PDA's in Medicine

Vernon W. Huang, MD

PDA's in Medicine

- WHAT is a PDA?
- WHY are they important in medicine?
- WHO makes and has used them?
- **HOW** can I use one?
- **HOW** can I create PDA software?
- Break/Demo/Q&A

What is a PDA?

- Defined by Apple CEO John Scully in 1992
- Referred to Newton, a handheld device to:
 - Capture
 - Organize
 - Communicate
- Ancestry: knowledge Navigator, AT&T Eo, Go Penpoint
- Evolution:Palm, WindowsCE/PocketPC



1990 (concept)

- Small Size: like a notebook computer
- Light Weight: 4-6 pounds
- ≁ Low Cost: <\$4000</p>
- Long Battery Life: 3-4 hours



1996 (Newton MessagePad)

- Small Size: fit in a white coat pocket
- Light Weight: under 1 pound
- ≁ Low Cost: <\$1000</p>
- Long Battery Life: one shift of frequent use



2002 (Palm/PocketPC)

- Small Size: fit in a shirt pocket
- Light Weight: under 1/4 pound
- ≁ Low Cost: <\$500</p>
- Long Battery Life: days of frequent use

What is a PDA? A Real Life Example of Moore's Law

	1990 (concept)	1996 MessagePad	2002 Palm/PocketPC
Size	Tablet	Coat pocket	Shirt Pocket
Weight	4-6 lbs	Under 1 lb	< 1/4 lb
Cost	<\$4000	< \$1000	< \$500
Battery Life	3-4 hrs	Days	Weeks

A PDA is *not:*

A replacement for desktop computers

A shrunken down version of an existing operating system

A stand-alone device



How is mobile information currently managed

- 3x5 index cards
- 8 1/2 x 11 paper
- Laptops on wheels
- Ubiquitous computer terminals

Why PDA's?

Isn't paper good enough?

- Advantages
 - Portability
 - Easy access
 - Fast data entry
 - Persistence
 - Low cost
 - No training required

- Disadvantages
 - Limited space
 - Personal shorthand
 - No backup
 - Static view
 - Volatility



Forces driving adoption of PDA's in Healthcare

- Rapidly rising cost of healthcare
- Greater awareness of medical errors
- Increased physician demand
- Increased demands on physicians
- Advances in technology



Rising Costs of Healthcare

- Healthcare accounts for 14% (\$1.2 Trillion) of GDP in 1998
- Costs expected to be over \$2.2 trillion this year
- US Prescription costs represent \$100B growing at 15% annually
- Generic Switching and Formulary Compliance
 = 3-4% savings

Greater awareness of medical errors

- IOM Study: 98,000 deaths/year
- Errors cost society \$15B/yr

Why PDA's?

- ~ 25% secondary to poor handwriting
- Texas physician ordered to pay \$225k for poor handwriting

Patients demand and deserve better care!!

Increased Physician Demand

Why PDA's?

- Many medical students and residents being issued PDA's and required to use them
- Increasing complexity of disease management driving physicians to better methods of information management
- Increasing number of medical graduates computer literate



Increased Demands on Physicians

Up to 46% of a physician's day is lost in administrative tasks

Physicians are seeing more patients per day while getting paid less for their services.

Why Now?

Advances in technology

- Devices converging: PDA's, cell phones, pagers
- Acceptable Form factor: smaller, less intrusive devices
- Price: 1/5 the cost of desktops in terms of capital and support
- Improving Technology:
 - Connectivity
 - Screen technology
- Battery life
- Memory capacity



Who makes PDA's?

Palm OS Devices

- 79% market share in US
 - Palm 58%
 - Handspring 15%
 - SONY 6%
- Nice blend of form and function
- Simple and intuitive applications
- Limited processor and memory, poor screen resolution



Who makes PDA's?

Pocket PC

- Don't ever bet against Microsoft
- Market Share increasing dramatically
 - Compaq from 2 to 7% PDA units
 - H-P from 3 to 5% PDA units
- Powerful, full-featured
- Shorter battery life
- Larger than Palm, but still passes the white-coat test







Where we are today...

Others:

- Psion
- Research in Motion
- WAP Phones
- Many more to come...



Advantages: Hardware

Size: Palm

However, we haven't seen real innovation in a long time

Weight: Palm

Battery Life: Palm

Screen Size/Resolution: PocketPC

Processor Speed/Memory: PocketPC (but may not be reflected in end user experience)

Advantage: Built in Software

Ease of Use: Palm

Function: Windows CE

Windows CE has the distinct advantage of including "Pocket" versions of their office suite allowing viewing/editing of documents on the PDA. Also, MS has included extras like ebook readers, voice recorders and MP3 Players

Advantage: Third Party Software

Palm: Tens of thousands of developers who have learned a new development environment and recognize that handheld computing is a different paradigm.

Microsoft potential: Can leverage existing code base but run risk of "shoehorning" desktop solutions into a PDA

Advantage: Connectivity

Microsoft:

- Faster synchronization times (690kbps vs 115.2 kbps)
- Serial vs. USB options in same device
- Better integration with Windows OS
- No support for other Operating Systems

Who has used PDA's

- Studies in PDA usage for
 - References
 - Patient Diaries
 - Patient Surveys

Use of PDAs by Residents

The Constellation Project: Experience and Evaluation of Personal Digital Assistants in the Clinical Environment

Labkoff SE, Shah S, Bormel J, Lee Y, Greenes RA

SCAMC, 1996

Constellation Results

- PDA accessed 3486 times by 28 residents
- Average 1.25 uses/day/resident
- Overall the PDA (Newton MessagePad 100) was:
 - a time-efficient way to get reference info (22/28).
 - portable
 - too big/too heavy (10/22)

Available medical references

Epocrates

- Rx and ID guide in use by 25% of all physicians
- Free !!!
- Autoupdate via IP based syncing
- PocketMedicine
 - New company creating PDA specific content by known authors
- Handheldmed
 - Porting of popular medical handbooks to PDA format

Overall Assessment

- Evidence (and the masses) supports use for storing and retrieving small amounts of text
- Opportunities for improvement with newer technology that promise even more utility

PDA as a Forms-based Data Entry Tool

- Electronic Diaries
- Surveys
- Guideline-based Documentation

PDA as an Electronic Diarv

- Use pen to select responses
- Can capture text responses
- Can skip irrelevant questions
- Can ensure accurate and complete data

	New Quest	ionnaire		
How have you been FEELING IN GENERAL during the past week?				
0	In excellent spirits			
े	In very good spirits			
0	In good spirits most	ly		
0	l have been up and d	own		
0	In low spirits mostly	,		
0	In very low spirits			
Qu	estion No: 1 of 22	Next Question		

Figure 1. A question from the PGWB section of the electronic questionnaire. The subject tapped the appropriate box with a stylus to indicate the response.

Example Domains

- Diabetes
- Asthma
- Gynecology
- Headaches

- Quality of life
- Nutrition
- Pain
- Smoking Cessation

Advantages Over Paper

- Automatic date/time stamping
- May be more available if device is carried everywhere
- May be more interesting to use

Electronic Diaries for Asthma

- Filled out randomly mornings and evenings for 4 weeks.
- Used PDA and paper surveys to record
 - Peak flow
 - Medication use
 - Symptoms
- 13/19 preferred electronic; 5 paper; 4 no pref
- Higher proportion of missing data using PDA (did not allow data to be entered retrospectively)

Tiplady B, et al. Qual Life Res, 1995





Tiplady B, et al. Qual Life Res, 1995

PDA-based versus Paperbased Survey



Johnson KB, et al. Pediatrics, 1995

PDA-based versus Paperbased Survey

- PDA also significantly better for:
 - use by other teenagers
 - 7/10 said they would love it or think it was pretty good.
 - 7/10 paper users said others would not like their method
 - answering questions when not feeling well
 - 9/10--good or best way they could imagine
 - 2/10 paper users said good or best way they could imagine

Choosing Technology to Support the Measurement of Patient Outcomes

Johnson, CJ, Nolan MT, 1999



Overall Assessment

- In general,
 - Faster than paper, especially if complex surveys
 - High patient and provider acceptance
 - especially useful for codified entries
 - Overall expense lower than other solutions such as scanning forms! (PDA + app + training+ support)

Asthmonitor

- PDA-based implementation of Practice Parameter for outpatient asthma
- Allows data entry, printing
- Provides decision support at point of care
 - patient-specific
 - automatic

How Far To Go? The Evidence Speaks

- Increased frequency of measured peak expiratory flow
- Increased administration of quickreliever medications

BUT...

No improvement in intermediate patient outcomes!

Shiffman RN, et al. Pediatrics 2000

How can I use a PDA

Types of Applications

Solution Architecture

Handheld Applications

Administrative

- ✓ Charge Capture
- 🗸 Email
- Contacts
- ✓ File Cabinet
- Procedure Logs

Clinical Information

- ✓ Results
- Orders
- Medications
- ✓ Problem Lists
- ✓ Consults

Reference and Tools

- ✓ Drug Reference
- ✓ Formularies
- EBM Tools and Calculators
- ✓ Literature
- ✓ Research

Architecture of Handheld Solutions



Always Connected





Occasionally Connected

Rarely Connected



Solution Architecture

Always Connected: PDA as a thin-client

- Requires always active wireless connectivity
- Useful Applications:
 - Order Entry
 - Real time monitoring
 - Lab Results viewing
 - Radiology Results viewing

The Wireless Revolution

Personal Area Network:

Bluetooth 10-30 feet



- **Local** Area Network: 10-30 meters
 - IEEE 802.11
- Wide Area Network: Everywhere
 - CDPD Cellular Network (OmniSky, WAP
 - Mobitex Pager Network (Palm VII)



Always Connected Solutions

- Approach taken by most existing HIS companies
 - Port existing web application
 - Most using 802.11 wireless standard
 - Not acknowledging that PDA's are different

Solution Architecture

Often Connected

- Frequently synchronized applications that can operate in a connected and disconnected modes
- Typically exist within the firewall of an enterprise
- Useful Applications:
 - Charge Capture
 - Lab Results
 - Medication Lists

Often-Connected Solutions

AvantGo: The Internet on your handheld

- Provides Palm, PocketPC and WAP Phone support for http based content and forms
- Free avantgo.com site allows configuration of public channels
- Enterprise server available for custom applications requiring security
- Advantage in leveraging existing http based infrastructure

Often-Connected Solutions

Middleware solutions from a variety of companies

- Proprietary server integrates handhelds, web and existing IS systems
- Services, Interfaces, Hardware, Training provided under a service contract
- Integrates to existing ADT, Billing, Lab systems
- Examples: PatientKeeper, MercuryMD, MedAptus

Solution Architecture

Occasionally Connected

- Connected once a day or less, typically via internet
- Used for information management tasks that don't change much in a day
- Useful Applications:
 - Charge Capture--MDEverywhere
 - Electronic Prescription Pads--AllScripts, ePhysician
 - References with update features (ePocrates)

Occasionally Connected Solutions

Automatically Updating Reference Companies CPOCRATES

- 500,000 user network including 25% of all physicians
- "DocAlerts" push information to users PDA's
- Free drug and infectious disease reference
- Will be providing automated Rx refill capability
- Users to earn honoraria (\$\$\$) by participating in marketing



 Subscription-based access to text-book references (e.g. The Merck Manual)

Solution Architecture

Rarely Connected

- Connected less than once per day, typically just for backup to PC or periodic upgrades
- Many freeware or shareware examples available online

Examples:

- References
- EBM Tools
- Medical Calculators
- Stand-alone patient management applications

How do I create PDA software

- Palm
 - Metrowerks Codewarrior
 - Appforge for Visual Basic
 - Satellite Forms
 - Pendragon Forms
 - J-File, HanDBase
- Windows CE
 - MS Visual Basic, Visual C++

How should I design PDA software

- Sub-second response
- UI design for Pen
 - Don't let the pen obscure the screen
 - Most common controls in lower right corner (sorry lefties)
 - Minimize pen taps (3 tap rule)
 - Content/Functionality appropriate for device

Keys to Success in the Enterprise

- Integrate with *existing* Healthcare Information Systems
- One (and only one!) handheld, centrally administered
- Integrate applications with physician workflow
- Easy migration from wired to wireless environment (and back again...)

Learnings over the last 5 years

- PDA's are here to stay
- Size Matters--The Newton had everything Palm does and more but it took the Palm Pilot to jump start the market and the Palm V to make it really take off.
- People will adopt their style for the right device/functionality--Grafitti



- Reference Applications
- Medical Utility Applications
- EMR "Light" or PGMR (pretty good medical record)

