Türk Biyokimya Dergisi [Turkish Journal of Biochemistry–Turk J Biochem] 2007; 32 (4) ; 154–159.

Research Article [Araştırma Makalesi]

Yayın tarihi 30 Aralık, 2007 © TurkJBiochem.com

[Published online 30 December, 2007]

A Novel Solution for the Problem of Gaining Rapid Access to Information Resources in Clinical Biochemistry: Personal Digital Assistants and Relevant Medical Applications

[Klinik Biyokimyada Kaynak Bilgilere Ulaşım Problemleri İçin Yeni Bir Çözüm: Kişisel Cep Bilgisayarları ve İlgili Tıbbi Uygulamalar]

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Kayıt tarihi: 10 Eylül 2007, Kabul tarihi: 07 Kasım 2007
[Received: 10 September 2007, Accepted 07 November 2007]

ABSTRACT

It is necessary for modern-day laboratory specialists (clinical biochemists, microbiologists, etc) to be able to access current scientific information at anytime and anywhere, without difficulty. Even though there have been dazzling advances in informatics, accessing the necessary information in existing databases requires remarkable amount of effort and time. Commercial softwares for personal digital assistants seem to provide an effective solution to this problem. In this study, the effectiveness of 11 selected commercial software products (Uptodate, ePocrates, Inforetrive, Pepid, eMedicine, FIRST Consult, and 5 laboratory e-books released by Skyscape and/or Isilo) and the benefits of their use were examined by seven laboratory experts. The following items regarding the content considered while evaluating the software: How many tests were included in, for example does the software contain detailed information for each test on process, method, interpretation of results, reference ranges, critical values, interferences, equations, pathophysiology, supplementary technical details such as sample collection, and additional information such as linked references, evidence based data, price, etc. In terms of technique the following items are considered: how much memory required to run the software? Is the graphical user interface user friendly? What is the frequency of new and/or up-date releases? It is obvious that there is no single, unique software product that can provide solution to all of the above mentioned problems. Interpretation of laboratory results requires not only easy-to-use software (such as ePocrates and Skyscape e-books) but an integrated software (such as Uptodate, Pepid, Inforetrieve etc). Methodological information is mostly not included in the software evaluated. However, it seems likely these shortcomings will be fixed in the near future and personal digital assistants and relevant medical applications will become indispensable for all physicians, including laboratory specialists, in education and in patient care.

Key Words: Personal digital assistants, handhelds, medical software

ÖZET

Çağdaş laboratuvar uzmanı (Klinik Biyokimya, Mikrobiyoloji uzmanı gibi) herhangi bir yer veya zaman içinde güncel bilgiye kolaylıkla ulaşması gereklidir. Her ne kadar bilgi teknolojisinde göze çarpan bir ilerleme olsa da, gerekli bilgiye ulaşım ciddi bir zaman ve çaba gerektirmektedir. Kişisel cep bilgisayarları ve bunun için geliştirilen ticari programların, çözüm konusunda etkin olabileceği düşünülmektedir.

Bu çalışmada kişisel cep bilgisayarları ile kullanılan seçilmiş 11 ticari tıbbi program (Uptodate, ePocrates, Inforetrive, Pepid, eMedicine, FIRST Consult ve Skyscape ve/veya Isilo tarafından kullanılan 5 e-book), 7 laboratuvar uzmanı tarafından etkinlikleri yönünden incelenmiştir. Bu programlar aşağıdaki özellikleri yönünden incelenmiştir: Kaç adet test içeriği olduğu, detaylı bilgiye sahip olup olmadığı, sonuçların yorumlanması, referans değerler, kritik değerler, interferanslar, eşitlikler, patofizyoloji, örnek tipi gibi teknik ayrıntılar, kaynakçalara ulaşım, kanıta dayanırlılık, ücret gibi. Teknoloji ile ilgili olarak ise, bu programları çalıştırmak için gerekli olan hafıza miktarı, grafik destekli arayüzlerin kullanım kolaylığı ve güncelleme sıklıkları gibi parametreler incelenmiştir.Bu incelemeler sonucunda, yukarıda belirtilen problemlerin çözümünün, tek bir program ile sağlanamayacağı açığa çıkmıştır. Kullanımı kolay olan programlar ile (ePocrates veya Skyscape e-kitapları gibi) daha geniş kapsamlı programların (Uptodate veya Pepid, Inforetrieve gibi) beraber kullanımının uygun olacağı saptanmıştır. Metodolojik bilgilerin hiçbir programda yeterli oranda bulunmadığı gözlenmiştir.Sonuç olarak kısa bir zaman içinde kişisel cep bilgisayarları ve ilgili tıbbi programların, bütün klinisyenlerin ve laboratuvar uzmanları için steteskop gibi vazgeçilmez olacağı görülmektedir.

Anahtar Kelimeler: Kişisel cep bilgisayarları, avuç-içi, tıbbi bigisayarlar

INTRODUCTION

The wealth of information in biomedical sciences and its constant change means that it is impossible to keep traditional information resources up to date. Most clinicians use mobile devices for a variety of purposes, including accessing evidence-based guidelines, medical references, drug references, patient information, and laboratory assessments. Personal Digital Assistants (PDAs) are the most popular mobile devices among physicians (1-4).

PDA, handheld computer, handheld PC, and pocket PC are the terms that all refer to similar devices with comparable capabilities. PDAs are compact, handheld computers that literally fit into one's palm or pocket. Handheld computing term was limited to the use of complicated calculators previously, and they rarely had data storage option. PDAs are small devices with a touch-sensitive screen, a dedicated input area or keyboard, customizable application buttons, and a multi way (button or mini joystick) navigator to browse information on the screen. Some devices feature an expansion slot for memory cards or accessories, a built-in camera, headphone jacks, speaker, microphone, ports for infrared, Bluetooth, or Wi-Fi (Wireless Fidelity), General Packet Radio Service (GPRS), and even built-in GPS (global positioning system) receivers (1,3).

PDAs run on mobile operating systems such as Palm OS and Microsoft Windows. These operating systems allow customization of the PDAs through the installation of third-party software applications in addition to their intrinsic functionality. Newton Psion, BeOS, Symbian OS, and Blackberry are the other, less popular operating systems developed for PDAs. Currently available PDAs are generally equipped with a comprehensive suite of personal information management software or the option to integrate with common brands of such software, note-taking applications, and contact databases. PDAs can connect to desktop computers and/or wireless local area networks (W-LAN) using infrared, Bluetooth or Wi-Fi communication technology. The desktop synchronization software or additional add-on applications provide compatibility with popular office file formats. Most devices feature an e-mail application to integrate with the current office suites, which allows users not only to bring critical files with them but also to synchronize important files quickly and easily between desktop and hand-held devices (1,3).

Health-care professionals and students must use their knowledge which is built on ever increasing and constantly changing information to treat their patients and should associate the patient data with the most recent diagnostic and therapeutic recommendations and management options to make sound decisions. Traditionally, health-care professionals consulted to collected personal notebooks and article cut-outs, pocket manuals, subscripionted journals, medical reference books, or electronic references on desktop computers. To keep these information resources up-to-date and organized requires a huge amount of effort and is impractical. PDAs have a great potential to offer a versatile, rapid, and cost-effective solution to this problem if appropriate hardware and software combination could be made (1,3)

In this study, seven clinical experts examined a selection of optimized PDAs and evaluated 10 software programs.

MATERIALS AND METHOD

Eleven commercially available softwares were evaluated. These softwares are UpToDate (UpToDate, 95 Sawyer Road Waltham, MA 02453 United States, http://www.uptodate.com), ePocrates (Epocrates, Inc. 1800 Gateway Drive Suite 300 San Mateo, CA 94404, http://www2.epocrates.com), Inforetrieve (Wiley/Interscience, New York, NY, USA, 780 http://www.infopoems.com/), Firstconsult (Elsevier Co.125 Park Avenue 23rd Floor New York NY 10017, United States http://www.firstconsult.com), Pepid (PEPID, LLC 1840 Oak Ave. Suite 100 Evanston, IL 60201 USA www.pepid.com), Skyscape books (Skyscape Inc., 100 Locke Drive Marlborough, MA 01752 http://www.skyscape.com), Isilo readers (Isilo Com, http://www.isilo.com). Skyscapes books included in the study are: (1) Bakerman's ABC's of Interpretive Laboratory Data, 4th Ed Seymour Bakerman, Paul Bakerman, Paul Strausbauch Interpretive Laboratory Data, Inc. (2) Pocket Guide to Diagnostic Tests, Diana Nicoll, Stephen J. McPhee, Michael Pignone, The McGraw-Hill Companies, Inc. (3) Mosby's Diagnostic and Lab Test Reference, 7th Ed., Kathleen Deska Pagana, Timothy J. Pagana, Mosby - An Elsevier Health Sciences Company (4) Ferri's Best Test - A Practical Guide to Clinical Laboratory Medicine and Diagnostic Imaging, Fred Ferri, Mosby - An Elsevier Health Sciences Company (5) Nurse's Manual of Laboratory and Diagnostic Tests, 4th Ed., Bonita Morrow Cavanaugh, F.A. Davis Company. Isilo is used while reading Interpretation of Diagnostic test Jacques Wallach, Lippincott Williams & Williams.

Test content, description, interpretation, method properties, reference ranges, related tests /strategy/panel test, interferences, equations, pathophysiology, tech info (collection methodology and guidelines), critical values, linked references, and evidence based data included in each software and their price, update frequency, collaboration-integration, memory requirement, practicality and other specialties were evaluated individually and graded (+++:very good, ++:good, +: weak, 0: not available).

RESULTS

Keeping the balance between the requirements and the cost is the most important issue in deciding on which PDA is appropriate. Table 1 may provide assistance in selecting the appropriate PDA and applications. It

Table 1. Personal digital assistants (PDA) specialities and its application

Device	PDA, PDA+Telephone (GSM)	
Processor	Microsoft CE, Palm OS, Symbian OS, Newton, Psion, BeOS etc.	
Options and specialities	**Specialites**	Size, weight and data entry (touch screen or built-in keyboard)
	Display	-Monochrome or color -Resolution -Indoor and outdoor visibility -Backlighting and contrast adjustment
	Communication	-Wifi (Wireless Fidelity), W-LAN (wireless local area networks) Bluetooth and infrared. -USB (Universal Serial Bus) connection
	Memory and storage	-RAM, ROM -Memory stick (or compact flash, multimedia card etc.)
	Battery	**Type :** Lithium polymer (the longest), lithium ion, nickel hydride etc. **Charge duration**: Less than 1 hour **Backup :** You should know whether or not you'll lose date and aplications if the PDA's battery runs out of power. In some devices, you can protect data and aplication by storing them in ROM.
	Recording	-Voice and image recording
	Handwriting recognition	
	Others	-GPS (Global Positioning System) -Stylus (comfortable to use and easily stored in device) -Mp3 player, radio and TV -Protection -Warranties -Appearance
Applications for health professionals	e-books and e-book readers (Skyscape Isilo books, Atlas, eBooks, Dictionary etc.)	
	Patient follow-up (Hospitals programs, diaries etc)	
	Entegre programs (ePocrates Essential, UpToDate, Pepid, FIRST Consult etc)	

should be kept in mind that each additional application will increase the cost.

Determining how to select the best PDA and its applications is a controversial issue. There is no unique answer to this question. Different brands of PDA and applications are preferred among those even at the same age, specialization, and education. The selection of the "best" PDA and its applications eventually depends on personal preferences (11).

However, following suggestions may be helpful to those having uncertainty.

1. Using a PDA with a built-in telephone is very practical. Besides, these PDAs can be connected to the internet everywhere. The connection costs are very expensive, nevertheless (Clue: While connecting to the internet through GPRS, you should disable "show image" option).
2. Minimum 32 MB RAM and 32 MB ROM and, Memory cards more than 2 GB should be preferred (especially if you intend to use up-to-date).
3. Those who attend to the lectures frequently should consider the availability of voice recording option while selecting a PDA.
4. The dimension and resolution of the screen display seriously affect the visual quality, especially in those with hypermetropy.

After deciding on a certain PDA, selection of the appropriate software is the next important issue. A comparison of the softwares included in the study is given in Table 2.

Table 2. A comparison of the softwares included in the study

						Skyscape and/or Isilo					
	UpToDate	Epocrates (essentially)	Pepid (Laboratory manual)	Inforetrieve	FIRST Consult	Bakerman's ABC's of Interpretive Laboratory Data	Pocket guide to diagnostic test	Mosby's Diag & Lab Test Reference	Ferris best test: A Practical guide to clinical laboratory medicine and Diagnostic Imaging	Manual of Laboratory and Diagnostic Tests	Interpretation of Diagnostic test
Content (the number of tests)	+++	+++ (>300 test)	+++ (>300 test)	+++	++	+++ (>500)	+++ (>350)	+++	+++ (>200)	+++	+++ (>350)
Information for each test	+++	+++	+++	+++	++	+++	+++	+++	+++	+++	+++
Interpretation of results	++	+++	+++	++	+	+++	+++	+++	+++	+++	+++
Method feature (Sensitivity, specificity, screening etc)	+++	+++	+++	+++	+	+	++	+	-	+	+++
Reference Ranges (sex and age related)	++	+++	+++	++	++	+++	+++	+++	+++	+++	+++
Related Tests / strategies / panel tests	++	+++	+++	+++	+++	+++	+++	+++	++	++	++
Interferences	+	+++	+++	+		++	+	+++	+++		
Equations /calculators	++	+++	+++	++	-	+	+	+	+	+	+
Pathophysiology	+++	++	+++	+++	-	++	+	++	-	+++	++
Technical data (Sample collection, methodology)	+	+++	+++	-	+++	+++	++	+++	-	+++	+
Critical Values	+	++	+++	+	+	-	+	+++	-	+++	+++
Linked References	+++	++	++	++	-	++	++	+	+	+	+
Evidence based data (Meta analysis etc)	+++	++	++	+++	++	++	+	+	+	+	+
Price ($)	495 for per year	59 for lab, 149 for complete	40 (Only lab)	249 for per year	149 for per year	43.96	39.95	44.95	39.95	44.95	20.55
Update frequency	6 months	Daily	3 months	Daily	Weekly	a	a	a	a	a	a
Collaboration- integration (with other disciplines)	+++	+++	+ pay per group	+++	+++	b	b	b	b	b	b
Memory requirement (Mb)	~1000	8	16	65	6-12	11.3	6.2	10.7	8.24	17.7	
User friendly	++	+++	+++	++	+++	+++	++	+++	+++	+++	+++
Others	• Topics are written by nearly 3000 physicians • Including specilities: Cardiovascular Medicine, Endocrinology, Family Medicine, Gastroenterology, Hematology, Infectious Diseases, Nephrology, Obstetrics, Gynecology and Women's Health, Oncology, Pediatrics, Pulmonary and Critical Care Medicine, Rheumatology, Allergy and Immunology, Emergency Medicine, Neurology	Epocrates Essentials consist of five section • Drugs • Diseases Epocrates Sx, Dx • Epocrates Lab • Embedded, veriety tables and calculations etc.	Subject to additional payment • Drug information • Disease and trauma topics with diagnosis, pathophysiology, treatment • Toxicology • Weapons of mass destruction • Illustrations	• Abstracts of Cochrane Systematic Reviews • Decision and diagnostic guidelines and calculators • The complete 5-Minute Clinical Consult • Patient Education Handouts	• Diagnostic tables covering over 350 complaints • Links to Summaries of over 1,500 diagnoses, • Over 600 highly structured, condition-specific medical topics covering.	• More than 1,000 entries are alphabetically catalogued in the handheld version, representing the 500-plus individual and panel tests included in the popular hardcopy manual.	• Basic principles of diagnostic test • Microbiological test • Therapotic Drug Monitoring • Electrocardiogram • Algoritms • Nomogramlar • Figures of urine microscopy • Definitions are given in tables which makes it difficult to read from the display.	• Twenty-five new test entries - including bioterrorism infectious agents, breast ductal lavage, electrophoresis, SARS viral testing, sexual assault testing, and virtual colonoscopy - present the latest tests and procedures	• Describes the most common imaging studies for each organ system, reviewing their indications, advantages, disadvantages and approximate costs. • 222 common diseases and disorders	• Microbiologic laboratory, nuclear medicine, cytology and genetic test, endoscopic examination, ultrasonografic tests, pulmoner function test • Protocols for collecting saliva, breath, nail, and hair specimens and forensic evidentiary specimens.	• Microbiologic laboratory, nuclear medicine, cytology and genetic test

+++:very good, ++:good, +: weak, 0: not available. The median of 5 experts' results are given in the table.

(a) The software comes with the offer of free updates for 12 months, or for until new edition released.

(b) Each software interacts with the other softwares from the same group

DISCUSSION

PDAs can be used in medicine to realize different goals.

Education: Higher education is more and more rely on the use of computer technology. PDAs successfully comply with the concepts of contemporary education theories and it is not surprising that the students are among the earliest adopters of PDA use (5-14). Several programs for junior doctors at the leading US academic institutions (such as Harvard Medical School and Georgetown University Medical School) are the early adopters of PDAs and provide their junior doctors with PDAs and bundled software (3).

However, large randomized controlled trials comparing PDA-users with non-PDA-users and with objective outcome measures, such as performance in in-house or board examinations, are needed to substantiate these early observations. Another important aspect of hand-held computer-assisted learning is the integration of faculty staff who traditionally more reluctant to adopt new technology than students (15).

Quality of care: Quality of care can be improved by implementing clinical-decision support software, evidence-based medicine, other critically appraised publications, and alerting systems in PDAs. The use of PDA-based decision support devices have been reported to be useful or advantageous in many clinical settings such as emergency and mass casualty triage, data management of transplantation patients, management of patients with stroke, infection control, enforcement of institution-specific, rational medicine use, and patient data management (16-20). The usefulness of PDA-based drug references, including parenteral nutrition, blood products, and chemotherapy, and drug interaction checks has been examined in several studies (21-26).

PDA use in data collection and processing: Several studies in medical specialties including anesthesia, emergency medicine, family practice, general surgery, internal medicine, neurology, obstetrics and gynecology, radiology, and urology, neonatal care unit have demonstrated that use of PDAs simplify data collection and assessment of doctor and program performances (27-31).

The use of PDA improves trial efficacy, quickens data analysis, and even improves patient safety due to earlier availability of results of interim analyses.

Others: A significant increase in self-efficacy in the groups is demonstrated where personal digital assistants have been used (32). PDA-based medical information management could even have an environmental effect that goes beyond paper-saving (33).

The use of PDAs is increasing and today, they are widely used by clinical specialists, junior doctors and medical students for a variety of purposes. There is insufficient study, however, related to the use of PDA by laboratory specialists.

In our study, 11 different commercial software and programs which are popular among laboratory specialists were evaluated by 5 laboratory experts. However, according to our results, there is no unique software available that combines evidence-based clinical and laboratory data. Accordingly, it is necessary to keep several softwares in PDA to meet demands. For example, combining UpToDate with ePocrates or combining Pepid with a skyscape e-book could be appropriate.

There are certain problems with the use of PDA. These problems are itemized below.

1. The screen displays of most PDAs are not really acceptable due to their dimensions and poor visibility. The use of PDAs is even more difficult for those with hypermetropy.
2. The letters, figures, and tables are of low quality in most softwares (34).
3. Data input process will be slower and more awkward than with a PC keyboard.
4. There is no commercial software available for basic medical education (Basic Biochemistry, Microbiology, etc).
5. Not all software contains methodological information which laboratory experts require.
6. Battery life tends to be insufficient in most models, and so, most PDAs need to be charged each day.
7. Use of a PDA as a telephone is difficult due to its weight, size, and key set.
8. Free access Wi-Fi areas are very restricted in most places. Internet connection through GPRS is also expensive in most countries.
9. Memory requirement increases every day due to new releases (34).
10. PDA and software prices have not been reduced as quickly as expected.
11. Secrecy of patient record cannot be guaranteed at present (35).
12. There is a probability of catastrophic data loss (36). So, PDA should be frequently synchronized with a desktop computer for back-up.
13. A minor point: the interference between wireless PDAs and cardiac pacemakers or defibrillators is not conspicuous at this moment (35).

However, most of these problems are likely to be solved in the near future.

In conclusion, it can be claimed that the use of PDAs will facilitate medical applications, constitute an information base for new learnings, and make learning more pleasant. Several studies support these arguments. However, most of the studies reported are not randomized, controlled, or are in a multicenter design (37). In the near future, we believe, PDAs will become a crucial tool for the laboratory experts.

ACKNOWLEDGEMENTS

I would like to thank Ugur KUCUK M.D, UpToDate, Epocrates, Inc. Skyscape Inc. for providing information about their products and technologies.

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