

IN BRIEF

- Provides a background to the use of Portable Digital Assistants (PDAs) in dentistry and dental education from findings in a formally conducted trial.
- Provides a rationale for all dental students at one large dental institution to have a PDA as part of their standard equipment.
- Addresses technical and security issues associated with wireless internet links to mobile devices, for example when accessing an online virtual learning environment.
- Provides evidence of educational use in clinics and the social use of PDAs.

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CPD PAPER

Portable Digital Assistants (PDAs) in dentistry: Part I

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Aim To provide a basic understanding of the features of a portable digital assistant (PDA) and how it may be useful for the general dental practitioner. **Objectives** To outline the various types, functions and applications of a PDA and suggest its use for the dental professional now and in the future. To enable appreciation of the technology and educational evaluation carried out in the pilot study reported in Part II. **Design** Part I is a descriptive account of the use and function of the PDA in dentistry and its potential for the future. **Method** A review of the literature was carried out drawing on evidence from general healthcare and assessments of portable computing aids evaluated in a dentally related setting. **Results** Choosing a PDA for use in dental practice is complex but should be based on the user's needs mapped to key features, size and cost of the device. **Conclusion** No ideal customisable mobile digital solution currently exists but evidence from general healthcare use suggests that there are valuable features that can aid the general dental practitioners such as personal management and point of source assistance.

INTRODUCTION

The maturity and prevalence of mobile technologies is such that a generation of prospective students is increasingly familiar with digital tools such as PDAs, as well as smart mobile phones and handheld computers.¹ This new generation is both willing and wishes to extend its usage of these tools² from

social use into the realms of study and work.³ US experience suggests that for medical students, residents and doctors, PDA use will become increasingly useful, if not ubiquitous.⁴ However, what does this mean for the dental profession? Part I describes what a PDA is and does and examines the potential uses in the future. This will aid appreciation of a technical assessment of the functionality and wireless networking of PDAs as part of a pilot study into the educational use of PDAs by students in the Primary Dental Care Unit of a large UK teaching hospital (Part II).

Definition and development of PDAs

A Portable Digital Assistant is a handheld device that combines computing, especially personal organisation, with the options of mobile communications such as telephone/fax, internet and networking features. The term was first coined in 1992 by Apple Computer's then CEO, John Sculley,⁵ followed by the launch of their now discontinued

MessagePad (Newton) in 1993. Shortly thereafter, several other manufacturers offered similar products which differed in their operating systems, range and presentation of functionalities eg Psion™, iPAQ™ and Palm™.

PDAs are also called palmtops, handheld computers and pocket computers. With the emergence of mobile technologies over the last decade, the convergence of PDA and phone has led to the 'smartphone' which is set to lead as the dominant platform of mobile computing and communications.⁶ The Blackberry™ started its life using paging technology but soon became subsumed by the mobile technologies as a smartphone.⁷ Global positioning systems (GPS) for navigational use are also incorporated into some PDAs and in the second quarter of 2005 almost half the number of PDAs sold had GPS included.⁸ Furthermore, the use of different wireless communications technologies such as Bluetooth™ and third generation (3G) mobile equipment has extended the

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connectivity and capabilities of PDAs to the ultimate mobile appliance. Video-conferencing and digital TV are but two of the functionalities now available.⁷

Uses of PDAs in dentistry

The newly available capabilities of the PDA clearly offer innovative applications for the future, but the basic core of the PDA – the Personal Information Manager (PIM), synchronised to the user's main personal computing device, remains the mainstay of day to day usage. Table 1 lists the common functionalities.

Basic features of a simple PDA

Today PDAs are more powerful than desktop computers were 10 years ago. Although there are many similarities between a desktop computer and a PDA, there are some important differences. The hard disk of a PC contains the basic operating system, programmes and stored data and takes several minutes to 'boot up'. The PDA does not have a hard disk, though it does have a central processing unit (CPU) to carry out basic digital operations. The PDA therefore relies on 'read only memory' and 'random access memory' chips (ROM and RAM) which allow it to work the moment it is switched on. However, if the batteries run out, most of the PDA data is lost. PDA batteries (currently Lithium-ion) usually last for several hours of continuous use, and are increasing in their capacity as each new model is developed. Most PDAs include a non-rechargeable backup battery to prevent data loss. Additional memory cards can be slotted in to save data and add functionality.

Whatever the type of PDA, it will have a similar range of basic features (Figs 1-2). The appended glossary explains some of the common technical terms used and Table 2 summarises the common features.

Choice

PDAs are relatively affordable compared to laptop or desktop computers, but the choice is often daunting. The needs of the novice user will most certainly be met by most models. Simple organisers can cost as little as £60 but average PDA costs range from £150 to £350 depending on the features required. It is important to estimate the total cost, not just the purchase price, as there may be a need for additional hardware or software such as

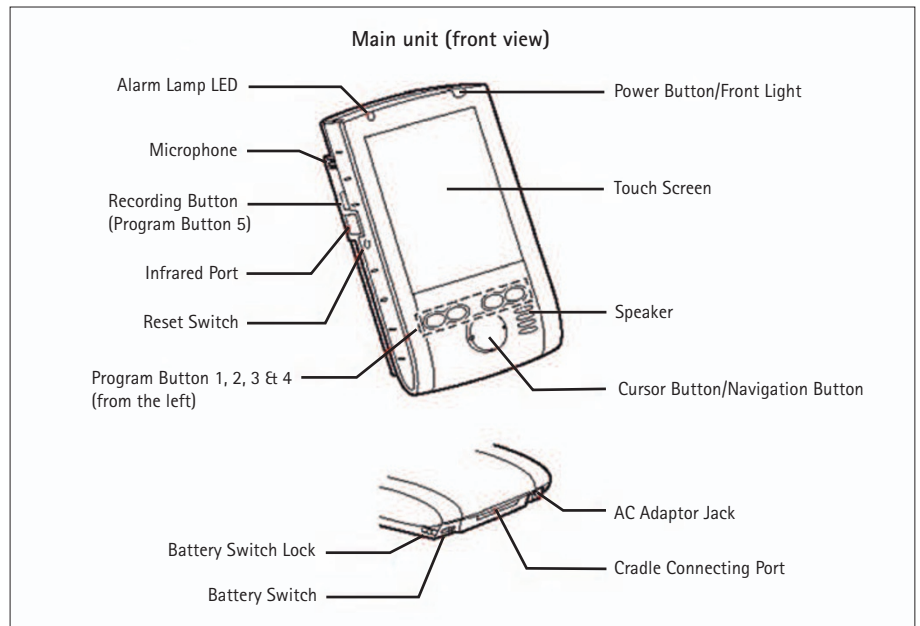



Fig. 1 Typical parts of a basic PDA

When you turn on your Pocket PC for the first time each day (or after 4 hours of inactivity), you'll see the Today screen. You can also display it by tapping  and then Today. On the Today screen, you can see at a glance important information for the day.

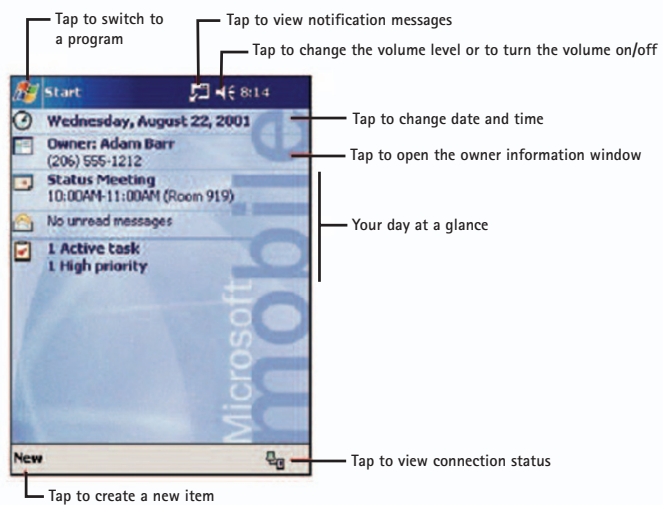


Fig. 2 A typical PDA start page

wireless and multimedia capabilities.

The latest PDAs use maturing technologies that improve the ease of use of features such as connectivity to peripherals eg printers or the internet. Such technologies include Bluetooth (see glossary) and 3G (third generation connectivity) and thanks to both open standards and advanced middleware (connective software such as AvantGo)⁹ this improved connectivity will also address usability problems raised by some users. For example, it will make it easier for a PDA to connect to a printer, thus satisfying expressed wishes for the ability to

download data and read it more easily on paper than on screen.

Wired and wireless networks (infrared 'beaming', WiFi [wireless fidelity], bluetooth, broadband, 3G) together with advanced compression technologies, can now support the fast transmission of rich multimedia content.¹⁰ More standard mobile communications using GPRS (general packet radio system) and GSM (global system for mobiles) provide mobile phone and internet access for some brands of PDA.

The Joint Information System Committee (JISC) is a strategic advisory

committee working on behalf of the UK higher and further education bodies. JISC commissioned an important PDA review by Anderson and Blackwood (2005).⁶ Table 1 usefully compares most features of recent PDAs and can be accessed at http://www.jisc.ac.uk/index.cfm?name=techwatch_ic_reports2005_published#reports.

Size matters – ergonomic challenges

Many ergonomic issues relating to PDA usage have already been noted; in particular, users’ dislike of small screens,¹¹ clumsy electronic note-taking abilities and concerns about battery life and possible data loss due to lack of power. Environmental issues such as light levels in the clinic or classroom as related to screen brightness also need to be taken into account, although much information on these matters is available as they are common to PDA use across all sectors, for example the lucrative business and commercial sectors, which are seeing strong growth in PDA usage. Recent technological developments have addressed many of these problems.^{11,12} The issue of small screen sizes, for example, is being addressed by flexible film screen displays; data input is being improved by the development of advanced voice recognition and handwriting systems and by connectable flexible portable keyboards; and battery life is fast increasing due to new lithium batteries.

Content

The design and presentation of content available to PDA users, especially for educational uses, is also of the utmost importance to their effectiveness. In the early days of PDA use, there was a general concern that digital handheld tools would be viewed as ‘a technology push with no user pull’. However, the general success of applications and content delivered specifically for PDA usage has now successfully challenged this view. For example, many PDAs can view familiar content such as Powerpoint presentations, and some offer the functionality to edit slides. Increasingly, library material is being made available online in formats appropriate for PDA use. There are a growing number of PDA-specific learning, dental, medical and research applications available both as freeware (free software distributed online) and in proprietary software suites.¹³ More

Table 1 Uses of a PDA in dentistry

| |
|---|
| <p>Personal management:</p> <ul style="list-style-type: none"> • Calendar/Diary • Clock/alarm and time zone adjustment when abroad • Office suite: Word processor etc |
| <p>Communications:</p> <ul style="list-style-type: none"> • Address book and contact list • Internet access (wireless, smartphone etc) Email • Access to Practice promotional software eg own website |
| <p>Point of care assistance</p> <ul style="list-style-type: none"> • Prescribing information • Clinical guidelines and decision aids • Patient education • Electronic patient records |
| <p>Educational</p> <ul style="list-style-type: none"> • CPD, online courses • Webcasts • Lecture notes, presentations, photographs and diagrams • Research activities, data collection etc |
| <p>Recreational</p> <ul style="list-style-type: none"> • Gaming which can include educational games • Shopping but including practice ordering |
| <p>Other:</p> <ul style="list-style-type: none"> • GPS for domiciliary visits, patient directions to practice etc |

advanced technologies are behind a new generation of PDAs that can use content such as video, animation and images.¹⁴

Finally, antivirus software is becoming a necessity as ever more devious and malicious software elements develop and spread. This is especially so now that PDAs can have independent internet access or become infected during data transfer during synchronisation with a PC.¹⁵

Future uses

Table 3 lists some of the future uses of PDAs. Many are already available but are likely to become relevant in the future daily lives of practitioners. The convergence of technologies and functionality together with the streamlining or dominance of different forms of connectivity will mean that mobile devices such as PDAs, mobile phones and MP3 audio players (eg iPOD™) will provide ever richer resources and capabilities.

The pace of change in the current digital era has been phenomenal and adjusting to newer support methods of personal management and computing has meant a sea-change especially for the generations that did not grow up with computing. In the study by McAlearney *et al.*,⁴ doctors agreed that incorporating

Table 2 Common features of a PDA

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|--|
| <ul style="list-style-type: none"> • On screen keyboard or handwriting recognition. • Calendar – For meetings, appointments, etc, with the appearance of the original ‘FiloFax’ • Address Book – A list of important contacts and their details. • Memo Pad to jot notes • Calculator • To-Do List– Helpful reminders • Email – Lets you compose email and send via synchronisation or through wireless connectivity • Backlight for working in darker environments • Access to a suite of PDA programmes including Office suites, Acrobat™ (portable digital format pdf) • Internet access– mainly through WiFi and a local wireless network or in smart phones with mobile phone connectivity • Plug-in capabilities for features such as cameras and additional memory although many newer models may include them |
|--|

new electronic technologies into medicine would continue – it was ‘inevitable’. The participants also felt that PDAs were destined to become critical because of the potential to improve quality of care even though there were concerns over losing autonomy and becoming dependent on the devices. However, availability of training in the use of PDAs would be beneficial to those who did not have the time or technical skills to update their knowledge by themselves.

CONCLUSION

The development of ever more ingenious and innovative portable communication and computing devices is inevitable. This may include physically wearing the device, but will most certainly involve wireless connectivity at increasing bandwidths. However, it is important to ensure that they are user friendly, robust, safe and secure to use and do effectively support patient care and CPD. Modern society is now mobile and global and there is an expectation that professionals must remain up to date to meet the growing expectations of the public.

This article introduces the practitioner to the concept of the PDA but the literature and evidence base is lacking for dentistry. The following pilot research project (Part II) was designed to start bridging the gaps by looking at

Table 3. Future uses of the PDA for the practitioner

In the Practice

- Electronic prescribing
- Electronic patient record creation and review including images
- Dental practice management software, administration support, diary, alerts, ordering, practice security, synchronized by a secure wireless network
- Remote patient diagnosis /advice and secondary referrals
- Patient information and reminder notices sent to patient's own mobile device
- Communications between the dental team

Personal Management

- Mobile computing, anyplace, anywhere
- Voice activated constant companion
- Videoconferences and links to the family and recreational activities
- Security
 - Linked to home or practice if there is an intruder
 - Automatic entry to authorized areas

CPD

- Ultimate portable communication and teaching device
 - e-Learning, webstreaming, assessments etc
 - Conferencing
 - Wireless connection to peripheral equipment and virtual tools
- Automated attendance recognition at meetings

the secure use of PDAs in a professional environment and to understanding the barriers and difficulties encountered by the users (undergraduate dental students). The pilot project also aimed give an insight into the potential of PDAs in teaching and learning in dentistry.

Glossary

3G: Third generation connectivity protocols in mobile telephony that support much higher data transmission rates, measured in Mbps (Mega bits per second), intended for applications such as full-motion video, video-conferencing and full internet access.

AvantGo: Software that reconstructs standard web pages into a PDA viewable format, thereby giving access to webpages for news, weather, stock quotes etc.

Bandwidth: The maximum amount of data measured in kilo bits per second (kbps) that can be transmitted along a communications channel. A dial up modem typically runs at 56 kbps.

CPU: Central Processing Unit - the chip which performs the digital operations

that run the PDA. The speed at which this chip runs is measured in megahertz (MHz).

Cradle: Device into which a PDA slots to charge its batteries and connect to a PC. Not all PDAs use a cradle, instead a cable plugs directly into the PDA.

Display resolution: The number of dots (pixels) which make up the screen, written as the number across the screen x the number down the screen. Higher resolutions mean clearer, sharper, text and graphics. Older PDAs had resolutions of 160 x 160 pixels, but VGA resolution has now made 640 x 480 quite possible.

Display colour: Early PDAs were monochrome but the newer colour displays are usually described by the number of colours eg 65,000 colours.

Expansion cards: Newer PDAs have a slot or slots for adding memory cards or other peripherals, such as a wireless modem or GPS location device. Additional memory is also important for electronic books (e-Books), maps and images. Additional programmes can be loaded. Some PDAs allow you to play music or video stored on a card (MP3 or MPEG formats respectively). Common types of expansion card include Compact Flash (CF), Secure Digital/Multimedia Card (SD/MMC) and Sony's Memory Stick format.

GPRS: General Packet Radio Service. An enhancement to the GSM mobile communications system that supports data packets and transmission speeds akin to those seen with dial up connectivity.

GSM: Global System for Mobile communication is a globally accepted standard for digital cellular communication.

Handwriting recognition: Most PDAs allow you to enter text by writing on the screen with a stylus. This is also termed 'graffiti', which relies on a range of strokes that represent letters, numbers and other characters. More sophisticated systems recognise blocks of text and individual letters.

MP3: (MPEG-1 Audio Layer-3) A standard technology and format for compressing a sound.

Reset: When a PDA loses power to its RAM, all data is lost. When power is restored the device will restart with an empty memory and all settings will have reverted to the factory defaults. However, data can be restored from a backed up PC version. Some Pocket PC devices allow a small amount of essential data to be stored in Flash ROM.

OS: Operating System - the built-in, underlying program which lets the PDA run specific programs such as Office applications. The main operating systems are Palm OS and Pocket PC.

PDA: Personal Digital Assistant (see text).

RAM: Random Access Memory - the amount of storage space the PDA has for data and additional programs. RAM loses its data without power but in a PDA the battery maintains the memory as long as it holds some charge, even with the device switched off.

ROM: Read-Only Memory - a built in memory chip which holds the operating system and a few related programs. 'Flash ROM' which means the programs on the chip can be overwritten for upgrades. Essential data are sometimes also stored here and would not be lost in a reset.

Synchronisation: although capable of basic tasks on their own, a PDA works more effectively when synchronising its data with a PC. Pocket PCs call this ActiveSync and Palm's HotSync. It is usually done by placing the PDA in a docking cradle which often serves as a battery charger. Wireless synchronisation is also possible. Programs can be installed onto the device from the PC or through an internet connection on the PC.

Smartphone: Generally considered to be any handheld device that integrates personal information management and mobile phone capabilities in the same device.

Touch screen: The display screen which through a digitising layer detects the pressure of the stylus, allowing you to enter data and navigate the PDA.

USB: The USB (Universal Serial Bus) is a fast way of connecting the PDA to a PC.

Wireless connections: A wireless connection allows a device to communicate with other devices by radio. The two main types of wireless connection are Bluetooth and WiFi wireless fidelity with the International standard number of IEEE 802.11b or 802.11g. Bluetooth (named after the Danish King Bluetooth who turned the Danes to Christianity in the ninth century), was designed to be a short-range radio network to connect peripherals such as headphones to PCs or PDAs. WiFi is a faster and longer-range system for definitive networks between computers.

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