

Handheld Computers: A New Era in Medical Information Management

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The times they are a-changin’

—*Bob Dylan*

Handheld computers, a new clinical tool, are suddenly appearing in doctors’ offices, hospital floors, and emergency departments across the country. These devices promise to change the way that physicians look up information, much as the stethoscope changed the way physicians listen for heart sounds. A medical information revolution is underway that will ultimately allow complex medical information to be available at a moment’s notice, when needed, while physicians are caring for patients. This easy access to information will allow physicians to be confident they are giving correct up-to-date medical care, will reduce the likelihood of errors, and will make life better for both physicians and their patients.

Over the past 4 years, personal organizers have evolved into handheld computers with greatly expanded capabilities. These capabilities now allow physicians to carry full electronic reference books, patient lists, and medical calculators in their handheld computers. These electronic books and other software can be purchased in real time over the Internet, downloaded to a desktop personal computer (PC) moments after purchasing, and immediately “hotsynced” (ie, downloaded from the PC) to a handheld computer for use in the emergency department, in the office, or during hospital rounds.

This article will review a few of the major resources on the market, attempting not to be comprehensive but rather to identify quality products that are useful and illustrative of what is now available. Specifically, the review will concentrate on the Palm OS platform, because most physicians using handheld computers are using Palm OS devices, and currently there is approximately 10 times more medical software available for Palm OS devices than for devices with Windows CE, Windows Pocket PC, or other operating systems.¹ Palm OS devices include handheld devices made by Palm, Inc. (Santa Clara, CA), Visor handhelds from Handspring (Mountain View,

CA), and Clié devices made by Sony (San Diego, CA). Windows devices include iPAQ handhelds from Compaq (Houston, TX), the Jornada from Hewlett Packard (Palo Alto, CA), and pocket PCs from Casio (Dover, NJ).

DOWNLOADING INFORMATION

In general, software for handheld computers is obtained by downloading it from the Internet. Suitable reference material for downloading can be found either at sites serving, essentially, as electronic bookstores selling handheld references or at publishers’ Web sites (**Table 1**). A number of considerations should influence the decision about what software to load onto a handheld device. These considerations include the price of the software, the amount of memory the software uses (most Palm OS devices have between 2 and 8 megabytes of memory available for storage), the organization of the material for ease of use, and the reliability of the information presented (with well-referenced books being optimal).

After identifying a reference to purchase, a buyer usually needs to register with the seller, often necessitating giving a credit card number over the Internet. The reference is downloaded a few seconds later directly from the supplier to the buyer’s PC. The package downloaded to the computer is usually in “zipped” form, which can be “unzipped” using any of a number of software packages (a commonly used one, WinZip, is available at <http://www.winzip.com>). Installation varies somewhat with different products. Using a Palm OS device as an example, the application is usually double-clicked; then the next time the Palm OS device is hotsynced with the computer, the reference is loaded onto the Palm OS device, ready for use.

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Table 1. Internet Resources for Handheld Computers

General resources

PalmGear.com (<http://www.palmgear.com>) and Handango (<http://www.handango.com>)

These companies are both major vendors of software, medical references, and just about anything for handheld computers.

ZDNet (<http://www.zdnet.com>)

This site features software for the Palm and Windows CE operating systems.

Medical resources

Redi-Reference (<http://www.redi-reference.com>)

Redi-Reference is a leading publisher of electronic medical handbooks—including handbooks on Cardiology, Obstetrics, Clinical Guidelines, and Infectious Diseases—and a twice monthly *Clinical Update Newsletter*.

pdaMD.com (<http://www.pdamd.com/vertical/home.xml>)

This site provides reviews, general helpful hints, and the ability to purchase medical hardware and software for handheld computers.

Handheldmed (<http://www.handheldmed.com>)

Handheldmed is a major publisher of electronic medical texts.

Peripheral Brain (<http://pbrain.hypermart.net/medapps.html>)

Peripheral Brain is a superb site that has excellent short reviews of medical resources for the Palm Pilot and links to dozens of sites.

Franklin Electronic Publishers (<http://www.franklin.com/medical>)

Franklin Electronic publishes many electronic medical texts.

CollectiveMed.com (<http://www.collectivemed.com>)

This site provides reviews, general helpful hints, and the ability to purchase medical applications for handheld computers.

MEDICAL REFERENCES

ePocrates

The most popular electronic reference used by physicians is a drug reference, ePocrates qRx, which is available at no cost at www.epocrates.com. To date, more than 100,000 physicians are using ePocrates qRx.² The drug database in ePocrates qRx is large and well-organized, including virtually every drug on the US market. The database, currently available for PalmOS devices only, is easy to use, allowing a user to access, with just a few taps of the screen, a full range of information including brand and generic names, tablet size, dosing, serious and common adverse effects, drug interactions, drug cost, pregnancy category,

and route of metabolism. In addition, ePocrates qRx includes a drug interaction program called *Multicheck*, which allows the user to enter up to 30 medications. The program automatically checks for potential drug-drug interactions and lists the interactions in detail. ePocrates qRx is updated regularly as the user hotsyncs the handheld computer while his or her computer is connected to the Internet. The total amount of memory taken by ePocrates is approximately 1.4 megabytes.

Recently ePocrates qID was issued; this reference is an infectious disease guide, organized by system, and lists recommended antibiotic therapy for a wide range of infectious diseases. With a tap of the stylus on the recommended antibiotic, the user is taken automatically to ePocrates qRx, for more detailed information about the medication. This reference is also currently only available for Palm OS devices.

Redi-Reference

Redi-Reference Medical Handbooks produces a number of eReference books, including references on clinical guidelines, cardiology, obstetrics for primary care physicians, and infectious diseases. These inexpensive handbooks use 50 to 150 kilobytes of memory, so they easily fit on all Palm OS devices (currently, they are only available for a Palm OS platform). Redi-Reference handbooks are updated at no extra cost 3 to 4 times a year as the handbooks are revised to include new information.

The Redi-Reference *Clinical Guidelines* handbook, recently endorsed by the American Board of Quality Assurance and Utilization Review Physicians, gives concise, easy-to-use summaries of national clinical guidelines. Guidelines summarized in the reference include those of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (sixth report); the National Cholesterol Education Program's Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (third report); the American Thoracic Society on the Diagnosis and Treatment of Latent Tuberculosis Infections; the American Heart Association on prevention of bacterial endocarditis; and many others. Because this handbook generally is updated quarterly, it is a good way to stay informed about changes in guidelines. Given the rapidity of change in medical information, the ability to receive regular updates is one of the most exciting advances that electronic references offer.

Redi-Reference recently came out with a *Clinical Update Newsletter* (Figure 1) that is e-mailed twice monthly

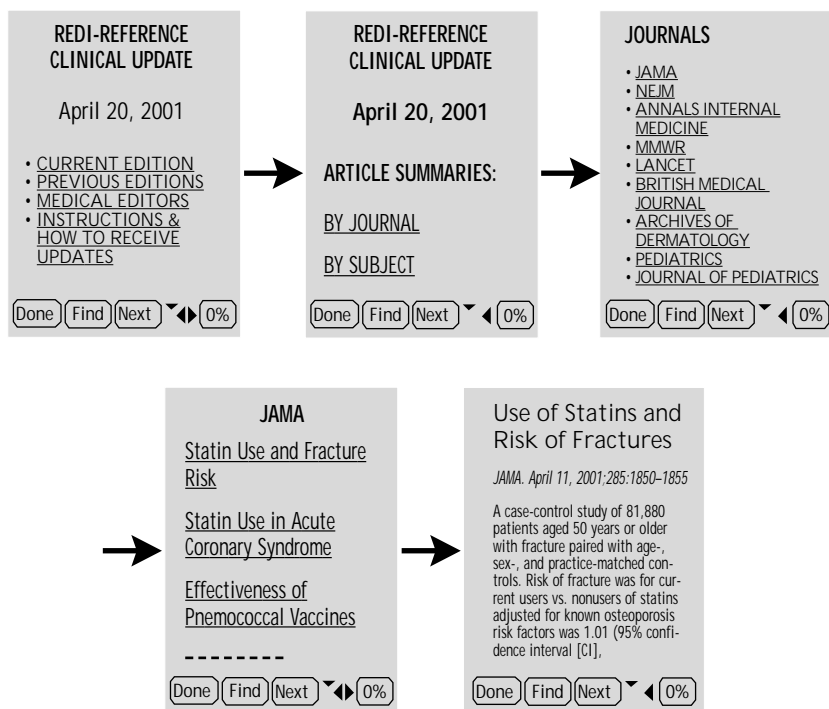


Figure 1. Five screen displays (from a Palm III) of the *Clinical Update Newsletter* from Redi-Reference. Starting at the first screen, tapping with the stylus on “CURRENT EDITION” brings the user to the most current edition of the Redi-Reference *Clinical Update Newsletter*. The user can then either look at the current literature by journal or by subject. Tapping on “BY JOURNAL” on the second screen brings the user to a list of journals summarized in the current issue, at which point the user can tap on the journal of interest. In this case, tapping on “JAMA” on the third screen brings up a fourth screen listing the articles reviewed from the past 2 weeks of the *Journal of the American Medical Association*; the user can then choose the article of interest. Tapping on “Statin Use and Fracture Risk” leads to a concise summary of the article on the fifth screen.

directly to subscribers’ computers for hotsyncing with Palm OS devices (currently only available for these devices). The clinical update reviews the most significant primary care medical literature published in the previous 2 weeks (including reports in *The New England Journal of Medicine*, the *Journal of the American Medical Association*, the *British Medical Journal*, *Lancet*, *Pediatrics*, *Journal of Pediatrics*, and others). Once the newsletter is hotsynced with the handheld computer, information it contains is always available for review when physicians have time to read it. In addition, reviews of material published in the previous 6 months are archived in each volume of the newsletter, so that an article reviewed in the past can be easily found and read.

Franklin Electronic Publishers

Franklin Electronic Publishers, in collaboration with Skyscape, also offers a number of textbooks that have been reformatted to make them work on handheld platforms. Titles include the *Washington Manual of Medical Therapeutics*, *Griffith’s 5 Minute Clinical Consult*, the companion handbook to *Harrison’s Principles of Internal Medicine*, and others, all moderately priced. These books are well organized and range in memory from 1.3 to 2.8 megabytes. The books are clearly credible sources of information and have been organized to work well on the handheld computer screen. Topics

can be found through indices, outlines, or a search function that searches for keywords throughout the book.

MEDICAL CALCULATORS MedMath

Another type of resource that has become available is the handheld computer-based medical calculator. Two excellent examples of such calculators are MedMath and MedRules, both of which are available for Palm OS devices only. MedMath (available at <http://www.stanford.edu/~pmcheng/medmath/index.html>) allows calculation of many commonly used medical formulas. The user enters the values needed in the desired calculation, then taps the “calculate” icon, and the result is displayed. The program also gives the equation used, the normal range for the result, and a reference for further information for each calculation. Calculations in MedMath include the reticulocyte index, body mass index, creatinine clearance, corrected serum sodium concentration, and many other calculations often needed. Thus, tedious calculations can be made easily, simply by entering the relevant data. Similar available products are Archimedes (available at <http://www.skyscape.com/products/archimedes>) for the Windows CE platform and Medikit (available at <http://www.palmaris.com/medikit.htm>) for Psion5 devices.

HANDBELD COMPUTERS ON ROTATIONS

As a first-year family practice resident, my role in the hospital changes every month; it is not unusual to have rotations in pediatrics, obstetrics and gynecology, and the intensive care unit in consecutive months. Having a handheld computer has allowed me to make these seemingly difficult transitions more easily, as I have truly come to rely on the software loaded into this device for clinical information, drug information, and formula calculations that would normally require several textbooks and a calculator to be carried in my white coat.

For example, an 81-year-old patient being admitted to the intensive care unit with diverticulitis can be quickly researched with my *Griffith's 5 Minute Clinical Consult*, preferred drug regimens can be evaluated with ePocrates qID, and proper drug dosages can be evaluated by using MedMath to calculate this patient's estimated creatinine clearance. How about a 32-year-old pregnant woman being admitted for deep venous thrombosis? No problem; I can quickly brush up on the condition with my *Griffith's 5 Minute Clinical Consult*, calculate her estimated date of delivery using PregCalc, and review treatment options and pregnancy categories using my ePocrates qRx.

Although a handheld computer cannot substitute for sound clinical knowledge and the advice of attendings and consultants, it is a handy and practical way to provide the medical resident with information at the point of contact with the patient; further information can be gleaned from bulky textbooks or journals later in the day.

—Harris Cohen, MD

MedRules

MedRules (available at <http://pbrain.hypermart.net/medrules.html>) is a unique calculator designed for educational purposes that gives literature-based calculations of the probability of disease after entering defined clinical characteristics. It includes the Gail model for calculating breast cancer risk; a model for calculating coronary disease risk based on age, cholesterol, blood pressure, smoking status, and diabetes status; a model for calculating pulmonary embolism probability based on clinical characteristics and D-dimer results; and many other calculations. MedRules is an excellent tool for defining disease risk and for teaching students how altering specific clinical characteristics can affect the probability of disease.

Pregnancy Calculators

PregCalc (available at <http://www.thenar.com>) and PregTrak (available at <http://www.stacworks.com>), both currently available for Palm OS devices only, offer obstetrical calculators that work like an electronic "pregnancy wheel." The user puts in the date of a woman's last menstrual period or ultrasound measurements, and the program calculates the estimated date of conception, the most likely delivery date, and the gestational age of the fetus. In addition, the program will prompt the user regarding tests that need to be considered at any gestational age, such as a triple screen at the 16-week visit during pregnancy. Both of these programs can store data on individual patients for recall on subsequent office visits.

PATIENT-TRACKING SOFTWARE

Patient-tracking software allows the user to input data on specific patients and update and recall that data over time. One of the more popular patient tracking programs is PatientKeeper. PatientKeeper is available (for Palm OS devices only) for a fully functional 21-day trial at <http://www.patientkeeper.com>. The program can be registered for a modest fee, which entitles the registrant to a year of free updates; once the program is registered, data can be permanently saved. PatientKeeper uses 340 kilobytes of memory, and each patient entered takes up an additional 5 to 10 kilobytes.

Patients can be grouped according to category, and categories can be set up by hospital floor, by service, or in any other way that might meet a physician's needs. The patients within a selected category are displayed on the initial screen, along with their age, room, and diagnosis. The opening screen can be customized, and each user can choose to display the information that is pertinent to their personal area of interest. Below the list of patients is a selection of icons that open pages containing labs, studies, or progress notes. This information is entered individually for each patient. One major convenience of patient tracking programs is the ability to "beam" information to other physicians for sign-out purposes. All of the tracking information on patients on 1 floor or service can be beamed to another physician in a matter of seconds, thus eliminating the need to write sign-out slips at the end of each day and making patient discharge much smoother. Other patient tracking programs include Raphael (for Palm OS devices and Windows 95, 98, and NT systems; available at <http://www.pdamed.com>), Grail (for Palm OS devices only; available at <http://www.thenar.com/grail>), PocketMD (for Palm OS devices only; available at <http://www.pocketmd.com>), and Wardwatch (for Palm OS

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devices only; available at <http://www.watch.aust.com/pilot/wardwatch/default.htm>).

The question then becomes the following: is it time to throw out the 3 × 5 cards and the handy preprinted sheets that allow the tracking of patients by hand? Although the simplicity of the display and communication of information with handheld patient-tracking programs is attractive, data input is still cumbersome. It can take from 5 to 10 minutes with a handheld computer and a stylus to input all of the necessary data on each patient, compared to just a minute or two of jotting information on a note card. The amount of time required to achieve organized data input on a handheld computer makes the scribbled note card a more desirable option, at least for now.

CONCLUSION

Handheld computers are revolutionizing the way physicians are able to find up-to-date medical informa-

tion, whenever and wherever that information is needed. There are currently many eReferences, medical calculators, and patient-tracking programs that can facilitate excellence in patient care while at the same time making the lives of physicians easier by giving them quick access to accurate up-to-date information. HP

NOTE

The opinions expressed in this article are solely those of the authors. *Hospital Physician* does not endorse or recommend any of the products discussed in the article.

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