Evaluation of Personal Digital Assistant Drug Information Databases for the Managed Care Pharmacist

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ABSTRACT

BACKGROUND: Personal digital assistants (PDAs) are becoming a necessity for practicing pharmacists. They offer a time-saving and convenient way to obtain current drug information. Several software companies now offer general drug information databases for use on handheld computers. PDAs priced less than $200 often have limited memory capacity; therefore, the user must choose from a growing list of general drug information database options in order to maximize utility without exceeding memory capacity.

OBJECTIVE: This paper reviews the attributes of available general drug information software databases for the PDA. It provides information on the content, advantages, limitations, pricing, memory requirements, and accessibility of drug information software databases.

SUMMARY: Ten drug information databases were subjectively analyzed and evaluated based on information from the product's Web site, vendor Web sites, and from our experience. Some of these databases have attractive auxiliary features such as kinetics calculators, disease references, drug-drug and drug-herb interaction tools, and clinical guidelines, which may make them more useful to the PDA user.

CONCLUSION: Not all drug information databases are equal with regard to content, author credentials, frequency of updates, and memory requirements. The user must therefore evaluate databases for completeness, currency, and cost-effectiveness before purchase. In addition, consideration should be given to the ease of use and flexibility of individual programs.

KEYWORDS: Personal digital assistant (PDA), Drug information, Drug information software, Drug information databases, Pharmacist

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Personal digital assistants (PDAs) have become an indispensable tool for pharmacists practicing in a variety of settings. They promote patient safety and improve quality of care by providing quick access to drug information. PDAs offer a significant advantage over text publications in terms of information currency. Many pharmacy database programs offer monthly, weekly, or even daily information updates. Pharmacists are not only using PDAs to access drug information but also to record activities and interventions, reconcile patient medication histories with medications on admission, and document medication errors. PDAs permit more efficient use of the pharmacist's time.[1]

Pharmacists join other health care providers in using PDAs in the scope of their daily practice. Approximately 30% of physicians now own a PDA, with the percentage expected to increase to 50% by 2005.[2] Fifteen percent of physicians are using PDAs in their clinical practice to access drug and reference information.[3] By 2004, 20% of physicians will be using PDAs for prescription entry, retrieval of lab data, dictation, and medical billing.[4] This percentage may further increase as managed care organizations become involved in electronic prescribing initiatives. A study by Papshev and Peterson in the *Journal of Managed Care Pharmacy* found that 61% of managed care pharmacy managers felt electronic prescribing implementation was feasible, while only 16% had implemented electronic prescribing.[5] Nurses, too, are finding that PDAs are an efficient way to streamline the patient-information-gathering process and to reduce paperwork.[6]

Health care professionals are reaching for PDA technology not just for convenience but also to combat the number of medication errors that occur each year. A recent study of 1,116 hospitals showed that medication errors occurred in 5% of patients per year, corresponding to approximately 1 error every 23 hours or 1 in 20 hospital admissions.[7] Fortunately, not all of these medication errors adversely affected patient outcomes. Medication errors are not confined to the inpatient setting, and a current study is underway to determine if the use of PDAs reduces medication errors in the primary care setting.[8]

As with all new technologies, PDAs have limitations. Cost, battery life, and memory capacity may place restrictions on their usage. Costs range from $100 to $800 per device, depending on the features of the model selected.[9] Batteries last for up to 15 hours before having to be recharged. Most PDAs are preloaded with one of 2 operating systems, Palm OS or Microsoft Pocket PC, which manage all other software programs installed on the handheld device. Memory capacities range from 2MB to 51MB for Palm OS and 4MB to 128MB for Pocket PC systems,[10] often with the option of adding additional memory via an expansion card, which resembles a tiny disk.[9] Table 1 lists drug

TABLE 1	Database Program Compatibility With Expansion Cards
Database	**Expansion Card Compatibility**
A2zDrugs	Expansion cards of Palm OS or Pocket PC devices
AHFS Drug Information	Expansion cards of Palm OS or Pocket PC devices
DrDrugs	Expansion cards of Palm OS or Pocket PC devices
ePocrates Rx	Not compatible with expansion cards
ePocrates Rx Pro Premium	Not compatible with expansion cards
Lexi-Platinum	Expansion cards of Palm OS or Pocket PC devices
MobileMICROMEDEX	Expansion cards of Palm OS devices
MosbyDrugs	Expansion cards of Palm OS or Pocket PC devices
PDRDrugs	Expansion cards of Palm OS or Pocket PC devices
Physician's Drug Handbook	Expansion cards of Palm OS or Pocket PC devices
Tarascon Pocket Pharmacopoeia Deluxe	Expansion cards of Palm OS devices

information software program compatibility with expansion cards. PDAs priced less than $200 often have limited memory capacity; therefore, it is necessary to make drug information program choices from an ever-growing list of options without exceeding memory capacity.

This article reviews and subjectively analyzes 10 general drug information database options, their potential advantages, possible limitations, pricing information, memory requirements (Table 2), and where they can be accessed via the Internet. Other PDA specialty drug information databases have been reviewed elsewhere.[11] The 10 databases evaluated were, to our knowledge, the only general drug information databases available at the time this manuscript was developed. Databases were analyzed using information provided on the product's Web site, vendor Web sites, and from our experience. An asterisk (*) indicates that a particular product has been tested by one or more of the authors.

▰▰ Drug Information Database Options

A2zDrugs (version 6.0.152)*
Description: There are several A to Z Drug Facts products produced by Facts and Comparisons, including A2zDrugs, Drug Facts Silver, Drug Facts Gold, and Drug Facts Platinum.[12-14] The A2zDrugs information database has more than 700 drug monographs. These monographs contain information such as brand name, classification, actions, route/dosage, overdose, indications, precautions, contraindications, adverse reactions, lists of interacting agents, pregnancy information, administration/stor-

age, patient/family education, assessment/interventions, and lab interference information. Drug Facts Silver offers more drug monographs (more than 850), pronunciation guides, information on dosage form/strength and how the product is supplied, and auto-updates. Drug Facts Gold includes drug interaction screening technology, which allows the user to input patient medications and "screen" for interactions, in addition to the enhancements made to the Drug Facts Silver database. The drug interaction screening tool iFacts includes interaction significance, principals, drugs, effects, mechanisms, management, and references. Drug Facts Platinum includes all of the information from Drug Facts Gold plus a natural products database with more than 300 monographs taken from *The Review of Natural Products,* published by Facts and Comparisons. These natural product monographs contain scientific and common names, uses, dosing, lists of drug interactions, side effects, and sections on botany, history, pharmacology, and toxicology.

Additional Information: Costs for A2zDrugs and Silver, Gold, and Platinum products are $49.95, $59.95, $109.95, and $159.95, respectively, for a 1-year subscription with monthly updates. A2zDrugs can be purchased from www.collectivemed.com or www.skyscape.com.

Potential Advantages: A free trial version is available from www.skyscape.com. Patient care and clinical information are separated for ease of use in monographs. In addition to the full monographs provided for approved products, condensed information is also presented for investigational, orphan, and combination drugs. The iFacts tool provides references for interactions. A personalized list of frequently used drugs can be created for faster access to information. Free-text notes can be entered in the note section.

Potential Limitations: The A2zDrugs information database is sold separately from the drug interaction screening technology. Drug Facts Silver, Gold, and Platinum are compatible with expansion cards of Pocket PC but not Palm OS devices. There is no information on cost or cost comparisons. *The Review of Natural Products* received only a fair recommendation as a primary reference in a recent review of herbal-reference literature, based on inconsistencies among monographs.[15] A recent study, supported by the St. Louis College of Pharmacy Research Incentive Fund, questioned the clinical usefulness of A to Z Drug Facts.[16]

AHFS (American Hospital Formulary Service) Drug Information (version 2003)

Description: The handheld version of *AHFS Drug Information* has a database of more than 1,200 monographs indexed by therapeutic class, brand name, generic name, and keywords.[17] Monographs contain dosage and administration information, uses, cautions, toxicity, drug interactions, pharmacology, pharmacokinetics, stability, and expert analysis. There is also an option to create a personalized formulary through the American Society of Health-System Pharmacists (ASHP) Access System.

TABLE 2 Summary Description of Drug Information Databases

Software Program	Memory Required	Advantages	Limitations	Cost
A2zDrugs	3.6MB Palm OS 7.3MB Pocket PC	• Free trial version • Investigational and orphan drugs • Can create personalized drug lists • Note-entering capability • Monthly updates	• Drug interaction screening software sold separately • Silver, Gold, Platinum products only compatible with Pocket PC expansion cards • No drug cost information	$49.95 per year
AHFS Drug Information	Multimedia card	• More portable than the text version • Monthly updates	• Updates are not automatic • No free trial version	$100.00 per year
DrDrugs	2.5MB Palm OS 5.8MB Pocket PC	• Free trial version • Monographs for 30 alternative agents • Note-entering capability	• No drug cost information	$49.95 per year
ePocrates Rx	2.5MB Palm OS	• Free download • Formulary information • Automatic updates • MultiCheck drug interaction software	• Not compatible with expansion cards	Free
ePocrates Rx Pro Premium	3.0MB Palm OS 4.0MB Pocket PC	• Alternative agent monographs • DocAlert system • MedMath calculator • ePocrates ID	• Not compatible with expansion cards	$49.99 per year
Lexi-Platinum	2.7 to 5.8MB Palm OS 3.4 to 5.8MB Pocket PC	• International brand name index • Free trial version • Discounts available for students, faculty and on multiple database purchases	• Each Lexi database is sold separately • No drug cost information	$75.00 per year
Mobile MICROMEDEX	1.8MB Palm OS 2.2MB Pocket PC	• Free for individuals/institutions who subscribe to the MICROMEDEX system • Automatic updates • Free trial version	• No drug cost information • Drug interaction screening software purchased separately • No note-entering capability	$74.95 per year
MosbyDrugs	5.6MB Palm OS 13.5MB Pocket PC	• Evaluates drug interactions and gives recommendations for clinical management • Free trial version	• Source of drug cost information is not revealed	$64.95 *
PDRDrugs	2.1MB Palm OS 5.6MB Pocket PC	• Free trial version • Note-entering capability	• Package insert information only • Drug interaction screening software purchased separately	$49.95 per year
Physician's Drug Handbook	2MB Palm OS/Pocket PC	• Does not present any significant advantages over other databases due to dated material	• Corresponds to the 9th edition of the *Physician's Drug Handbook* published in 2001 – not current	$75.00 *
Tarascon Pocket Pharmacopoeia Deluxe	1.5MB Palm OS/Pocket PC	• Prerelease version available as a free download • Referenced drug interaction software • Alternative agent monographs	• Limited drug cost information	$25.00 per year

Indicates a one-time fee; no updates except with release of new product version.

Additional Information: *AHFS Drug Information* is supplied on a multimedia card that is compatible with Franklin eBookman, Palm OS, and Pocket PC devices. The database can also be purchased on CD-ROM and then downloaded onto an expansion card for use on the PDA. The multimedia card and CD-ROM are available for $100 from www.ashp.org.

Potential Advantages: The PDA version of *AHFS Drug Information* is a more convenient way to utilize this reference than the print version. The PDA multimedia card version is not abridged and contains all monograph information (approximately 4,000 pages) available in the printed *AHFS Drug Information*. Free monthly online updates are available.

Potential Limitations: A free demonstration of the multimedia card is not available, although a 30-day trial of the ASHP Access System, which includes a choice of *AHFS Drug Information* monographs, is available. An automatic update feature is currently unavailable. The user is informed of monthly updates via e-mail and then must download the update from the Internet.

DrDrugs Davis Drug Guide for Physicians (version 6.0.152)*

Description: DrDrugs is a collection of 1,500 drug monographs with concise drug information.[12,14] Monographs contain the following: U.S. and Canadian drug brand names, classification, action, pharmacokinetics, time/action profile, route and dosage, indications, contraindications and precautions, adverse drug reactions and side effects, lists of interacting agents, pregnancy risk factors, controlled substance schedule, and U.S. and Canadian availability. Monographs are indexed by brand and generic names, therapeutic classification, and pharmacologic classification. In addition to standard drug monographs, there are also monographs for 475 combination products and several commonly used alternative agents.

Additional Information: DrDrugs is compatible with Palm OS and Pocket PC. An annual subscription costs $49.95 and can be purchased from www.collectivemed.com or www.skyscape.com.

Potential Advantages: This database provides monographs for approximately 30 alternative agents. A free demonstration version is available from www.collectivemed.com or www.skyscape.com. Notes can be entered for each drug monograph.

Potential Limitations: No cost information is provided in drug monographs. References are not provided for monographs or drug interactions.

ePocrates (version 6.0)*

Description: The daily-updated drug information program ePocrates is divided into 2 databases: ePocrates Rx and ePocrates Rx Pro Premium.[18] Both databases offer more than 2,800 drug monographs, formulary information for selected health plans, MultiCheck drug interaction technology, and automatic updates when hot syncing, linking the PDA to a desktop or laptop computer that is connected to the Internet. Individual monographs are indexed by brand name, generic name, and drug class, with information on mechanism of action, metabolism, excretion, adult and pediatric dosing, contraindications and cautions, adverse reactions, drug interactions, pregnancy and lactation, DEA schedule, dosage forms, manufacturer, and cost. Monographs for several over-the-counter medications are included. DocAlerts, which provide updated clinical information, are available with both databases.

Additional features of the ePocrates Rx Pro Premium product include alternative agent monographs, an enhanced MultiCheck interaction system, ePocrates ID, a medical calculator, drug-comparison tables, and clinical guideline tables. Alternative agent monographs are taken from the Natural Medicines Comprehensive Database and include information on reported uses, reported dosing, adverse drug reactions, cautions, potential drug interactions, and synonyms. MultiCheck software for Rx Pro Premium scans for both drug-drug and drug-herbal interactions for up to 30 medicinal agents. The infectious disease database ePocrates ID indexes more than 300 diagnoses, 350 microorganisms, and 250 drugs. It gives empiric as well as specific treatment recommendations for adults and children. The medical calculator, MedMath, also available online free of charge, contains medical equations and will calculate patient-specific variables. MedMath provides the equation used in the calculation and a literature reference. Equations include body surface area, ideal body weight, and creatinine clearance, among 34 total equations. There are approximately 45 tables included in Rx Pro Premium, including steroid comparisons, insulin comparisons, therapeutic drug levels, and hypertension treatment guidelines.

Additional Information: The ePocrates Rx program is available as a free download from the company's Web site (www.epocrates.com). The enhanced version, ePocrates Rx Pro, is also available at www.epocrates.com for an annual fee of $49.99. Both ePocrates Rx and ePocrates Rx Pro are compatible with Palm OS. Pocket PC is compatible with ePocrates Rx Pro.

Potential Advantages: The Natural Medicines Comprehensive Database, which provides the alternative agent monographs, was recently reviewed and highly recommended for clinicians.[15] The editors, authors, and reviewers of the ePocrates database include physicians and pharmacists who obtain monograph information from primary literature, such as clinical trials; drug manufacturers; society; or expert panel recommendations; drug safety alerts; and tertiary literature, such as textbooks and review articles. The DocAlert system is activated by updating ePocrates and enables the clinician to request, by selecting from a topic list on the PDA, additional information on new drugs, clinical trial results, FDA safety alerts, and other medical news. The requested information is then sent to the clinician via e-mail. The free version of ePocrates, which serves as a product demonstration, can satisfy general drug information needs. A note section is available for free text to be entered for each drug monograph. References are provided for MedMath calculations, ePocrates ID monographs, and for some clinical guidelines (e.g., Advance Cardiac Life Support Guidelines). Formulary information is available for more than 130 health plans as well as for many hospitals, pharmacy benefit managers, and other health care groups.

Potential Limitations: Drug cost information is estimated from pricing at drugstore.com, which provides costs for many oral and topical products, but few parenterally administered products. ePocrates is currently not compatible with expansion cards.

Lexi-Comp (version unspecified)*

Description: Lexi-Comp is separated into several databases with multiweekly information updates.[19] Lexi-Platinum, the comprehensive drug database, is divided into 3 views: Essential View, Comprehensive View, and Comprehensive Plus Specialty View. The Essential View contains information on brand/generic drug names, drug class, mechanism of action, pharmacokinetics/dynamics, general and special dosing information, approved

and investigational drug uses, contraindications/precautions, adverse reactions, lists of interacting agents, pregnancy/lactation, and dosage forms. The Comprehensive View adds synonyms; Canadian brand names; more detailed pregnancy/lactation information; drug effects when used with ethanol, herbs, or supplements; laboratory test interactions; product stability; administration; reference drug levels; dietary considerations; patient education; nursing information; overdose/toxicity data; monitoring parameters; anesthesia/critical care considerations; and geriatric information. The Comprehensive Plus Specialty View adds cardiovascular considerations, compatibility, mental health considerations, emetic and vesicant potential, bone marrow transplant considerations, and additional monitoring information. An international brand-name index, with medications from 58 countries, can be downloaded for use with the Comprehensive Plus Specialty View.

Additional Information: The complete collection of handheld products, Lexi-Complete, is $225 for a 1-year subscription and includes a general drug information database as well as 10 specialty databases (e.g., Lexi-Drugs for Pediatrics, Lexi-Natural Products). A 1-year subscription for Lexi-Platinum, the drug information database, is $75. Lexi-Interact, the drug interaction screening tool, is sold separately for $75 per year. Lexi handheld products are compatible with Palm OS and Pocket PC systems.

Potential Advantages: A recent comparison of Lexi-Platinum with other programs found it to be the most comprehensive and dependable drug information database.[16] Specialty databases are available in the areas of infectious disease, pediatrics, poisoning and toxicology, natural products, dentistry, and nursing. A free product demonstration is available for each database and can be used up to 20 times. A discount is offered if multiple handheld databases are purchased together or if the purchaser is a student, resident, or faculty member. Lexi-Comp is compatible with the expansion cards of Palm OS and Pocket PC devices. Individual notes can be made and incorporated into drug monographs.

Potential Limitations: Subscriptions for Lexi products must be renewed annually, and since each database is priced separately, costs may accrue rapidly. Lexi-Comp does not provide estimated drug cost information.

MobileMICROMEDEX (version 116)*

Description: MobileMICROMEDEX is a compilation of databases including Drug Information, Alternative Medicine, Acute Care, Toxicology, and Drug Interactions.[12,20,21] The Drug Information database is updated quarterly in March, June, September, and December and contains monographs for more than 1,400 drugs. Monographs include generic and brand names, therapeutic classification, dosage information for adults and children, renal/hepatic dosage adjustments, indications, adverse effects, lists of interacting agents, pregnancy/lactation information, and dosage forms/packaging information. Monographs are indexed by generic name, trade name, and drug class.

The Alternative Medicine database has classification, dosage, administration, dosage forms, usage, contraindications, adverse effects, interactions, and pregnancy/lactation information for approximately 270 herbs and supplements. The Acute Care database has diagnostic and treatment information for 320 emergent conditions. The Toxicology database has treatment, effects, and toxicity range for about 185 poisonings. The drug interaction tool, based on the MICROMEDEX DRUG-REAX system, allows for interactions to be checked for up to 32 medications simultaneously. Interaction analysis includes severity, documentation, onset, potential adverse effects, management, and suspected mechanism.

Additional Information: MobileMICROMEDEX can be purchased at www.collectivemed.com or www.palmgear.com Web sites for $74.95 per year. The drug interaction screening tool can be added for a total of $99.95. MobileMICROMEDEX is compatible with Palm OS and Pocket PC systems. It is also compatible with expansion cards of Palm OS devices.

Potential Advantages: The PDA program can be downloaded free of charge for individuals or institutions that subscribe to the MICROMEDEX system. A free demonstration is also available for nonsubscribers. The handheld databases are written and peer-reviewed by physicians, pharmacists, nurses, and toxicologists. MobileMICROMEDEX contains monographs for some over-the-counter medications in addition to prescription products. The database is automatically updated when the user hot syncs with a desktop computer. Individual hospitals or other institutions can have their formulary made accessible via PDA or desktop PC by using the MICROMEDEX Formulary Advisor.

Potential Limitations: There is no estimated drug pricing information. The scope of the MobileMICROMEDEX database is narrower than that of the MICROMEDEX system available online. The previously cited study in *Pharmacotherapy* found MobileMICROMEDEX to be unsuitable for clinical use.[16] Interaction screening technology must be purchased separately. No references are provided for monographs. There is no opportunity to enter free-text notes within drug monographs.

MosbyDrugs (version 2001)*

Description: MosbyDrugs is the handheld version of *Mosby's Drug Consult* combined with MosbyIx, an interaction screening tool.[12,14] This database references the Top 200 Drugs, plus other commonly used drugs. The database includes information on domestic and foreign brand names, therapeutic classification, clinical pharmacology, pharmacokinetics, adult and pediatric dosage, indications, contraindications, precautions, adverse effects, lists of interactions, pregnancy/lactation, special considerations, dosage forms, and cost. There are multiple indexes: Main Index (generic name), Brand Index, Chemical Index, Therapeutic Index, Indications Index, and the Index for International Brand Names. The MosbyIx interaction database

presents the significance, recommended actions, special circumstances, and references for drug interactions. It also analyzes drug-lab interactions.

Additional Information: The PDA database is available from multiple vendors, including www.collectivemed.com and www.skyscape.com, for $64.95. It is compatible with Palm OS and Pocket PC systems.

Potential Advantages: MosbyDrugs evaluates drug interactions and gives recommendations for clinical management. Drug interactions are referenced. A free product demonstration is available from www.collectivemed.com. Notes can be added to individual drug monographs.

Potential Limitations: The updated version of MosbyDrugs must be purchased when new editions are made available. The source of drug cost information is not revealed.

PDRDrugs (version 6.0.151)*

Description: This handheld database contains information from the *Physicians' Desk Reference*[12,14] Drug monographs include drug brand and generic names, therapeutic class, adult and pediatric dosing, indications, contraindications, adverse reactions, warnings and precautions, Black Box warnings, lists of interacting agents, pregnancy and nursing information, U.S. Drug Enforcement Administration class, how the product is supplied, and the manufacturer's name.

Additional Information: PDRDrugs is compatible with Palm OS and Pocket PC systems. An annual subscription with quarterly updates can be purchased for $49.95 at www.skyscape.com or www.collectivemed.com.

Advantages: A free product demonstration is available from www.collectivemed.com or www.skyscape.com. Drug monographs include the manufacturer's name. A section for free-text notes is provided.

Limitations: This database does not contain information on herbal products or non-U.S. Food and Drug Administration-approved indications since information is based on manufacturer package inserts for FDA-approved products. The drug interaction screening tool must be purchased separately. Drug cost information is not available.

Physician's Drug Handbook (version 2001)

Description: This product is based on the *Physician's Drug Handbook* and has 900 generic product monographs.[12,22] The following information is contained within the monographs: pharmacodynamics and pharmacokinetics, route and dosage, overdosage, geriatric use, pediatric use, indications, contraindications, adverse reactions, interactions, effects on diagnostic tests, breastfeeding, how supplied, special considerations, information for the patient, and summary information of drug use in specific disease states.

Additional Information: This database is compatible with Palm OS and Pocket PC systems.

Potential Advantages: Currently, the Physician's Drug Handbook does not provide any significant advantages over other PDA drug databases because the information may be dated.

Potential Limitations: The Physician's Drug Handbook does not provide information on alternative medicinal agents, drug cost, or a section for individual notations. The database corresponds with the ninth edition of the handbook, published in 2001, and therefore does not provide the most current drug information. A free product demonstration is not available.

Tarascon Pocket Pharmacopoeia Deluxe PDA Edition (beta-test version)*

Description: This second-generation product is currently in development as a replacement for Tarascon ePharmacopoeia, which is no longer available.[23] Drug monographs are indexed by brand and generic names, classification, and indication. They contain mechanism of drug action, metabolism, adult and pediatric dosing guidelines, FDA-approved and -unapproved uses, warnings and cautions, adverse reactions, lists of interacting agents, pregnancy and lactation information, dosage forms, and cost information. Drug interaction screening technology, alternative agent monographs, 47 reference tables, and calculators for 9 medical equations are also included.

Additional Information: A prerelease test version is currently available as a free download from www.tarasconpublishing.com. When the product is officially released, it will require a $25 annual subscription. Tarascon Pocket Pharmacopoeia is compatible with Palm OS and Pocket systems as well as expansion cards of Palm OS devices.

Potential Advantages: Information for the drug interaction screening tool is referenced and taken from *The Medical Letter.* Alternative agent monographs are incorporated into the database as a separate section. Drug monographs are peer-reviewed by experts. The test version of the product is currently available free of charge. The date of the last update is provided.

Potential Limitations: Drug cost information is provided from www.drugstore.com for many oral and topical products but is often absent for parenterally administered products. Once the product is officially made available, the subscription must be renewed annually.

■ Discussion

Most of the information on PDA handheld drug information databases is provided on product or vendor Internet sites and is subject to change, potentially on a daily basis. Since Web sites vary with regard to frequency of updates, some vendors may offer older versions of drug information products even though updated versions are available. It is important to check for a version number or a year of publication especially when purchasing electronic versions of products offered in book or handbook format. To make a product more appealing, some vendors report the number of brand-name drugs referenced in

the drug information product instead of the number of monographs (by generic drug name). Since a single product may have multiple brand names, a misleading representation of the breadth of information may be created. Some vendors disclose specific product details, including monograph reviewers, the depth of information provided, and database update information. This information is an indication of the quality of the drug information database. If it is not provided, most sites offer an e-mail address for the purpose of requesting additional information.

Current, complete, flexible, cost effective, accurate, evidence-based, relevant, simple, and verifiable are key characteristics of information databases[24,25] and are defined as follows:

- *Current:* One of the merits of handheld electronic databases compared with handbooks and other annually published drug information sources is its ability to be up-to-date. It is important to determine the frequency of updates of the databases—daily, weekly, monthly, quarterly, or yearly—since programs are not all updated with the same frequency.

- *Complete:* Monographs should provide brand and generic names, drug classification, mechanism of action, kinetic information, adult and pediatric dosing information, drug uses and indications, contraindications and precautions, adverse drug reactions, drug interactions, pregnancy and lactation information, DEA schedule, dosage forms, manufacturer, and cost information.

- *Flexible:* The drug information user should be able to adapt drug monographs by entering his or her own notations for a particular drug.

- *Cost effective:* Costs quickly accrue when multiple databases must be purchased in order to attain the desired breadth of information. A single database that provides all the necessary information should be sought. It is important to note that product cost does not correlate with information breadth or dependability.[16]

- *Accurate:* Programs should be free of typographical errors and information omissions.

- *Evidence-based:* References should be provided for individual monographs and for supplemental features.

- *Relevant:* Information provided in drug monographs should be applicable to clinical practice. For example, programs that include pictures of medicinal plants, while interesting, are not likely to be clinically useful.

- *Simple:* Information should be presented in such a way as to allow a novice to install, update, and access drug information.

- *Verifiable:* Drug information should be consistent with that found in authoritative literature sources.

Databases that meet these criteria can enhance clinical decision making, reduce variability of pharmacist recommendations, and save time in a managed care setting. In addition to drug information, helpful PDA programs may include disease references, medical abbreviations or medical dictionaries, laboratory references, medical or kinetics calculators, and inter-

vention documentation technology. These auxiliary programs can be purchased from multiple vendors, or in some cases, are available free of charge, and have been reviewed elsewhere.[11]

■■ Conclusion

Electronic drug information programs for PDAs are designed to fill in the gaps in human memory, particularly important in light of the volume of new information that is reported each day. Drug information databases are generally abridged and are not a substitute for consulting textbooks, original research, and other appropriate drug information resources.

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