

## Personal Digital Educators

James J. Cimino, M.D., and Suzanne Bakken, R.N., D.N.Sc.

“What’s his infection sensitive to?” In 1995, getting the answer to this question required a house officer to find an unoccupied computer at the nursing station, sign on, and traverse the necessary screens to get the culture result. Armed with the answer — say, “levofloxacin” — she would ask the follow-up question: “What’s the renal dosing?” The next step would typically entail a search for a tattered copy of a drug reference manual.

In 2000, the house officer still needed to turn to the computer for the first answer, but for the second, she might have skipped the scavenger hunt and pulled out her personal digital assistant (PDA). A few quick taps and scribbles, and she had her answer.

Rapid access to prescribing information probably represents the single most visible and widespread effect of PDAs on health care today. In 2003, a survey of just one popular PDA-based drug reference found that 25 percent of U.S. physicians were using it in their practice,<sup>1</sup> and another survey found that when physicians had a question about antibiotics and could not get an answer from a colleague, they turned to PDA-based resources 50 percent of the time.<sup>2</sup> These trends promise to continue as students and professionals in the fields of social work, nursing, and medicine struggle to get the accurate, current patient information and medical knowledge they need to make informed decisions.

At the same time, the educational processes in health care have become increasingly intense and complex, with increased student needs for timely access to resources and increased pressure on faculty time for mentoring and supervision. The PDA offers the potential to provide resources for “just-in-time” education and to extend the ability of educators to monitor and instruct their students.

PDAs come in many forms, with a variety of capabilities, but all share some basic characteristics: they are small and lightweight; have small, touch-sensitive screens; and run a variety of software, in-

cluding personal organizers (phone and appointment books), electronic references (ranging from “cheat sheets” to textbooks), and data-collection forms. They can operate in several different modes. In “stand-alone mode,” applications are loaded onto the PDA, and the user refers to them at will. In “synchronization mode,” information — and requests for additional information — can be exchanged between the PDA and a desktop computer through a wire or an infrared link. In “wireless mode,” the PDA can maintain a continuous Internet connection, either over a cellular telephone network or with the use of wireless local area network (wi-fi) standards, allowing it to receive and send e-mail, browse the World Wide Web, and communicate with remote clinical-information systems. When the wireless connection is made through the cellular-telephone network, the PDA can usually double as a cellular telephone. These three modes of use correspond to different types of information support for health care trainees and practitioners.

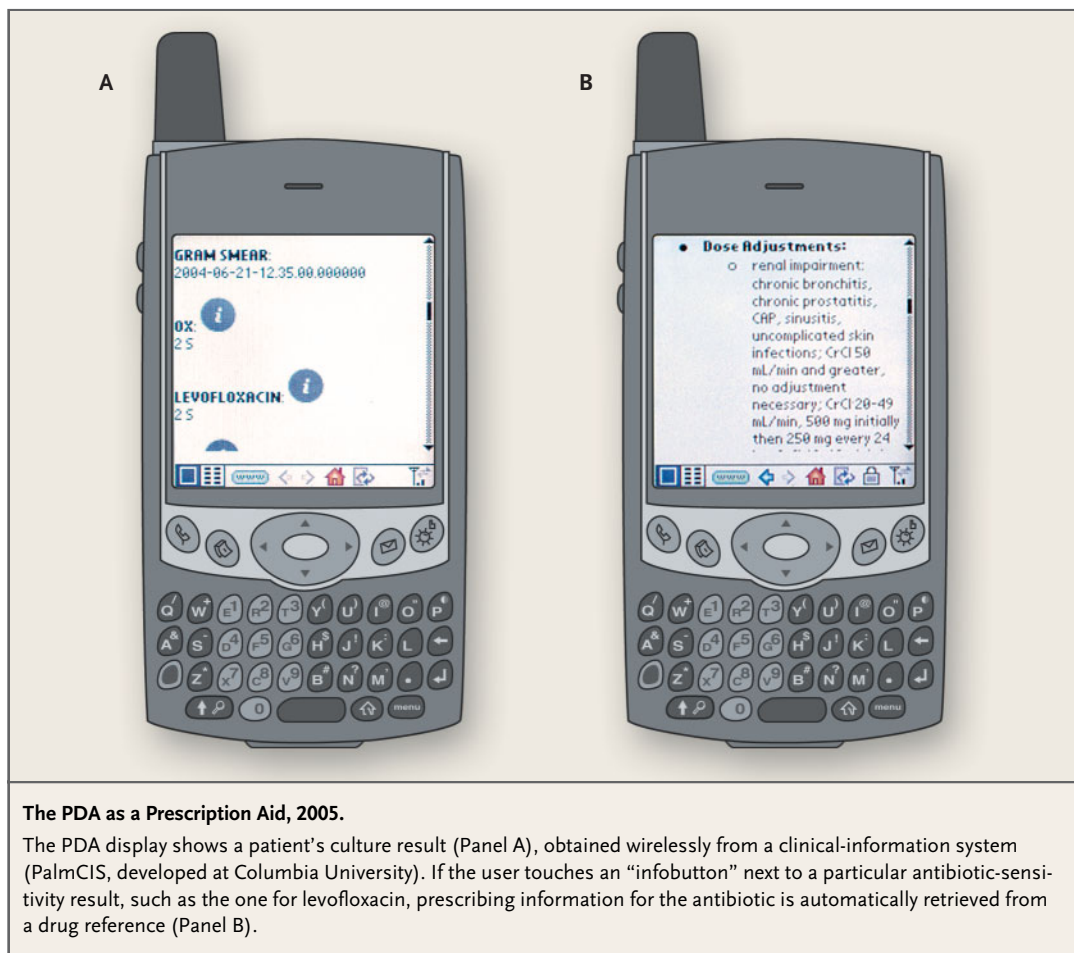
In the stand-alone mode, the PDA can replace the plethora of references that accumulate in the pockets of white coats. At Columbia University, for example, medical students’ PDAs are loaded with more than 30 applications and reference sources whose paper versions would be difficult to fit into a backpack, let alone a pocket. Studies, such as one conducted at the University of Louisville, have found that these resources are popular and are widely perceived as improving efficiency.<sup>3</sup>

Synchronization both allows the user to obtain updates, such as new drug information and guidelines, and provides two-way communication between the user and other external resources: the user fills out a form on the PDA and, when the PDA is synchronized, the form is transferred to the computer, the requests are processed, and the responses are transferred back to the PDA. In this way, users can request medical literature and information on patients.

The synchronization mode is also being exploited by educators to monitor the clinical experiences of trainees. For example, third-year medical students at Columbia use a case log on their PDAs to collect information about the patients they see. These cases are transferred to a central database, where clerkship directors can review students’ en-

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Dr. Cimino is a professor of medicine and biomedical informatics at the Columbia College of Physicians and Surgeons, and Dr. Bakken is a professor of biomedical informatics at the Columbia College of Physicians and Surgeons and a professor of nursing at the Columbia University School of Nursing, New York.



counters to ensure that there is an appropriate mix of cases. The Columbia School of Nursing integrates a patient-tracking log with a variety of decision aids to monitor the extent to which students are providing evidence-based care.

The wireless interaction mode simplifies coordination with external information resources because it does not require proximity to, or configuration of, particular computers. The real-time nature of wireless connectivity makes timely access to information more practical — for example, by giving users the ability to conduct online literature searches. Wireless connectivity also makes access to patient records practical and enables physicians to send prescriptions electronically directly to a pharmacy; however, it introduces security issues — if the PDA is lost, anyone who finds it can read the patient information stored on the device and gain access to new records at will. Fortunately, techniques such as password protection and encryption appear to be adequate for protecting patients' privacy.

PDA's are not cheap, especially when wireless connectivity is included. A residency program with 100 residents could theoretically spend \$100,000 a year on the devices and connection costs alone; costs for software, servers, support, and maintenance would be extra. Although PDA's can support evidence-based practice, the evidence in support of the technology itself is only beginning to trickle in. Early findings, however, have been encouraging, with PDA's demonstrating that they can improve the educational experience<sup>4</sup> and reduce the time spent gathering data on patients.<sup>5</sup>

Although clinicians are free to obtain their own PDA's and install resources of their own choosing, several factors are essential to successful implementation for institutional deployment of PDA's to students, residents, and practitioners. First, key stakeholders, including the administration and faculty, must buy into the project, offering more than moral support; where necessary, resources must be allocated for components such as educational re-

sources or the extension of clinical-information systems to render them compatible with PDAs. Second, PDA use must be integrated into the curriculum and the workflow of the users. Whether users are updating their software, requesting online information, or logging clinical data, the processes must be as nondisruptive as possible. For example, the use of PDA technology by students should be coordinated with training in the use of the device and decision-support applications, as well as with education in the principles of evidence-based practice.

In 2005, when the same question arises — “What’s his infection sensitive to?” — the PDA comes into play immediately (see the figure). A few taps, and the PDA obtains the answer from the clinical-information system: “levofloxacin.” Then

“What’s the renal dosing?” One additional tap on the PDA screen provides the answer.

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## Genetic Factors in Alzheimer’s Disease

Thomas D. Bird, M.D.

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Nearly 100 years ago, Alois Alzheimer described the clinical and pathological characteristics of a 50-year-old woman with the dementing illness that now bears his name.<sup>1</sup> She had no family history of dementia. It soon became established dogma that Alzheimer’s disease was a rare, noninherited cause of presenile dementia.

The past 25 years have seen an astounding confluence of seven new observations that have resulted in fundamental changes in our understanding of this important disease. First, Alzheimer’s disease is by far the most common cause of dementia. Second, the major pathological component of the disease is the accumulation of a form of amyloid termed A $\beta$  peptide. Third, this peptide is cleaved from a larger protein, the amyloid precursor protein, the gene for which resides on chromosome 21. Fourth, the pathological changes of Alzheimer’s disease are found in the brains of adults with trisomy 21 (Down’s syndrome). Fifth, many families

have an abundance of members with Alzheimer’s disease, suggesting autosomal dominant inheritance. Sixth, mutations in any of three genes are sufficient to cause the disease in certain of these families. And finally, the  $\epsilon$ 4 allele of apolipoprotein E is a risk factor for the most common type of Alzheimer’s disease in the general population. The dogma has now been reversed: Alzheimer’s disease is a common disease with important genetic components.

Initially, the genetic discovery with the greatest importance was that point mutations in any of three genes could cause autosomal dominant inherited forms of Alzheimer’s disease that were clinically and pathologically identical to nongenetic forms of the disease except that the age at onset was younger.<sup>2</sup> The first mutations were found in the *APP* gene on chromosome 21. These mutations tend to cluster near sites where the A $\beta$  peptide is cleaved from amyloid precursor protein ( $\beta$ - and  $\gamma$ -secretase sites) or where the A $\beta$  peptide itself is cleaved (the  $\alpha$ -secretase site). The next group of mutations was found in the genes encoding two proteins called presenilin 1 and 2. Subsequently, it was discovered that

Dr. Bird is a professor of neurology, medicine, and psychiatry at the University of Washington and a research neurologist at the Veterans Affairs Medical Center in Seattle.