Application of Personal Digital Assistants to an Infectious Diseases Consult Service

Since the launch of the Palm Pilot handheld computer (Palm Inc., Santa Clara, California) in 1996, sales of personal digital assistants (PDAs) have grown exponentially. With over 700 medical software applications available for Palm OS based systems, the health care industry has definitely contributed its share to this soaring technology.[1] Recently published studies[2-4] evaluating the use of PDAs for documentation in pharmacy practice have identified several advantages, including accuracy, efficiency, and portability. However, Brody and colleagues[4] discussed common shortcomings of using a PDA-driven documentation tool, including the high maintenance requirements of the devices, economical and practical implications, and the potential incompatibility with existing programs used by clinical services. Clearly, it is important to evaluate PDAs and their application software to determine their suitability to either an individual's or a department's clinical services.

The demands of an infectious diseases clinical service require accuracy, efficiency, and organization in documentation to ensure effective provision of pharmaceutical care to patients. The features and capabilities of PDAs can play an important role for the infectious diseases pharmacist. In the past year, the authors of this letter, a pharmacy resident and the infectious diseases clinical coordinator at Sunnybrook and Women's College Health Sciences Centre in Toronto, Ontario, developed and evaluated an electronic patient monitoring form and database management system for the infectious diseases consult service. One of the objectives of this project was to assess the feasibility of incorporating an electronic patient monitoring tool into existing infectious diseases pharmacy services. Preliminary evaluation of several commercial patient-monitoring and database application software programs determined that 2 software packages, ePatient2000 (IatroSoft Corporation, Houston, Texas) and Pendragon Forms (Pendragon Software Corporation, Libertyville, Illinois), were best suited for further investigation in the development of an electronic monitoring form for infectious diseases.

ePatient2000 is a patient-tracking software application with built-in medical resources.[5] Although ePatient2000 contains a comprehensive medical documentation form, its major disadvantage is the lack of a direct link to PC databases. As a result, a user cannot directly transfer data that has been input through the PDA to his or her personal computer.

Pendragon Forms is a software program for designing forms, based on Microsoft Access (Microsoft Corporate, Seattle, Washington). This software allows the user to create customized forms, which are transferred to the PDA for data collection. The collected data can be synchronized to the desktop for analysis by a database application such as Microsoft Access.[6] The dual role accomplished by this application software (form creation and data synchronization) laid the foundation for developing the electronic patient monitoring form at the authors' institution.

The electronic patient-monitoring form used the existing paper documentation tool as a template. To ensure that the final form was flexible and adaptable for use by different pharmacists, input and suggestions were obtained from pharmacy students, residents, PharmD candidates, and the clinical coordinator as they used the electronic form. These suggestions were incorporated into the monitoring tool on an ongoing basis. "Pick lists" of common medications and infectious diseases diagnoses, as well as scripting formulas for calculations, were added to ease data entry and enhance the clinical utility of the electronic form.

The electronic form was piloted during the pharmacy resident's clinical rotation in infectious diseases. During that period, a paperless system was used to track and monitor patients referred to the consult service. The electronic monitoring form made the pharmacist's clinical workload easier by consolidating patient information (summarized histories, medication lists, and laboratory results) in one medium, replacing a multitude of paper records. Furthermore, patient data were directly synchronized and stored in Microsoft Access. Direct synchronization to the database application program enhanced the efficiency of data collection and analysis.

The reports that can be generated from data collected this way may be used to facilitate projects such as tracking drug expenditure on specific services,

performing drug use evaluations, and analyzing a clinician's workload statistics. The following reports were generated as part of the database application for the infectious diseases consult service:

- Antimicrobial usage, including itemization of costs and indications
- Summary of specific diagnoses, treatments used, and cost of treatments
- Types and number of specific diagnoses
- Diagnoses, with organisms grown and antimicrobial sensitivity patterns
- Summary of pharmacist interventions
- Summary of "active" patients within the consult service

The development and piloting of an electronic patient monitoring form for the infectious diseases consult service provided assurance of the benefits of incorporating a PDA into a specialized area of clinical practice. There are many untapped resources and applications that PDAs can offer to pharmacists. Exploring the contributions of this new technology will definitely facilitate the progress of clinical pharmacy services.

References

1. Felkey BG, Fox BI. Palm OS or Pocket PC? *Hosp Pharm* 2002;37:545-50.
2. Reilly JC, Wallace M, Campbell MM. Tracking pharmacist interventions with a hand held computer. *Am J Health Syst Pharm* 2001;58:158-61.
3. Lau A, Balen R, Malyuk DL. Using a personal digital assistant to document clinical pharmacy service in an intensive care unit. *Am J Health Syst Pharm* 2001;58:1229-32.
4. Brody J, Camamo JM, Maloney ME. Implementing a personal digital assistant to document clinical interventions by pharmacy residents. *Am J Health Syst Pharm* 2001;58:1520-2.
5. Solutions [ePatient2000 product information]. In: ePatient mobile healthcare productivity platform [Internet homepage]. Houston (TX): IatroSoft Corporation; 2002. Available at: http://www.iatrosoft.com (accessed 2002 Jun 19).
6. Pendragon Forms 3.2 [product information]. In: Web site for Pendragon. Libertyville (IL): Pendragon Software Corporation; 2002. Available at: http://www.pendragon-software.com (accessed 2002 Jun 19).

Stephanie Ong, BScPhm
Pharmacy Practice Resident
Sunnybrook and Women's College Health Sciences Centre
Toronto, Ontario

Sandra A.N. Tailor, PharmD, FCSHP
Clinical Coordinator
Infectious Diseases
Sunnybrook and Women's College Health Sciences Centre
Assistant Professor
University of Toronto
Toronto, Ontario

Combined Olanzapine- and Risperidone-Induced Diabetic Ketoacidosis

Atypical antipsychotics have been reported to cause diabetic ketoacidosis and new-onset diabetes.[1] The risk of developing diabetes mellitus or impaired glucose tolerance (or both) is 2-fold greater with atypical agents than with typical agents.[2] A recent admission to our intensive care unit illustrates the need to be aware of the possibility of drug-induced diabetic ketoacidosis and new-onset diabetes.

A 22-year-old Caucasian man with a 1-year history of schizophrenia was transferred to our institution for management of diabetic ketoacidosis. The patient had presented with thirst, polyuria, polydipsia, nocturia, and mild epigastric pain of several weeks' duration. The results of laboratory investigations at the time of presentation were as follows: presence of serum ketones, blood glucose 27.6 mmol/L (normal range 3.3 to 6 mmol/L), serum pH 7.10, serum bicarbonate 5 mmol/L (normal range 22 to 26 mmol/L), and anion gap 20 (normal range 8 to 12). The patient had no history of diabetes mellitus, but there was a family history of the condition (both father and grandfather). The patient was obese, weighing 125 kg and having a body mass index of 40 kg/m^2.

Before admission, the patient had been receiving olanzapine 10 mg daily, risperidone 4 mg twice daily, clonazepam 0.25 mg twice daily, and benztropine 2 mg as needed. A review of the patient's neuroleptic therapy revealed that he had been started on risperidone 0.5 mg twice daily approximately 1 year before the current admission; olanzapine had been added soon after to control decompensation. Medical records confirmed that 2 months before the current presentation, the patient had been taking olanzapine 10 mg once daily and risperidone 4 mg twice daily. The possible contribution of these 2 agents to the patient's metabolic problems went unrecognized until 3 days after presentation. At that time, both the olanzapine and the risperidone were discontinued, as it was believed that they were contributing to the diabetic ketoacidosis and new-onset diabetes. The patient was discharged on alternative antipsychotics and insulin therapy with no adverse sequelae.

Both olanzapine and risperidone have been reported to induce diabetic ketoacidosis and new-onset diabetes.[1,3,4] The exact mechanism or mechanisms underlying this toxic effect are unknown. The lag period from initiation of atypical antipsychotics to development of hyperglycemia also varies. Several