is in the tablet's unique form factor and pen driven interface similar to that of a PDA or mobile phone.

Tablet PCs can be grouped into two basic categories: slate and convertible. The slate tablet has no attached keyboard or mouse and closely resembles a paper notebook or clipboard. Data entry is performed via a tablet pen or voice, although a keyboard and mouse can be attached via a variety of ports. Slate tablets are often smaller, thinner and lighter than convertible tablet models. Examples of slate tablets include the LE1700 and Motion C5 and F5 from Motion Computing and the Sahara Slate i400 series by TabletKiosk.

Convertible tablets closely resemble a laptop with attached keyboard and navigation device. The lid may be rotated and folded down over the keyboard creating a form factor similar to a slate tablet. The convertible tablet PC may also be used as a traditional laptop with the lid in the upright position. The convertible tablet offers several advantages over the slate with its attached keyboard and navigation device providing flexible data entry. However, the addition of the keyboard and navigation device adds bulk to the device often making them heavier than the slate tablet. Anecdotally convertible tablets appear to be more popular than their slate counterparts. Convertible tablet PC examples include the Dell Latitude XT by Dell Computing and the ThinkPad X200 Tablet offered by Lenovo.

Common to both the slate and convertible tablets is the use of digitizing tablet technology (digital inking). Digital inking is made available through the use of a digitizer overlain on an LCD screen that creates an electromagnetic field. The motion of the digital pen on the screen is recorded via this field as a series of data points that are ultimately displayed and stored as pen strokes. The user sees visual confirmation of this on the screen as writing, allowing users to input data via the digital pen provided with the tablet. The end result is similar in look and feel to writing with traditional pen and paper. The digitized handwriting can be converted to standard text via handwriting recognition software or as sketches, drawings or notes making paper notes nearly obsolete. Annotating electronic documents such as those in the portable document format (PDF) is also possible. Handwriting recognition can be challenging, but practiced use can result in remarkable speed and accuracy during data entry.

The digital pen also acts as a navigation device similar to the stylus on a PDA or a mouse on a traditional desktop PC. The pens included with tablet PCs often have programmable buttons that are similar to the buttons on a typical desktop PC mouse. Applications may be accessed by tapping the pen on the screen, simulating a mouse click.

Tablet PCs are equipped with hardware configurations similar to that of desktop PCs making them capable of running hospital systems and office suite programs, such as Microsoft Office. The benefit of this is seen with user comfort and familiarity, creating less of a learning curve to the new device. They offer an ideal solution for the mobile pharmacist.

A great source of information for tablet PCs is TabletPCReview.com. They cover the latest trends in tablet PC use and manufacturing.

Tablet PC use among pharmacists

While there is much anecdotal evidence for the popularity of tablet PCs among healthcare professionals, the medical literature supporting their use in healthcare is limited. This is especially true for pharmacy. An article by McCreadie and McGregory described the implementation of tablet PCs into the workflow of six clinical pharmacists.[16] Of the six pharmacists in the article only two made a complete switch from a manual system to an electronic record keeping system on the tablet PC, and one pharmacist found the tablet PC actually decreased efficiency. Obviously this is a small sampling, but typical of pharmacists feelings toward tablet PC use in general. Not all pharmacists are open to the idea of new technology, especially newer technology like tablet PCs.

When forced to make a decision, pharmacists have chosen the tablet PC over other options. Krough, et al. compared a "computer on wheels" (COW) to a tablet PC for clinical documentation.[17] Eight pharmacists participated in the survey. As expected the pharmacists in the study preferred the tablet PC to the COW, however pharmacists on advanced services like the transplant unit continued to maintain a manual documentation system even though they felt the tablet PC was beneficial. Unlike the study by McCreadie and McGregory, this group lacked an integrated electronic medical record (EMR), resulting in a significant amount of free-text input into their tablet PC. An integrated EMR may have altered these results. Unfortunately, no study exists in which to make the comparison.

Our department has integrated tablet PCs into key areas of the hospital where there is a strong pharmacy presence, specifically the intensive care units. Initial response from end users has been positive. Most activity revolves around accessing laboratory values and patient medication records while on rounds. The ICU pharmacists were given a Motion C5 tablet (slate style) for six weeks followed by a Compaq TravelMate C300 series tablet (convertible style) for six weeks. No preference for one model over the other was given as one pharmacist preferred the convertible and the other preferred the slate. We have since purchased a Dell Latitude XT tablet PC which has also received positive feedback. Based on feedback and continued use, we are planning to implement tablet PCs on other units including pediatrics, oncology and general medicine later this year.

Barriers

It is unclear why tablet PCs have not been widely adopted into pharmacy practice. Healthcare as a whole appears to be interest in mobile computing as is evident by the explosion of literature investigating their use. Unfortunately the healthcare industry has been hesitant to adopt new technology as quickly as other markets. The ASHP national survey on informatics reinforced this idea as some hospital pharmacy departments continue to struggle with the implementation of basic technologies such as pharmacy computer systems, intervention tracking and integration with other hospital systems.[1]

The inability to see the benefit offered by tablet PCs clearly limits their utility in pharmacy practice. The mobile pharmacist is no longer tied to a single location, instead performing patient centered and cost saving interventions at the bedside. However, a recent survey of 700 hospital chief information officers (CIOs) showed that only 29% felt that point-of-care data collection was important. Over 50% of those same CIOs

believed that patient safety was a priority. Obviously these CIOs fail to equate pharmacists at the point-of-care with patient safety. Literature clearly establishes the benefit of pharmacists at the bedside[18-21] as well as the roll of technology in improving efficiency and patient safety.[22,23]

Other barriers include:

- Lack of interest for tablet PCs when compared to other mobile devices This may not be the case for long as tablet PC popularity has increased dramatically over the past few years.[24]
- Lack of capital necessary for tablet PC implementation.
- Lack of solid wireless infrastructure in healthcare facilities.
- Availability of newer technologies.
- Lack of knowledge for support resources
- Technology naïve pharmacists
- Fear of change.

Some of the barriers to tablet PC implementation can be easily handled via education and various changes to the tablet, making it easier to use. Other barriers, however will require more effort and involvement of the pharmacy director and CIO. With that said, none of the barriers to implementation are large enough on their own to prevent further investigation by pharmacy departments.

It's clear that technology can bring a positive impact to pharmacy practice. What is not clear however is whether tablet PCs will be a stop-gap or a permanent solution for the mobile pharmacist. The evaluation and implementation of tablet PCs into pharmacy workflow is a daunting task and several questions must be answered and barriers addressed prior to moving forward. I believe it's worth the effort as the tablet PC offers unparalleled access to patient data and drug information resources in a mobile platform. It is clearly a tool worth further investigation.

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Appendix

Batch files can be created to open multiple applications (or browser with multiple tabs) at once. They can be written using Notepad and saved as *.bat (for batch files) and *.js) (for the javascript file).

To open applications: Opens our pharmacy system (SMS), Notepad, Internet Explorer

```
@ECHO OFF
Start "SMS" "C:\Program Files\SMS\PCW\I86\23079035\bin\PCWSTAPL.EXE"
Start “NOTEPAD” “%SystemRoot%\system32\notepad.exe”
Start IEXPLORE.EXE http://www.google.com
```

Batch files to open up browsers to multiple locations (i.e. multiple tabs at once)

Google's Chrome Browser: Open the browser (chrome.exe) and populate the tabs (Google, JerryFahrni.com, UpToDate, Micromedex)

```
@ECHO OFF
START /d "C:\Documents and Settings\jfahrni\Local Settings\Application Data\Google\Chrome\Application\" chrome.exe www.google.com www.jerryfahrni.com
 WWW.UPTODATE.COM http://www.thomsonhc.com/hcs/librarian
```

Firefox Browser: Open the browser (firefox.exe) and populate the tabs (Google, JerryFahrni.com, UpToDate, Micromedex)

```
@ECHO OFF
START firefox.EXE www.google.com www.jerryfahrni.com WWW.UPTODATE.COM http://www.thomsonhc.com/hcs/librarian
```

Internet Explorer version 6.0 and older: Open two browsers (explorer.exe): one with JerryFahrni.com and one with google.

```
@ECHO OFF
START explorer.EXE http://jerryfahrni.com
START explorer.EXE httpt://google.com
```

Internet Explorer version 7.0 and newer: This can be a little tricky. You cannot directly use a batch file like IE 6.0, Firefox and Chrome. You will have to use a small java script file.

```
var navOpenInBackgroundTab = 0x1000;
var oIE = new ActiveXObject("InternetExplorer.Application");
oIE.Navigate2("http://jerryfahrni.com");
oIE.Navigate2("http://www.google.com", navOpenInBackgroundTab);
oIE.Visible = true;
```

To get a polished look convert the batch (BAT) files to executable files (EXE) with a conversion program like *Bat To Exe Converter*. Icons for the EXE files can be created using an application like *Irfanview*.

Example screen shot showing BAT and EXE files used to help pharmacists. Other notations on the screen are used to help pharmacists find helpful programs and troubleshoot minor issue, like a lost wireless connection.