
CME Review Article

Editor's Note: This is the last of four articles published in 2004 for which a total of up to 4 Category 1 CME credit hours can be earned. Instructions for how credit hours can be earned appear after the Table of Contents. Exam questions will appear after the article.

A Pediatrician's Personal Digital Assistant: Ubiquitous Computing

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Target Audience

This CME activity is intended for physicians, medical students and nurse practitioners. Pediatric emergency department physicians, emergency physicians, pediatricians, and family practitioners will find this information especially useful.

Learning Objectives

After completion of this article, the reader will be able to:

1. Summarize the advantages of using a personal digital assistant (PDA).
2. Discuss which devices can be used to input text into the handheld device.
3. Describe the benefits that should be considered when expanding the memory component of a handheld device.
4. State which operating system has the largest medical application selection.
5. Identify the different pediatric palm application categories.

Abstract

Personal digital assistants (PDAs) can provide a portable, integrated platform for point-of-care clinical reference, patient management, and data communication for pediatricians practicing in an ambulatory or hospital setting. Clinical reference programs within the PDA can allow pediatricians to access

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information from the Internet and anticipatory guidelines issued by the American Academy of Pediatrics. Patient management programs allow pediatricians to access and store clinical information. Wireless technologies, such as the PDA, have potential for rapid exchange of clinical laboratory results and efficient electronic patient information transfers. Thus, these devices provide the potential for true continuity of care across all aspects of general pediatrics. In this article we present the basic hardware, operating system, and applications of the PDA for the contemporary pediatrician. *Int Pediatr.* 2004;19(4):198-203.

Keywords: Personal Digital Assistant, PDA, computing, handheld computer

Introduction

Increasing responsibilities and demands on pediatric patient management and health care services require more reliance on technology. Computers and personal digital assistants (PDAs) can enhance a pediatric practice by providing an effective means of storing, retrieving, analyzing, and sharing large volumes of information pertinent to patient care.¹ The advantages of using a PDA database for documentation of clinical services include: more efficient entry of data; increased portability of and access to patient and clinical data; and the ability to transfer information among collaborating clinicians.² The PDA empowers pediatricians with a small portable device to maintain lists of current and past medications, drug-related problems, and medical conditions. Data is generally clear and better organized compared with data on paper forms or conventional index cards with a plethora of reference information.

Although PDAs can provide many benefits in clinical practice, pediatricians need to be aware of some limitations. The lack of standardization of information

technology within and across institutions and departments is the single greatest problem.³ Many hospitals use multiple independent databases (e.g. for pharmacy, laboratory, and radiology) that are poorly integrated and result in an inability to combine patient information from various sources into a meaningful record. Contemporary computing however, allows for smooth integration of PDAs, within hospital computer systems, and electronic patient records enhancing access to critical medical information at the patient bedside or in the examination room.

Pediatricians can benefit greatly from using PDAs in all aspects of their clinical care. PDAs offer clinicians the ability to enter and manage critical information at the point of care.⁴ Although PDAs have always been designed to be intuitive and easy to use, recent advances in technology have made them even more accessible. The ability to link data on a PDA (client) to a central database (server) allows for near-unlimited potential in developing point of care applications and systems for patient data management. Although many stand-alone systems exist for PDAs, none are designed to work in an integrated client/server environment.

Although the handheld computer offers the promise of bringing evidence-based medicine to the bedside in everyday practice, most pediatricians today either do not own a handheld computer or use their handheld computers solely as a day planner for keeping track of important appointments and contact information.⁵

There are a number of reasons why many practitioners are hesitant about using handheld computers: data entry through the "Graffiti" character recognition pad on a handheld, although fairly easy to learn, can be tedious for entering large quantities of data; when compared with personal computers (PCs) handhelds have small screens that are less than ideal for reading long volumes of text and for displaying graphics; handhelds have limited memory and slower processing speeds, and finally, many physicians have raised questions about the security of storing confidential patient information on handhelds.

A recent study by Leitman et al demonstrates there is an increase in the use of handheld devices by general practitioners (from 15% in 1999 to 26% in 2001).⁶ Our goal is to present the practicing pediatrician the basic hardware, software, and medical applications available when selecting a PDA for practice in a pediatric ambulatory or hospital setting.

What is a PDA?

PDA is an abbreviation for personal digital assistant, which is a collective term often used to describe handheld devices that are sold in the market. Most PDAs are an extension of the standard-sized computers due to their size, portability and ease of use. PDAs will allow the practicing pediatrician to schedule tasks, manage patient cases, and look up clinical references.⁷ A PDA used for more than organizational purposes is not a stand-alone device. It will need to be connected via the cradle that comes with it for loading and updating software, transferring information, and backing up pertinent information (Fig. 1). For non-computer-savvy pediatricians, the handheld industry's excess of technical jargon and its rapidly expanding array of available gadgets can be dizzying. The aim of this article is to introduce handheld devices and the range of hardware options that are available to the practicing pediatrician.

Hardware

The general drift in the handheld arena has been toward smaller handheld devices. Some of the smallest devices, such as Handspring's Visor Edge, Palm's m500 series or the new Handspring Treo 90, can fit comfortably into a shirt pocket, and even larger devices can fit comfortably into a lab-coat pocket.⁸ Ultimately, handheld size is a matter of personal preference. There are 2 main factors that pediatricians should take into



Fig. 1 - PDA Palm m130.

consideration when contemplating the size of a handheld: price and portability. Smaller models tend to be more expensive. However, smaller models may also tend to be the ones that people continue to keep with them and use once the novelty of having a handheld dwindles.

Screen Resolution

Handheld devices, in general, have two screen types: monochrome or color.⁹ Devices with a monochrome screen feature a backlight that can be used in dim lighting conditions. However, not all monochrome screens are identical; some offer much sharper resolution that makes for easier reading of text. Similarly, like digital cameras, color handhelds differ in the number of colors that are supported and the screen resolution. Currently, all color models by Palm and Handspring support a resolution of 160 by 160 pixels. The HandEra 330 supports 240 by 320 pixels and Sony has models that range from 160 by 160 pixels to 320 by 480 pixels.^{10,11}

When weighing the importance of screen resolution, you should test the models yourself. If you intend to use your handheld primarily for reading text, then screen resolution may not be a particularly important consideration. However, if you would like to use your handheld to store graphics and even pictures of patients with particular conditions, it may be worthwhile to invest in a model with higher resolution. Screen brightness should also be taken into account when determining how well images are viewed on a screen. It is helpful to test the models with the backlight on.

Graffiti Input

There are many means of inputting data into a handheld. Graffiti, which is a set of characters very similar to the printed alphabet, provides a reliable and easy way to learn text entry into handheld computers. However, some people find it daunting to learn a new way of writing letters. As a result, "thumbboards" which are miniature keyboards that are designed for thumb directed text entry are becoming more popular. These thumbboards are similar to the keypads on the standard-shape computer keyboard. In fact, two of the newest handheld computers, the Treo 90 and the Sony NZ90, are equipped with built-in thumbboards.¹² Furthermore, many of the existing handhelds are able to support

add-on thumbboards. Seiko makes a thumbboard for the Palm Vs, m500s and Handspring devices that fit snugly over the Graffiti area. Palm's mini keyboard, with models compatible with the i705 and m500 series, is a thumbboard similar to that made by Seiko.¹³

External keyboards are also a great accessory for typing long memos or text documents. When combined with word processing software, such as Documents-to-Go, a program that is bundled with many handhelds and allows for the synchronization of documents with Microsoft Word, Excel and Powerpoint text documents can easily be created on a handheld computer and transferred to a PC. Think Outside's Stowaway Portable Keyboard is a full-sized keyboard that can be folded up to allow for portability. Think Outside manufactures keyboards for most Palm, Handspring and Sony devices.¹⁴ Palm also produces a similar fold-up full-sized keyboard that is compatible with their handhelds (Fig. 2).

Memory Expansion Cards

The Secure Digital (SD) card is a small flash memory card roughly the size of a postage stamp with the thickness of a credit card. It was jointly developed by Matsushita Electronic (best known as Panasonic), SanDisk and Toshiba. The SD Card weights approximately two grams. The SD Card can be used in a variety of digital products such as digital music players, cellular phones, handhelds, digital cameras, digital video camcorders, smart phones, car navigation systems and electronic books. The Palm M series and the i705 from Palm, as well as the Treo 90 from Handspring, feature a SD expansion card slot.¹⁵ The SD slot on handhelds is also compatible with MultiMedia Cards (MMC), which are now mostly used in cellular telephones.

The primary benefits of SD Cards are speed, input/output (I/O) capabilities, security, and interoperability. These features make it the most secure and flexible media to expand the capabilities of the handheld and interoperate with other devices. At 10 MB/sec, it is a very fast interface for both memory and I/O. The primary benefits of memory cards (MMCs) are cost and ROM capability. Because ROM is less expensive than flash memory, MMC ROM cards would likely be the best choice for the wide distribution of data, offering a significantly lower-cost alternative to either SD or MMC flash cards. Compact Flash

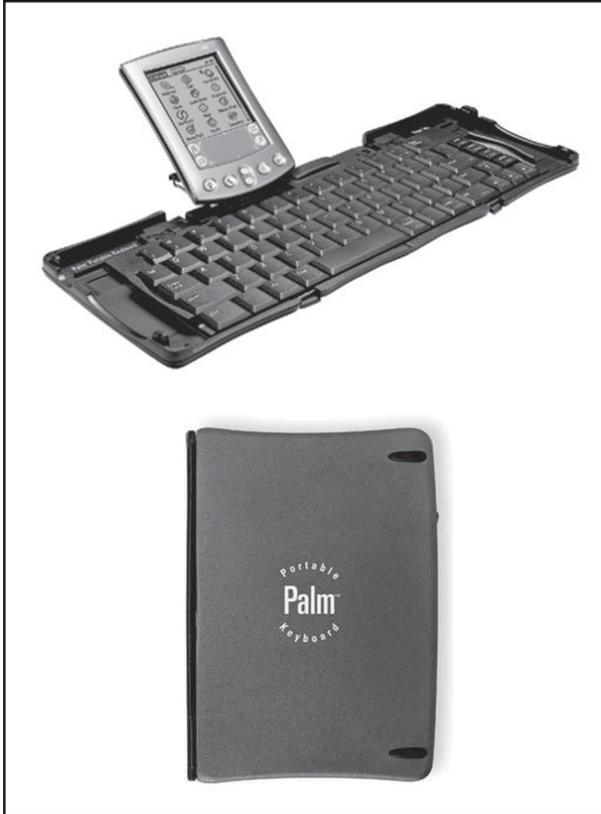


Fig. 2 - Thumbboard for various Palm series.

memory cards used by HandEra's lineup and Springboard expansion slot devices used by most of Handspring's models tend to be larger than the newer SD and Memory Stick cards.¹⁶ Memory cards with 128-MB capacity are in general circulation. A number of expansion-card manufacturers have announced plans to release much larger cards in the near future, with a 4-GB card.

Operating System

The first choice one needs to make in choosing a handheld device is which operating system (OS) best fits your needs. Handheld devices are typically differentiated from each other by the operating system or platform on which they run. A particular handheld device can only run a single operating system.¹⁷ The choice of operating system is similar to choosing a Mac OS or Windows platform for a desktop computer. The two main operating systems that run on handheld devices are Palm OS and Microsoft Pocket PC, formerly Windows CE (Table 1). The main factor

in choosing an operating system is the availability of applications. With regard to software availability, the Palm OS currently has about 14 000 different program titles and the largest selection of medical applications available for any handheld OS. More than 97% of handheld software titles sold in the United States last year were for the Palm OS.¹⁸ Because most medical personnel currently use Palm OS devices, this article focuses on hardware models that support the Palm OS.

Pediatric Applications

There are various applications that can be utilized in both ambulatory or hospital based pediatrics. For the purpose of this article we divided software (applications) into four broad categories: references, calculators, databases, and utilities. Reference software includes all applications that contain information for use at point-of-care such as Harriettlane handbook, ePocrates Rx Pro, and Tarascon ePharmacopoeia.^{19,20} Calculator applications such as MedCalc, NICU Math, and TPN Calc²¹ have been created to facilitate arithmetic problems. Database software for the PDA OS and Pocket PC platform allows storage and retrieval of pertinent patient information such as Patient Tracker, Patient Keeper, and AbPK. Lastly, software is also divided into utility applications that offer extra functionality to the PDA such as Palm EKG, Dorland's medical dictionary, and JournaltoGo. Studies have shown that using various utility software helps reduce medication error rates by comparing contraindications of medications prescribed.²² These applications can be downloaded, installed, and executed on the PDA by visiting the corresponding websites listed in Table 2.

The Future – Bluetooth Wireless Technologies

Bluetooth is the name for a short-range radio frequency (RF) technology that operates at 2.4 GHz and is capable of transmitting voice and data. Bluetooth transfers data at the rate of 1 Mbps, which is from three to eight times the average speed of parallel and serial ports, respectively. Developed by a consortium of leading technology vendors, including Palm, Intel, and Nokia, Bluetooth wireless technology provides high-speed, reliable, and ad hoc communications

Table 1 - Features of Microsoft Pocket PC vs. Palm OS

Microsoft Pocket PC	Palm OS
Parallel to desktop PC	Longer battery life
Multitasking	Stable OS
Multimedia	Large selection of software
Extra Memory**	More medical software availability
Pre-installed applications	Smaller memory size applications
Cumbersome to learn	Easy to learn

* Cellular and MP3 technology available on Palm OS platform.

** Palm OS devices have less internal memory (8mb), but applications are small and external memory cards are available.

Table 2 - Examples of PDA applications for Palm OS and Microsoft Pocket PC

Name of Program	Type of Program	Location for Download	Platform
5 Minute Pediatric Clinical Consult	Reference	www.skyscape.com	Pocket PC / Palm OS
The Harriet Lane Handbook PediSuite	Reference Calculator	www.skyscape.com www.medicalwizards.com	Pocket PC / Palm OS Pocket PC / Palm OS
Pocket Pediatrics Patient Tracker	Reference / Database Database	www.lww.com www.handheldmed.com	Pocket PC / Palm OS Pocket PC / Palm OS
Journals-to-Go	Utility	www.journaltogo.com	Pocket PC / Palm OS

connections with a range of up to 100 meters, or about 300 feet. Bluetooth wireless technology has built-in encryption and authentication and is thus very secure in any environment. Bluetooth trademarks are owned by Telefonakiebolaget L M Ericsson, Sweden.

Bluetooth wireless technology will enable pediatricians of handheld devices to communicate with other devices enabled by this technology—PDAs, PCs, cell phones, printers, network access points—without having to install cables and synchronization cradles, or use line-of-site technologies. It offers a low-power, low-cost connection in the medium range of 1-100 m with a bandwidth of currently 723.2 kbaud.²³ It holds significant promise for handheld use at sites such as hospitals, where busy pediatricians often do not have the time to wait at synchronization cradles. Thus, wireless communication could help to overcome current obstacles in medical devices and could enable medical services to offer completely new scenarios in health care.

of large databases and medical texts that can be retrieved quickly at the point-of-care. In the near future, handhelds promise to be even more useful to pediatricians by providing even faster access to greater volumes of information, improved security, support for wireless networks, better screen resolution, and audio playback and recording abilities. However, it will be up to licensees of the OS to decide which features they want to include in their products.

In addition, with devices offering improved audio playback and recording support, it is conceivable that a device will come to the market in the near future that would allow physicians to dictate their patient notes directly into their handheld, and then transmit the audio file directly to the desktop computer of their secretary through wireless networking. With the emergence of expandable devices and the potential of wireless access, the handheld may move from being a novel gadget with a devoted following among technologically savvy users to a standard pediatrician's companion.

Conclusion

With the advent of memory expandability, the handheld has made enormous strides toward increased functionality for the pediatrician by allowing the storage

Acknowledgments

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December 2004

EXAM POSTMARKED DEADLINE: DECEMBER 31, 2005

Personal Digital Assistant: Ubiquitous Computing

Alberto J. Caban-Martinez, BS, MPH; Alberto J. Caban-Alemañy, MD. *Int Pediatr* 2004;19(4):198-203.

QUESTIONS

- 1. Which of the following types of formats would you expect to find the resolution of a newly acquired handheld device?**
 - A. Monochrome only
 - B. Color only
 - C. Monochrome or Color
 - D. Gray scale only

- 2. Among the following, which one is NOT a device that can be used to input text into the handheld device?**
 - A. Graffiti area
 - B. Thumbboard
 - C. Mouse
 - D. Mini keyboard

- 3. When expanding the memory component of a handheld device, which of the following benefits should NOT be considered:**
 - A. Size
 - B. Speed
 - C. Security
 - D. Interoperability

- 4. Of the following operating systems, which one has the largest medical applications selection as described in the article?**
 - A. Mac Operating System
 - B. Windows Operating System
 - C. Microsoft Pocket PC
 - D. Palm Operating System

- 5. Which of the following pediatric palm application categories would the software "The Harriet Lane Handbook" belong to?**
 - A. Databases
 - B. Reference
 - C. Calculators
 - D. Utility

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1. Were the stated program objectives successfully met?

A. Yes

B. No

C. Partially (please explain) _____

2. Were the selected article and related questions relevant to your practice?

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B. No (please explain) _____

3. Do you anticipate that participation in this program will result in any behavioral change in your delivery of patient care?

A. Yes (please indicate the behavioral change that you anticipate) _____

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