Portable Computers and Applications in Respiratory Care

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Personal digital assistants (PDAs) have had a tremendous impact in the clinical setting, as they have in business and education environments. This report explores the health care application of PDAs, compares available PDA devices and software, and discusses PDA use for tracking patients, documenting clinical procedures, medical education, research, and accessing medical reference material. This report aims to increase awareness among health care providers about the potential roles of PDAs and to encourage further evaluation of PDAs in respiratory care. *Key words: computers, research, decision-support systems, personal digital assistant, PDA computer, handheld computer, patient records, data collection, information management.* [Respir Care 2004;49(5):497–504. © 2004 Daedalus Enterprises]

Introduction

Throughout the years information technology has contributed to the improvement of health care by giving clinicians faster access to patient information and state-of-the-art treatment options. Health care professionals have also benefited from the ability to select the most effective services in an efficient and time-conserving manner.[1] The risk for potential medical errors has been reduced.[2] Respiratory therapists (RTs) have profited from advancements in information technology as well. Beginning in the early 1980s information handling via desktop computers and integrated networks enabled RTs to rapidly collect, store, and retrieve patient-specific medical and billing information.[3] Computers were also used to tabulate and analyze information to develop practice standards and improve efficiency and effectiveness of pulmonary services.[4]

In our current health care delivery model, the emphasis is on patient-focused care and point-of-service demand. Technological advancements have enabled practitioners to provide services and testing at the bedside, in the home, or in transport. The medical literature supports that this technological progress has improved provider efficiency and the provision of quality care. Innovations in microelectronics information technology have improved the management of clinical information. This is exemplified by the adoption of handheld computers and other mobile devices that enable immediate data entry and access at the bedside.

The handheld computer, also known as a "personal digital assistant" (PDA) has become a valuable and popular tool for various medical applications. Since their introduction in the early 1990s, PDAs have been incorporated into many aspects of medical practice and have gained accep-

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Teresa A Volsko RRT FAARC presented a version of this report at the 33rd RESPIRATORY CARE Journal Conference, Computers in Respiratory Care, held October 3–5, 2003, in Banff, Alberta, Canada.

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Table 1. Comparison of Digital Personal Assistants *(Continued on facing page)*

Brand	Product	Approx. Price ($)	Built-In Memory (MB)	Operating System	Processor	Processor Speed (MHz)	Battery Type	Rechargeable
Palm	Zire	99	2	Palm OS v 4.1	Motorola	16	Lithium ion	Yes
	Zire 71	299	16	Palm OS v 5.2.1	TI OMAP 310	144	Lithium polymer 900 mAh	Yes
	m130	179	8	Palm OS v 4.1	Motorola	33	Lithium ion	Yes
	Tungsten T	349	12	Palm OS v 5.0	TI OMAP 1510	144	Lithium polymer 900 mAh	Yes
	Tungsten T2	399	32	Palm OS v 5.2.1	TI OMAP 1510	144	Lithium polymer 900 mAh	Yes
	Tungsten W	419	16	Palm OS v 4.1.1	Motorola	33	Lithium ion polymer 1500 mAb	Yes
	Tungsten C	499	64	Palm OS v 5.2.1	Intel PXA 255	400	Lithium ion polymer 1500 mAh	Yes
	m515	249	16	Palm OS v 4.1	Motorola	33	Lithium polymer	Yes
	i785	159	8	Palm OS v 4.1	Motorola	33	Lithium polymer	Yes
Sony	PEG-UX50 Clie	700	29	Palm OS v 5.2	Sony CXD2230 GA	NA	Lithium ion polymer	Yes
	PEG-UX40 Clie	600	29	Palm OS v 5.2	Sony CXD2230 GA	NA	Lithium ion polymer	Yes
	NX80V Clie	600	32	Palm OS v 5.0	NA	200	Lithium ion polymer	Yes
	NZ90 Clie	800	16	Palm OS v 5.0	NA	200	Lithium ion polymer	Yes
	TG-50	350	16	Palm OS v 5.0	NA	66	Lithium ion polymer	Yes
	SJ-33	220	16	Palm OS v 4.1	NA	66	Lithium ion polymer	Yes
	SJ-22	180	16	Palm OS v 4.1	NA	33	Lithium ion polymer	Yes
Compaq	H1935	200	64	Windows Pocket PC professional	NA	203	Lithium ion	Yes
	H1945	300	64	Windows Pocket PC professional	NA	266	Lithium ion	Yes
	H2215	400	64	Windows Pocket PC professional	NA	400	Lithium ion	Yes
	H5455	539	64	Windows Pocket PC professional	NA	400	Lithium polymer	Yes
Casio	H5555	650	128	Windows Pocket PC professional	NA	400	Lithium polymer	Yes
	E-125	300	32	Windows Pocket PC	NA	150	Lithium ion	Yes
	E-200	480	32	Windows Pocket PC	NA	206	Lithium ion	Yes

mic = microphone.
NA = information not available.

Table 1. *(Continued from previous page)*

Screen Size (mm)	Screen Type	Device Size (cm)	Weight (g)	Built-in Devices	Built-in Wireless Networking	Expansion Slot	Headphone/Headset Jack	Media Viewing (audio, video)	Web Browsing
160 × 160	Monochrome	11.2 × 7.4 × 1.5	107	No	No	No	No	No	No
320 × 320	Color	11.4 × 7.4 × 1.8	150	Camera	No	Yes	3.5 mm, stereo	Yes	No
160 × 160	Color	12.2 × 7.9 × 2.3	153	No	No	Yes	No	No	Yes
320 × 320	Color	10.2 × 7.6 × 1.5	158	Voice memo	Bluetooth	Yes	3.5 mm, stereo	Yes	Yes
320 × 320	Color	10.2 × 7.6 × 1.5	158	Voice memo	Bluetooth	Yes	3.5 mm, stereo	Yes	Yes
320 × 320	Color	12.2 × 7.9 × 1.8	181	Keyboard, phone	Yes, with GSM/GPRS service	Yes	2.5 mm mono/mic	No	Yes
320 × 320	Color	12.2 × 7.9 × 1.8	178	Keyboard, phone	Wi-Fi (802.11)b	Yes	2.5 mm mono/mic	Yes	Yes
160 × 160	Color	11.4 × 7.9 × 1.3	139	No	No	Yes	No	No	Yes
160 × 160	Grayscale	11.9 × 7.9 × 1.5	167	No	Yes, with Palm Net service	Yes	No	No	Yes
480 × 320	Color	11.9 × 7.9 × 1.5	175	Camera, keyboard	Wi-Fi (802.11)b	Yes	3.5 mm, stereo	Yes	Yes
480 × 320	Color	11.9 × 7.9 × 1.5	175	Camera, keyboard	Wi-Fi (802.11)b	Yes	3.5 mm, stereo	Yes	Yes
320 × 480	Color	7.1 × 13.5 × 2.0	226	Camera, keyboard	Available but sold separately	Yes	3.5 mm, stereo	Yes	Yes
320 × 480	Color	7.6 × 14.2 × 2.3	291	Camera, keyboard	Available but sold separately	Yes	3.5 mm, stereo	Yes	Yes
320 × 320	Color	7.1 × 12.7 × 1.3	175	Keyboard	Bluetooth	Yes	3.5 mm, stereo	Yes	Yes
320 × 320	Color	10.9 × 7.4 × 2.3	172	No	No	Yes	No	Yes	No
320 × 320	Color	10.4 × 7.4 × 1.8	139	No	No	Yes	No	No	No
240 × 320	Color	11.4 × 6.8 × 1.3	125	Keyboard	No	Yes	Yes	Yes	Yes
240 × 320	Color	11.4 × 6.8 × 1.3	125	Keyboard	No	Yes	Yes	Yes	Yes
240 × 320	Color	11.4 × 6.8 × 1.3	125	Keyboard	Wi-Fi (802.11)b	Yes	Yes	Yes	Yes
240 × 320	Color	11.4 × 6.8 × 1.3	207	Keyboard, fingerprint-recognition	Wi-Fi (802.11)b	Yes	3.5 mm, stereo	Yes	Yes
240 × 320	Color	11.4 × 6.8 × 1.3	207	Keyboard, fingerprint-recognition	Wi-Fi (802.11)b	Yes	3.5 mm, stereo	Yes	Yes
240 × 320	Color	13.0 × 8.1 × 1.8	178	No	No	No	Yes	No	No
240 × 320	Color	13.0 × 8.1 × 1.8	178	No	No	Yes	Yes	Yes	Yes

Fig. 1. One type of handheld computer (also known as a personal digital assistant or PDA) useful for storing, manipulating, and accessing various types of medical information.

tance as wireless access portals to computerized patient-record systems, as tools for practicing evidence-based medicine, and as tools for patient care, billing, clinical research, and outcomes data collection and management.[5]

Basic Features of a PDA

PDAs use somewhat different operating systems than do desktop computers. Although Macintosh was one of the first manufacturers to market PDAs, Palm, and Microsoft products dominate the market.

One of the earliest models was the Apple Newton MessagePad (Apple Computers, Cupertino, California), which was released in 1993 and discontinued 5 years later. It had all of the basic features of current PDAs, including handwriting-recognition, communication capabilities (e-mail), personal organizer applications (calendar, address book, to-do list, memorandum pad), calculator, currency exchange formulas, and time-zone maps. That the device did not achieve widespread use was attributed to its relatively large size (20×13 cm), weight (400 g), limited memory (640 kilobytes of random-access memory), short battery life (4 hours with a nickel-cadmium battery), and poor handwriting-recognition. There was a resurgence of PDA use in the mid-1990s with the introduction of new PDA operating systems: Palm (Palm Inc, Santa Clara, California) and Pocket PC (Microsoft, Redmond, Washington). PDAs manufactured by HandEra, Sony, IBM, and PalmOne (formerly Handspring) use the Palm operating system. PDAs made by Hewlett-Packard, Compaq, Sanyo, Toshiba, and Casio use the Microsoft Pocket PC operating system. The newer devices (Fig. 1) are smaller, lighter, more affordable, easier to use, have more (and more expandable) memory, longer rechargeable battery operating times, better display screens (backlit and/or color), and more powerful software than did early PDAs (Table 1). Most PDAs are operated with a pen-shaped stylus and have handwriting-recognition software to facilitate data entry. Attachable keyboards are available for users who prefer that data input method.

A newer PDA trend is built-in multimedia hardware. Some PDAs have voice-recording, MP3 (compressed music file format), digital camera, and cellular telephone capabilities. No voice-recognition software is available to date.[6] Some PDAs have secure wireless e-mail, instant messaging, and Internet connectivity.[7,8] Infrared-light data transfer (known as "beaming") allows easy data exchange between PDAs and other devices. PDAs are useful as independent units, but their potential increases dramatically when used in conjunction with hardware and software that allow the PDA and desktop computer to electronically transfer data (a procedure known as "synchronizing"). With synchronizing the user can download data from the PDA to the desktop computer, which can store much larger volumes of data than the PDA as well as manipulate and analyze the data with its more-powerful statistics and spreadsheet software.

Just as there are differences in respiratory care equipment such as mechanical ventilators, there are differences between the hardware options and performance characteristics of the 2 PDA operating systems (Palm and Microsoft Pocket PC). The user should recognize the differences and assess the needs the PDA will serve prior to product purchase (Fig. 2). If the PDA purchase is for more than one user, a formal purchasing process may be necessary, such as that described by Chatburn and Primiano for ventilator purchases.[9] The key components of their decision-making tool are generic, and the concept applies to the purchase of various portable computerized equipment. To identify the stakeholders, list the key components of the decision and assign a weight or importance to each factor.

Currently, a wider variety of PDA medical software applications are available for the Palm operating system[10] than for the Microsoft operating system, and a majority of the Palm software has been produced by independent developers and is technically less demanding. The Palm operating system was designed to operate a limited number of tasks and thus is not efficient for users who need to have multiple programs open.

The number of medical applications available for the Microsoft operating system is rapidly growing.[11] Products that work with the Microsoft operating system offer greater functionality than the Palm operating system applications and can run multiple tasks and programs simultaneously. There are PDA versions of several of the main component programs of the Microsoft Office software suite, including Word, Excel, and Access, which include many of the ad-

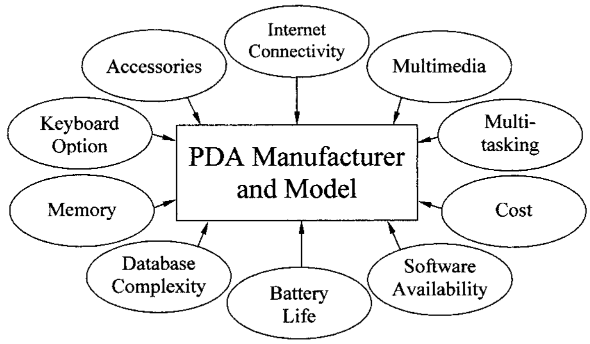

Fig. 2. Factors to consider in selecting a handheld computer (also known as a personal digital assistant or PDA) for use as a medical information tool.

vanced options available in the versions designed for desktop computers.

Documenting Patient Information

A core PDA application is entering patient information into an electronic medical record. Traditional paper-based medical records are commonly used in a variety of health care settings, and are not without virtue. However, research has uncovered many problems typically encountered with paper-based systems, including illegible entries, which contribute to medical errors.[12] Access and security difficulties may arise because patient information needs to be secure but may be needed in multiple settings.[13] For example, the patient chart needs to be kept in a secured area that prevents release of confidential information to unauthorized individuals. Furthermore, patient data may be needed in the intensive care unit for physician-directed rounds, but the health care team would be unable to review the patient data and write orders if the chart accompanied the patient to radiology. Recently, researchers have found it beneficial to use PDAs for electronic medical record keeping. Data can be easily transferred from the PDA to a central data repository for storage, review, and/or synchronization with a hospital-wide computer system.[14] Improvements in handwriting-recognition, display characteristics, and wireless networking capabilities provide a platform for immediate review of patient data, which improves health care work flow, efficiency, decision-support, and information management.[15] Carroll et al described the use of PDAs in a neonatal intensive care unit to record key components of care.[16] Their point-of-care data entry program was used across disciplines and improved clinician efficiency, workflow, documentation quality, and billing capture. There are similar results from studies in surgical and emergency medicine.[17,18]

Researchers at Cedars-Sinai Medical Center in Los Angeles, California, developed a sophisticated PDA-based clinical alert system[19] in which a rule-based analysis of clinical information identified serious and/or life-threatening clinical events. The physician's PDA wirelessly communicated with the central data repository. Patient data in PDAs are covered by the Health Insurance Portability and Accountability Act (HIPAA), so to comply with the HIPAA data confidentiality requirements, the PDAs were loaded with specialized software that secured confidential information with passwords and encryption. Although the authors provided a very detailed description of the system, from which the benefits of the system can be appreciated, they have not reported on the effectiveness of the system.

My review of the medical literature found that published reports of PDA use in the field of respiratory care are not abundant. Shiffman et al evaluated the effect of PDA use on the processes and outcomes of care in physician office management of pediatric asthma exacerbations.[20] Point-of-care data entry increased physician adherence to guideline recommendations, and the data revealed flaws in the authors' protocol. Their PDA system was associated with longer visits, more measurements of peak expiratory flow and oxygen saturation, and with higher health care costs, but there was no significant difference in immediate patient disposition, subsequent emergency department visits, hospitalizations, missed school or caregiver work days. Although the aim of the study was to determine the effectiveness and accuracy of data capture, the ability to easily capture reliable data led to a reevaluation of their practice guidelines.

Researchers at Rainbow Babies and Children's Hospital in Cleveland, Ohio, constructed a data-acquisition system to capture care-path information about patients hospitalized for cystic fibrosis exacerbation.[21] Their system included a Palm IIIx, a desktop computer, Pendragon Forms software (Pendragon Software, Libertyville, Illinois), and a Microsoft Access database. The system captures various disease-management information, including laboratory data, medication administration, respiratory therapies, and diagnostic testing. The researchers realized a time savings of 7.2 h/wk from improved collection and transfer of patient data, care-path compliance data, and patient outcome data.

The respiratory care department at Tufts-New England Medical Center in Boston, Massachusetts, successfully implemented a patient data management system that uses the Palm M-130 and commercially available software.[22] Their system captures data on ventilator settings, therapies, and other measured and monitored patient variables. That respiratory care department had previously used the traditional method of paper documentation. The author of that study pointed out that developing their data collection system was time-intensive, but the system obviated continual manual quality-monitoring of data entry. Development of a query component for the system streamlined the process by which practice standards were reviewed. The cost to implement their system was minimal, compared to the substantial initial investment and maintenance costs of clinical data management systems such as MediServe, Clinivision, or Tenet. In addition to the aforementioned benefits of PDA use, they realized an annual cost savings of approximately $5,000.[22]

Medical Education Applications

PDAs are useful for evaluating and training residents, nurses, and medical students[23] and for monitoring students' and trainees' clinical experience, documenting clinicians' competencies, and evaluating clinical instruction practices.[24] The PDA's utility extends to the classroom as well. In an 8-month cohort pilot study in an internal medicine residency program, PDA use enhanced didactic education and user satisfaction.[25] The residents found PDAs easier to use than laptop computers or note card transcription for tracking patients, downloading call schedules, confirming laboratory reference values, and taking lecture notes. Common technical difficulties included frustration with cumbersome modem cords, difficulty finding an analog telephone line within the hospital, incompatible operating systems, and synchronization problems. The authors concluded that despite technical obstacles, the PDAs enriched the education experience for those residents.

Although the literature lacks support for the use of PDAs in respiratory therapy technology programs, the experience with PDA use in medical education can be applied. In respiratory care instruction a PDA can be a reliable assessment tool for identifying gaps between perceived and actual education and clinical experience. PDAs can also expedite data collection and analysis on respiratory procedures and clinical competencies specific to respiratory care didactic and clinical education components. Nicolaou et al reported that use of a PDA procedure log reduced the time and effort needed for data collection, achieved a low data-entry-error rate, and provided immediate feedback to students.[26] This approach was also associated with very low administrative costs, training complexity, and overhead.[27]

Yet another advantage of PDAs is that they can store reference materials and provide immediate access to those materials at the point-of-care, which is very valuable to both students and experienced clinicians. Bedside PDA access to reference materials assists the clinician in dealing with formulary restrictions, time limitations, and changes in clinical practice; and also with increased pressure to follow clinical practice guidelines, clinical pathways, and care paths.

Numerous PDA programs are available that assist with calculations required in medical practice. For example, ABG Calculator version 2.01 can calculate bicarbonate and interpret acid-base balance from user-entered arterial blood gas values. Blood gas interpretation is also a feature in Med Mathematics.

Many PDA applications provide Internet access. AvantGo is a free service that provides Web access to PDAs. Medical journals' Web sites can be identified and abstracts and articles obtained. AvantGo requires installing a (free) program on the PDA. HealthProLink is another search engine designed to facilitate evaluation and retrieval of medical literature for distribution to a PDA. Ovid@Hand software also enables search, review, and retrieval of medical literature. This program displays the literature search and journal article abstracts on the PDA. Via synchronization this application also provides access to evidence-based medical research and a comprehensive PDA-based pharmacopoeia.

Franklin Electronic Publishers and Skyscape are among the publishers that have recently made textbooks and handbooks available in PDA format. The reference materials are available for both Palm and Pocket PC operating systems.

The Antibiotic Guide (http://hopkins-abxguide.org) is a free database developed at the Division of Infectious Disease at Johns Hopkins University. Queries can be customized to link antibiotic information to specific pathogens, affected organ systems, diagnostic, and/or therapeutic information.[28] The database is updated automatically with each synchronization.

Pharmacopoeias formatted for PDAs expeditiously retrieve and disseminate pharmacologic data. The ePocrates service is a free comprehensive drug information database formatted for the Palm operating system. It is the most widely used PDA pharmacopoeia program, providing more than 500,000 users with a comprehensive drug list, adult and pediatric dose guides, drug interaction guidelines, retail price listings, and common adverse reactions. A study found that the system is easy to use, enhanced physician satisfaction, caused minimal interruption of work flow, and improved drug-related decision-making.[29] This tool was found to be particularly helpful in assisting physicians overcome formulary restrictions and drug benefit limitations.[30]

PDA Use in Research

Recent advancements in PDA hardware and software provide researchers viable alternatives to paper-based data collection.[31] The quality of PDA data entry is directly related to proper training in the handling of computerized forms and the PDA. A plethora of literature supports the use of PDAs for data collection in clinical studies. Fletcher et al described the advantages of using PDAs in field observation studies. They found computerized forms better able (than paper forms) to handle branching patterns of data input, and that PDA data entry was associated with high integrity of data, reduced data entry labor, and immediate data analysis.[32] Lal et al found that PDA data collection was associated with a 23% time saving and a 58% reduction in data entry errors, compared to on-paper data collection.[33] PDAs were found to be an acceptable surrogate for paper patient diaries, yielding accurate and timely entries from patients in clinical studies.[34] The practicality of PDA use extends to quality outcomes monitoring and research, with similar results and professional acceptance.[35]

Decision-Support Functions

One of the applications of clinical information systems that relates to PDA technology is decision-support. Although the advantages of computerized decision-support systems have not been theoretically disputed, their application in clinical practice is rare. The PDA makes computerized decision-support available at the bedside and in the field, such as for paramedics and clinicians working in areas that have minimal health care resources.[36] For respiratory medicine PDAs can provide decision-support for ventilator management and respiratory-therapist-driven therapies and protocols. Complex protocols and algorithms commonly used with patients suffering pulmonary disorders can be indexed and displayed on a PDA, and protocol amendments can be easily disseminated via synchronization.

Emerging Portable Technology

One evolving technology is the "smart card," which is a plastic card similar in size and shape to a credit card. The microchip embedded within the smart card can store large amounts of data,[37] which can easily be accessed via a small peripheral device attached to a desktop computer or via a dedicated handheld card reader. The smart card technology is well established in the business world and has been in use for over 2 decades in telephone cards, cable television, bank cards, and identity cards. A smart card feature that is very important to clinical medicine is that it can act as a keyless entry system to an individual's clinical, insurance, and demographic information.[38] Health smart cards have been in limited use in Europe, Canada, and the United States. Québec's health smart card project made extensive use of smart cards: health information was divided into blocks for easy storage and access, including demographics, emergency care, personal information and history, diagnostic testing, immunizations, medication profile, and physician follow-up, categorized by specialty.[39] The card also contained a prevention module that provided recommendations to the physician for the provision of preventive health care and education. A drug advisor enabled the prescriber to identify contraindications and to foresee and avoid adverse drug interactions and dosage errors.[40] In the Canadian project smart cards were used by 299 clinicians and 7,248 patients. Although the technology was well received, some of the system's problems were similar to paper-based medical record systems. There were client and clinician noncompliance issues. Instances of incomplete documentation or client obligation reduced the usefulness of the smart card in that medical sector.[41] Data security concerns were handled with built-in encryption, levels of data access, and tamper-proof electronic observers.[42] By capturing patient data from emergency room visits, hospitalizations, and treatments, the smart card can help optimize care for patients with complex and chronic conditions, including asthma, chronic obstructive pulmonary disease, and cystic fibrosis.

Smart card technology also has application to medical education. They have been used in advanced trauma life support training and disaster drills. The use of "smart victims" offered a cost-efficient training tool that can evaluate trainees' knowledge and help assess equipment and staffing needs.[43]

Summary

The integration of information technology in health care is having a tremendous impact on both providers and patients. The rapid acceptance and ongoing development of PDAs and other portable technologies have revolutionized the transfer of clinical data from the bedside to the patient record. The use of electronic patient records, automated data capture, online data query, and computerized decision-support have improved efficiency and effectiveness in health care.

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Discussion

Chatburn: Terry, you make a lot of this look pretty easy, but would you comment on the hidden costs? I have seen other people try to build the sort of PDA system you've made, and they have found that there's a learning curve, an investment in personal time and effort to learn how to use the PDA and how to integrate it and use the software and related devices. What has been your experience?

Volsko: In the small PDA-based systems I developed for the cystic fibrosis population and for the multidisciplinary access clinic, it took 200–300 hours of programming time. Howard[1] pointed out similar problems in developing a PDA-based data collection system for capturing ventilator data and ventilator-check data. If you don't have people on board who already have the programming skills, there can be extraordinary costs to get such a system developed. I'm not proficient with HTMLor some of the programming languages, and I had difficulty getting my Microsoft Access database files to function on the Web. Our average cost for a technical support consultant was $125 per hour, and that was a discounted rate.

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Walker: I'd like to discuss the evaluation process for PDA systems and how they fit into the work flow of the end user. There's been a lot of discussion about using tablet-size portable computers, but, unfortunately, even the lightest tablet-size computer weighs more than a pound, so I don't think they're light enough yet for the RT to carry around.

Most RT staff are not used to using PDA technology, unless they have something like Clinivision and they use it routinely, so it's extremely important to choose the operating system that works best for you. The ability to capture data electronically from ventilators and patient monitors makes it a whole new world. And how do we go about that process? People like yourself, being a "power user" and advocate, who get in the trenches with the staff and shows them how this is going to improve their lives, make the introduction and integration of these technologies a lot easier.

As far as the cost, I think it depends on what you want to do with the device. And, as you mentioned, it's important to work with your information technology department and determine how you're going to integrate with them, because each interface that you add that uploads or downloads data costs money. Probably one of the best things to do is be part of your information technology department as an advocate/consultant to keep costs down, because the majority of the information technology work is going to be on the financial side.

Being able to integrate the clinical side, that's where the opportunities for RTs are today. We're so diversified throughout the entire organization. We work with all the different technologies, so RTs are well-positioned to influence the process of evaluating and integrating these systems with the hospital's strategic plan.

Volsko: We have to watch out, though; as we get more technologically proficient, because we have all these monitors and "bells and whistles" that we're so focused on, we have to be sure not to remove our focus from the patient. Just last week I had an RT say to me, "Wait a minute, this ventilator doesn't have the software update. I can't tell how many times a minute this patient is breathing." And I thought, "Yes you can. Watch the patient's chest rise and fall and count the respirations for a minute, using the second hand on your watch." Sometimes we forget the patient who's connected to all of our technology, which is remiss.

Ford: Just to add a different perspective to David Walker's comments, our staff has been using handheld devices since 1993, starting with the Clinivision 3300 device manufactured by Symbol Technologies, then moving on to a Telzon 4×6 tablet-size device, then to the Mitsubishi Amity tablet-size device. Now we're using the Fujitsu 4000 tablet-size device. MediServe has released a PDA, and Clinivision is not far behind with a PDA. But I can't say I'd use PDAs, because the view screen is small and you can't view much information at once, so I think the tablet-size devices do have some merit. We've been using the Fujitsu 4000 series for about 6 months, and I've had some experience with the smaller P-1000 series, which fits in your pocket. Also we have many staff who are over 40 and they have a bit of a problem seeing the characters on some PDA screens.

Hess: There's some pretty simple but effective things you can do with PDAs and inexpensive software. A piece of software that I use a lot is Documents To Go, with which I stored the ARDS [acute respiratory distress syndrome] Network protocol in a Palm document. I can beam it to RTs, residents, fellows, attending physicians—anyone with a Palm-type PDA. I've also used that application to bring our staff schedule, which is kept in Microsoft Excel, into the PDA, and, again, I can beam it to anyone with a Palm-type PDA. Documents To Go is very inexpensive, less than $100, and it allows you to transfer virtually any Word, PowerPoint, or Excel document to a PDA.

Volsko: Yes. However, Documents To Go does not work on Microsoft Access files.

Gardner: I'm concerned about meeting the HIPAA data security requirements. Data in a PDA is covered by HIPAA, and I think private networks can allow you to transmit data securely.

Belda: Many of these PDA applications seem to work in one-way fashion, with regard to how they communicate with certain Web-based applications. Is there any software to download a schedule from a Web-based application to a PDA, to update that schedule on the PDA, and then send the update back to the Web-based application?

Volsko: I don't know. The only reason that we went with developing our own PDA system was personal pride, ego, and the fact that I was on a limited budget. It was more cost-efficient for me to invest the time at home on a Sunday evening than it would be to buy a program. Some of the systems cited in the literature were home-made as well.

Ford: We use a Web-based calendar for supervisors' schedules that can be viewed from home or by the RTs out on the floor who have Internet access via their tablet-size computers. That system allows for updates and changes. That software can be found at http://www.calendarix.com.

Hopper: I want to insert a caution here. This is all really exciting stuff to me and it looks like it has amazing potential for the clinical world and administrators, but we need to be careful that we don't confuse information transfer with learning. We know that learning is a process of meaning-making, and we all like to think we can package it up and put it on the loading dock and transfer it out. So I'm cautious about the real educational value in this, although I really like the idea of putting complex protocols in PDAs. A lot of times in my work as an RT I would have liked to have had something like that, but I wouldn't confuse that with having *learned* the subject.

Volsko: But wouldn't it be beneficial to be able to easily evaluate what's going on at your clinical sites? Lapinsky's group[1] evaluated medical residents' experience and found that they were able to bring together the experience that each individual resident had and identify the root of many of their problems, such as whether there was a problem with the clinical rotation or a problem particular to the specialty service the students were with.

As RT educators we want to produce the best clinicians out there. Why couldn't we use PDAs to allow our students to log procedures and efficiently track their experiences so the clinical educator, the director of clinical education, or the program director can put together a report card for the facilities where the students are getting their experience? It may be that a certain hospital is a convenient facility for a clinical rotation but that our students are not getting a wealth of experience from that facility, whereas a less convenient hospital might provide a better quality of clinical rotation.

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Hopper: That's certainly true, but you're not talking about teaching and learning activities. You're talking about administrative, supervisory activities, which are housekeeping things, and the technology you're describing is certainly very useful for that. The caution I make is that students are using it to get information and using the technology as a cognitive tool, so we're not pretending that we've opened up a pipeline to somebody's brain and that we're infusing knowledge into them. We know that doesn't work. I was a director of clinical education and would have loved to have had that sort of data gathering and analysis capability. I think that's fantastic. But the things you mentioned are administrative functions, not learning.

Volsko: Yes, you're right.