CHAPTER 50

Computers in pharmaceutical management

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SUMMARY

Users should first define what functions or tasks computers will be used for, identify appropriate software for those functions, and then select hardware that is capable of using the software efficiently.

A computerization process is easier when—

- Efficient manual procedures exist
- Staff members are capable of, and interested in, learning to use computers
- Funds have been allocated for training, maintenance, and equipment upgrades
- A reliable power supply exists

Pharmaceutical management programs should usually begin with basic word processing and spreadsheet applications. Users can then gain experience and develop support systems for supplies, repairs, and security. Specialized pharmaceutical management programs are often used for quantification of pharmaceutical requirements, procurement, inventory management, or medicine-use analysis.

Medicine information is increasingly available through electronic communications systems. Most pharmaceutical supply systems have access to Internet communications. Two main options are available: e-mail and World Wide Web browsers. Use of the Internet for international communications has become increasingly important.

Central to most pharmaceutical management applications is a product master file, including product name, strength, dosage form, therapeutic category, route of administration, and packaging. A coding system with a unique identifier for each drug product must be developed.

Personal computers, or PCs, can be used in all aspects of the pharmaceutical management cycle. Hardware refers to the computer's electronic and mechanical parts, which include—

- A microprocessor chip
- Memory chips (RAM, for random-access memory)
- Input devices (keyboard, flash drive, mouse, scanner)
- Storage devices (hard disk drive, CD-ROM, magnetic tape)
- Output and peripheral devices (monitor, printer, modem, network card, speakers)

Software refers to instructions that can be understood and executed by the computer. Categories include—

- The operating system, which coordinates and directs information for the microprocessor
- General-purpose software, such as word processing, spreadsheets, and database management software
- Special-purpose software, such as presentation graphics, project management, and accounting software
- Utility programs, such as antivirus, file backup, and data recovery programs
- Specialized pharmaceutical management software, often a custom-programmed database application

When used effectively, computer systems save money, promote efficiency, and improve the quality of services. However, poorly conceived or implemented computer systems waste money, decrease efficiency, and distract attention from other management improvements.

This chapter discusses the uses of computers in pharmaceutical management and examines special issues in computerizing pharmaceutical management information. It also includes specifications for computer applications in pharmaceutical management, considerations for hardware selection, and requirements for maintaining and supporting computers. Preparing data for computerization is discussed, along with coding systems and definitions of units. This chapter focuses on personal computers because they are the most widely used by essential medicines programs. Instructing users in particular software programs or making recommendations for the purchase of a specific piece of hardware or software is beyond the scope of this chapter.

The question today is usually not whether but rather how and how much to computerize. Even more important, however, is how to computerize efficiently. This chapter provides guidelines to help decision makers computerize their operations effectively.

50.1 Uses of computers in pharmaceutical management

Computers can be used in all aspects of the pharmaceutical management cycle, from selection to use. Using communication devices, users can exchange or share information with other computers at the same site through a local area network (LAN) or with computers anywhere in the world. The term *computers* here also encompasses devices such as personal digital assistants (PDAs) and handheld and pocket devices such as "smartphones." Table 50-1 summarizes some of the many current computer applications for pharmaceutical management.

50.2 When and how to computerize

Computer technology changes quickly, with machines continually becoming faster, more capable, and less expensive. The benefits of computers in managing pharmaceuticals depend on the choice of tools, the commitment to using the tools, and the ability to overcome the hurdles involved in incorporating computers into the organization. No standard formula exists for successful computerization in pharmaceutical management, but rather a mix of elements applies; the right mix can yield great benefits.

Benefits and limitations of computerization

Some of the benefits of computerization are to—

- Simplify and speed up complex tasks
- Increase accuracy by checking spelling, calculations, and data integrity
- Update and access information quickly
- Automate repetitive tasks
- Provide management information for decision making
- Allow organizations to expand operations
- Streamline administrative processes
- Generate timely reports without repetition

Nevertheless, computers do have limitations. They cannot assume responsibilities, make decisions, define problems, set objectives, improve the basic data available, or make a person more organized. They cannot fulfill needs if appropriate hardware and software are not chosen, and they are not a one-time expense: funds are required for upgrades, training, and support over time for both hardware and software.

Conditions in an organization that support computerization include—

- Efficient existing manual procedures
- Other departments that have computerized successfully

Table 50-1 Computer applications for pharmaceutical management

Area of activity	Uses
Project planning	• Workplans • Simulation programs • Annual reports
Selection	• Preparation of essential medicines lists • Literature searches
Requirements planning	• Quantification of pharmaceutical needs • ABC analysis • Weight and volume analysis of kits
Financing	• Budget management • Pharmaceutical sales monitoring • Accounting • Financial analysis
Procurement	• Tender document preparation • Tender monitoring • Bid analysis • Preparing purchase orders and receiving reports • Monitoring of order status
Inventory control	• Monitoring of stock positions • Monitoring of expiry dates • Prediction of reorder dates and quantities • Invoicing
Transport	• Vehicle routing and scheduling • Weight and volume calculation • Transport voucher preparation
Pharmaceutical registration and control	• Database of registration data • Adverse reaction reporting • Medicines recalls
Medicines information	• Formulary preparation • Literature searches • Data storage and transfer • Pharmaceutical bulletin production • Training material preparation
Rational use	• Formulary • Standard treatment schedule • Calculation of WHO medicine-use indicators • Survey analysis • Training (simulation games)
Personnel management	• Training software • Personnel records • Supervision monitoring • Payroll calculations
Health statistics	• Population data • Morbidity data • Mortality data
Use	• Health care coverage calculations • Medicine consumption analysis
Presentation	• Graphs and charts • Overhead transparencies or slide shows for training
Communication	• Fax • E-mail • Mailing

Box 50-1
Key steps in the computerization process

1. Identify the tasks or the system to be computerized with a detailed analysis of needs compared to current systems.
2. Survey the environment and consider integrating with other systems to the extent feasible. (What software and hardware are being used by other departments? Does an institutional computer policy exist? What equipment is already available?)
3. Evaluate the staff situation (actual versus needed).
4. Select software before hardware.
5. Identify whether the software needed is available in the local language and to which original version it is equivalent (non-English-language versions are sometimes not as current as English versions).
6. Ensure the availability of supplies and maintenance.
7. Select the hardware and software suppliers that provide the most support.
8. Plan progressive implementation (one step at a time) and involve current and future users in the design and implementation process.

Box 50-2
Illustrative phases in computerization

Phase I: Convenience computing

This phase includes tasks that could be done with a typewriter and calculator but are easier on the computer. If the computer "goes down" (temporarily stops working), the work can still be done. Examples are—

- Word processing
- Simple databases (for example, an address list)
- Simple budgets

Phase II: Periodic analyses and special activities

These tasks would be extremely difficult to do by hand but could be delayed for a few days or weeks if the computer were down. Examples are—

- Quantification exercises
- Complex project budgets
- Survey analysis

Phase III: Essential daily activities

These tasks involve large volumes of data handled daily or almost daily. If the computer went down, the work would be seriously impaired. Examples are—

- Inventory control
- Accounting
- Pharmaceutical registration

- Staff capable of, and interested in, operating computers
- A reliable power supply
- Adequate funds to support maintenance, training, and equipment upgrades

Conditions that can impede computerization include—

- Hardware or software not suited to the task
- Not enough trained operators
- Lack of a maintenance plan
- Lack of reliable power (voltage surges ruin computers and databases)
- Inadequate supply of storage media, paper, or printer ink and toner
- Unsuitable physical environment (exposure to dust, heat, or magnets, which can damage hardware and software)

Starting the computerization process

Begin with the basic questions: What will the computer be used for? Who will use it? Where will it be used? What is the budget for equipment, software, and maintenance? What special functions may be required? Will data need to be shared? Will a network be necessary? The key steps are listed in Box 50-1.

In computerization, users should walk before they try to run. Trying to do everything at once increases failure rates, so organizations often computerize in phases (see Box 50-2). This strategy enables computer operators to handle increasingly demanding tasks, permits support systems for supplies and repairs to develop, and allows security systems to be put in place to protect against electrical damage, computer viruses, theft, and other hazards.

Perhaps most important, a phased approach to computerization allows users to develop a clearer concept of what computers can do, what kind of information they want from the computerized system, and which modifications they need to make in reporting and management systems to obtain that information. Computerization must be planned carefully so that implementation occurs smoothly, with a minimum of interruption and dislocation in the organization's work. Country Study 50-1 provides some examples of good and bad computerization experiences.

Computer software: options and guidelines

Software is always becoming more powerful, and upgraded versions appear regularly. Upgrades may mean that the software packages require upgraded hardware resources (such as additional hard disk space, processor power, and memory) to run effectively. This factor is the main argument for choosing software before hardware and for including hardware upgrades in the budget.

Computer magazines (and their websites, which are often free) are a valuable source of comparison articles on software and hardware. "After-market" software books published by companies such as Sybex or Que are often easier to use than the manual provided by the software company.

Three broad categories of computer software are useful in pharmaceutical management: general purpose, special purpose, and utility programs.

General-purpose software

General-purpose software programs (such as word processing, desktop publishing, presentation management, spreadsheets, and commercial database programs) perform routine daily activities or periodic analyses. Software suites that combine individual programs in one software package are designed to allow easy exchange of information among the different programs, such as linking spreadsheet figures in a text document. Standard suites usually contain a word processor, spreadsheet, and presentation program, while "professional" suites also contain a database program. The most important factor in choosing general-purpose software is access to local support. Some questions to consider are: Which package is the most common locally? Is local training available? What software is used in other local offices with which our office interacts?

Country Study 50-1
Sample computerization experiences

Poor planning. The central medical store (CMS) in a sub-Saharan African country was computerized as part of a program to strengthen the computer capacity of the Ministry of Health. Unfortunately, the firm chosen to do the work did not realize that two previous attempts at computerization had failed because of internal organizational issues that had little to do with computers. The firm repeated many of the previous mistakes, because it believed that the introduction of technology could establish organizational systems and controls, and it did not examine the organization's existing structure.

An ambitious plan to computerize inventory and financial accounts within three months was devised. What resulted was hardware that could not be serviced locally and inadequate training of staff. Only a few poorly attended meetings were held with CMS management, and for many reasons, the data entered into the software were never accurate or up-to-date.

After nine months, the main CMS computer was stolen. No data backup had been made for more than three months because no diskettes were available. The last four months of data were lost, and no one thought that the system should be revived. No maintenance budget had been set aside for recurring costs, such as printer toner, diskettes, and systems maintenance, and the computers were being used only for word processing.

Computer integration issues. In a rapidly developing South Asian country, problems have occurred in the integration and transfer of data. Many departments have computerized, and data collection and processing overlap because responsibilities have not been clearly defined. In addition, incompatible software packages have been used; coding of key data, such as locations and medicine names, has not been consistent; and data linking has been very difficult. Many of the problems could have been avoided by clear definitions of responsibilities, a software policy, and a common coding system for key data.

Well-planned computerization. A Southeast Asian country has undertaken the process of computerizing slowly. Initially, data on medicine consumption, procurement, supply, and health statistics were collected manually. Computers were first used to enter these data in a spreadsheet program. Although this system worked well initially, the amount of data to be processed eventually overloaded the system, and the decision was made to upgrade it. Appropriate software and a systems developer were carefully selected. Training of local staff by expatriate staff was very successful and is still important for maintenance of the system. Computerization has helped provide useful management data for consumption analysis, pharmaceutical procurement and supply, and reallocation of supplies among health facilities. A computerized registration system is planned. Computerization has been relatively successful in this country because a step-by-step approach was used, starting from manual systems and developing the system with end users to meet their information needs.

Word processing. Word processing programs have long replaced the typewriter. For most offices, 80 percent of computing time is spent on word processing. It is usually the easiest task to learn, because the input and output are obvious even to a novice. These programs are mainly used for correspondence and for producing documents. Features such as graphics capabilities, spelling checkers, search-and-replace functions, and generators for tables of contents make producing documents easier.

Desktop publishing. This software has word processing features but is more powerful for handling graphics, large documents, and production of files to be used by a printer for newsletters, bulletins, training materials, or books. Newsletters can also be produced using a word processing program.

Spreadsheet. A spreadsheet is a worksheet consisting of horizontal and vertical lines that define a matrix of rows and columns. It is modeled after an accountant's ledger, and data are entered in cells identified by coordinates in the matrix. Any type of data (text or numbers) can be entered in these cells, and sophisticated calculations and analyses (such as those discussed in Chapter 40) can be performed.

A major advantage of spreadsheets is their ability to revise totals, percentages, and other calculations immediately after any number or set of numbers is changed, allowing experimentation with "what if" alternatives. They can be linked to allow consolidation of accounts and can produce graphics and charts of the data entered.

In pharmaceutical management, spreadsheets are used for budgeting, financial analysis, quantification of pharmaceutical requirements, ABC analysis, price comparisons, pricing models, and creating or revising national essential medicines lists, as discussed in other chapters.

Presentation. A simple graph often has more visual impact than a complex table, so presentation graphics packages can be useful for preparing effective and attractive reports, funding proposals, overhead transparencies, and presentations.

Database. A database is like an electronic filing cabinet. Data (characters, numbers, dates, formulas, or memos) are stored in fields. The combination of fields forms a record, the records together constitute a table, and a group of tables constitutes a database. Database software can store and manipulate large amounts of data quickly. Databases are used in many business applications, allowing users to—

- Sort data in any order using multiple sorting keys
- Establish relationships between databases and generate sophisticated consolidated reports
- Improve data consistency by allowing or requiring data to be entered according to defined choices
- Quickly retrieve data according to specific criteria
- Develop complex applications using powerful programming languages
- Import and export data

In pharmaceutical management, databases are used in data-intensive tasks, such as inventory control, procurement, tender management, detailed analyses of prescriptions, accounting, and drug product registration. Databases are superior to spreadsheets for this type of application because they store more data in smaller files with less need for duplicating entries. A common field can link separate records in the database, limiting the need for duplication of data entry and facilitating data retrieval and reporting. The structure of databases permits easy data manipulation for access and reporting, and they can be designed to check the data entered for consistency with previously entered data. A relational database is particularly useful in pharmaceutical management because it allows multiple records for the same basic item (helpful for inventory management, tender analysis, or medicine-use analysis).

Special-purpose commercial software

Pharmaceutical management systems often need special-purpose commercial software packages, such as programs for presentation graphics, project management, statistics, accounting, bibliographic data, and communications.

Project management. Project management software organizes and tracks project tasks to be accomplished according to a defined schedule and shows potential conflicts in the use of resources. Budgeting information can also be included.

Statistical. Although spreadsheets and databases have standard statistical functions, using a dedicated statistical package is sometimes preferable. Epi Info, developed and distributed by the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC), integrates basic word processing, data entry, statistical, and database functions. It is particularly useful for processing survey data and tabulating data stored in standard database programs.

Accounting. Accounting programs are available with a wide range of capabilities. Basic bookkeeping can be done with spreadsheets, but a dedicated accounting package is often more appropriate. Selection depends on local factors: What can the bookkeeper use? What does a donor use? What support is available? What bookkeeping technique is used? Is the accounting format compatible with local regulations? Increasingly, reputable local accounting firms can advise which accounting programs are most suitable for an organization.

Bibliographic. Bibliographic software greatly facilitates storing, searching for, retrieving, and manipulating bibliographic information on books, journals, training materials, and government and project documents. This kind of software requires staff to keep the database up-to-date.

Utility programs

Programs called *utilities* help manage and maintain computers and stored data. Common utilities include antivirus, file management, file backup, file exchange, data recovery, data compression, firewall, and network software. Because operating systems now include many of the commonly needed utilities, checking the capabilities of a particular operating system is advised before buying a separate utility.

A current antivirus program is absolutely vital for computer units that handle essential day-to-day functions, such as inventory control, drug product registration, accounting, or maintenance of national health statistics. It is also essential for any system that receives data from outside sources, including branch offices within the country. A firewall program is equally necessary for any computer that connects to the Internet. The firewall protects the network from unauthorized access.

Network software

Establishing an office-based computer network may be useful. A LAN (local area network) connects the computers and printers in a single location. A wide area network (WAN) connects computers in separate locations. A LAN can be established with or without a server, although a server may be required for certain purposes, such as running centralized inventory software. If the network has a server, it must be protected in a secure, climate-controlled room and its data must be backed up regularly.

A network is helpful if a number of computers in the office need to easily share resources, such as a printer or an Internet connection. A network is essential if multiple computer users need to simultaneously access the same software program, such as an inventory program running on the server. Installing the inventory program on the server means that all of the program's data is stored in one central location (a secure server room) and that other computers on the network can access the data from various locations, such as the accounts department or the warehouse, if the appropriate permissions have been granted.

Although the cabling and configuration of the network are often done by an outside firm, someone on the office staff should know at least the basics of network troubleshooting and maintenance so that downtime is minimized if system problems occur. If physically cabling the computers together is problematic, a wireless network can also be an option.

Wireless networks can also be used to connect computers in separate locations over a WAN. Some countries have decentralized pharmaceutical operations such as distribution so that work is done at the provincial or district level rather than the central level. Using a WAN, the lower levels of the system can connect to a server at the central level to manage inventory distribution. Maintaining the information in a central location allows users from all levels to easily share data and coordinate work. Because the data are pooled in one location, management reports are easier to produce and use in a timely fashion.

Custom software

Development of custom-built software, such as an inventory program, is a complex and time-consuming task. Although the idea of custom-built software is attractive, purchasing software that has already been written and tested by others is usually preferable, unless a suitable program cannot be found. If new software does need to be developed, approach this task in a step-by-step fashion—

- Define the system requirements.
- Choose the software and tools for developing the custom program.
- Design a system.
- Develop and program the system.
- Test and debug the system.
- Implement the system through data entry and training.
- Develop system documentation and a complete user's manual.
- Provide system support, revision, and upgrades.

Frequently, lack of time, money, or expertise results in the development of unusable software. Developing custom software always takes longer than expected and often goes over budget. Users should explore all alternatives carefully before choosing to develop software themselves. Annex 50-1 contains advice on developing a product master file for pharmaceutical management database software.

Open source software

Open source software emerged when individuals inventing programming code as part of the software development process shared their inventions with other networked users. Because any user could modify any part of this code and then share it with the network, the phrase *open source software* became a natural way of describing it. Open source software differs from proprietary software because its programming code is available for inspection, modification, reuse, and distribution by others. Although open source software can be free of charge, it can also be purchased; but once attained, it is freely modified. Today, open source software is used by individuals and organizations in the public and private sectors worldwide and is gaining popularity. Linux is one of the best examples of open source software—in this case, to control the computer's operation.

Table 50-2 Computer hardware specifications

Hardware	Indicator	Significance
Hard drive	Gigabyte (GB)	The number of gigabytes describes the storage capacity of the hard drive—how much data and software it can contain.
Processor chip	Chip type, with speed in gigahertz (GHz)	The chip type and speed determine how quickly the computer can make calculations, run software, and function. Any chip sold today should be sufficient for most office uses. The type and speed are more important for computers that will be used as network servers.
RAM (random-access memory)	Megabyte (MB) or gigabyte (GB)	The amount of RAM in a system determines how many tasks the computer can run at once and how complicated a program it can handle. A gigabyte is approximately 1,000 megabytes.
Monitor	Size (inches or centimeters)	The LCD (liquid-crystal display) monitors sold today vary primarily in their physical size and can be selected on that basis and on price, unless they will be used for highly graphics-intensive work.
Printer	Characters per second (CPS), pages per minute (PPM), dots per inch (DPI)	Dot matrix printers are judged in CPS, and laser and inkjet printers in PPM. Both are important when producing large amounts of output. Printer quality is measured in DPI and is important when producing high-quality output.
Modem	Baud	The baud rate is how much information a modem can send in a second and controls how long it takes to send a file over a telephone line.
Ethernet card	Speed	The speed of the Ethernet card determines how quickly it can send and receive data on a network.
CD-ROM or DVD-ROM drive	Speed	The speed of a CD-ROM or DVD-ROM drive describes how quickly it can access and read information from a CD-ROM or DVD-ROM.
CD-RW or DVD-RW drive	Speed	The speed of a CD-RW or DVD-RW drive describes how quickly it can write information to a CD-ROM or DVD-ROM. These drives can also read information from CD-ROMs and DVD-ROMs.

Program decision makers need to evaluate a number of issues when considering the use of open source software, including—

- A definition of program needs
- The types of open source applications available for the needs
- A review of open source and proprietary software alternatives, including differences in costs
- The availability of resources to support the open source approach
- The functionality and usability of the open source application
- The availability of professional support skills

A good resource on the use of open source software in developing countries is available (Dravis 2003).

Computer hardware: options and guidelines

The size and speed of computer hardware continue to change so quickly that specific recommendations about what a user should buy are impossible to make. When purchasing computers and peripheral devices such as printers, the important issues are processing, storage, memory, and output capacities. Always buy the most powerful equipment that the budget will allow, especially if a new computer cannot be purchased for a few years. Hardware generally improves so rapidly that a computer should not be purchased until shortly before it will be used. Delaying a purchase for even a month or two can mean a lower price or greater capabilities for the same price. Table 50-2 describes different types of computer hardware. In general, larger numbers are better for the indicators listed.

The use of handheld computers called personal digital assistants (PDAs) is increasing in the health care field and in pharmaceutical management, because they are a convenient way both to access and record information while away from the office. Country Study 50-2 discusses different ways that PDAs are being used by various country programs.

Geographic information systems

A geographic information system (GIS) is a computer system that captures, stores, analyzes, and displays information that is identified according to a specific location. In other words, it provides an interface between all kinds of data and a map. GIS allows data sets from different sources to be brought together in spatial context to reveal relationships and patterns that are not necessarily obvious otherwise. In public health, for example, GIS technology can combine demographic, environmental, and health data with satellite maps to determine endemic or epidemic disease patterns.

A GIS can use digitized maps or coordinates from global positioning system (GPS) receivers to determine spatial relationships. In Tanzania and Uganda, Management Sciences for Health's (MSH's) East African Drug Seller Initiative is using GPS to map the locations of public- and private-sector clinics and drug shops to determine gaps in health care coverage in remote areas.

Country Study 50-2
Using handheld computers in pharmaceutical management

The increased technological ability and convenience of handheld computers or personal digital assistants (PDAs) or smartphones have made them popular tools in the health care field, including pharmaceutical management. Many information sources have been adapted for use on PDAs, including the National Library of Medicine's MEDLINE database and pharmaceutical-specific resources, such as the *British National Formulary*. Some of these resources are free and others are subscription-based.

In addition to providing easy access to health information, PDAs and smartphones are also being used to collect, analyze, and report data more accurately and efficiently in a number of countries.

Canada. In British Columbia, PDAs are being used as part of a quality-management program in a 285-bed hospital that requires the collection and analysis of quality indicators for pharmacy services. An electronic form was custom designed based on the pharmacists' data needs for process and outcome indicators, including adverse drug reactions and medication cost savings. The resulting electronic patient care form was installed on four PDAs and each pharmacist received a two-week orientation before switching from paper-based logs. The PDA data were downloaded daily to a single PC into a common database program, where it could be easily analyzed and used for reports. Users of the PDAs found that they were able to double the number of patients they counseled, and much less time was needed to collect, analyze, and report the data.

Source: Collins 2004.

Tanzania. In an effort to improve the effectiveness of its drug product and premises inspection programs, the Tanzania Food and Drugs Authority (TFDA) worked with Management Sciences for Health to introduce the use of PDAs in data collection and management. The TFDA inspectors collect data on a wide range of product- and site-specific information, which previously had been handwritten on paper forms, then transferred to a database. The program's PDAs include forms for port-of-entry inspections, premises inspections, and postmarket surveillance in a format that guides inspectors through the data-gathering process. Collected data are sent monthly to TFDA by public mail/transport or by hand delivery to the TFDA central office. Also, updated product references needed by the inspectors in the field are uploaded to the PDAs monthly. The new system makes analyzing data and creating reports easier, and it improves the accuracy of inspection records through design controls and by increasing inspector accountability.

Uganda. The Uganda Health Information Network is using PDAs that are connected through the local GSM cellular telephone network to help expand access to health and medical information and support data collection and analysis. Health workers in the field use PDAs to send and receive information and data via "jacks," which are relay devices that contain a GSM cellular transceiver and a data cache. The jack then communicates with a main server in Kampala. When users connect to the jack, information is both uploaded and downloaded. In the pilot of this program, the PDA system was used primarily for collecting and disseminating field data, such as weekly disease surveillance reports and broadcasting medical education material.

Source: UHIN 2004.

50.3 Specialized software for pharmaceutical management and control

Pharmaceutical systems that successfully computerize usually begin with basic word processing and spreadsheet applications and then seek specialized applications for inventory management, procurement, pharmaceutical regulation, or medicine-use analysis. This section provides an overview of types of specialized software for various tasks and guidelines to consider when evaluating alternatives. Examples of specific types of programs are given, and others are listed in the references at the end of the chapter.

Quantification of pharmaceutical requirements

Quantification of pharmaceutical requirements (see Chapter 20) is complex, and a computer can greatly speed up the process. Spreadsheets can be used if limited data are involved. Worksheets can be set up to forecast requirements using consumption data; formulas can be entered into the spreadsheet for estimates based on different scenarios. Spreadsheets can be linked, or a single spreadsheet can be divided into sections (one to record the morbidity profile, one to organize the standard treatments, and one to summarize pharmaceutical requirements within therapeutic

Figure 50-1 Summary of illustrative integrated pharmaceutical supply management software and characteristics

Management component		Uses
1.	**Accounting**	Accounting manages the financial aspects of pharmaceutical management activities.
1.1	Accounts Payable/Purchasing	Tracks and processes bills and payments and provides complete checking account management functions.
1.2	Accounts Receivable/Billing	Tracks all customer histories and accounts.
1.3	Job Costing and Cost Accounting	Job costing and cost accounting provide a method for collecting, analyzing, and reporting all costs associated with a particular job.
1.4	General Ledger	General ledger maintains the Chart of Accounts and provides the basis for all other financial functions.
1.5	Financial Reporting	
1.6	Accounting Standards	
2.	**Distribution**	Distribution addresses selling and providing pharmaceuticals to other facilities.
2.1	Client Orders/Sales Orders	Receives and processes client and sales orders.
2.2	Consumption Reporting	Reports the distribution of items in stock.
2.3	Delivery	Supports processes and methods of delivering ordered items to others.
2.4	Kit Management	Addresses putting together and breaking apart stock items for distribution.
2.5	Push System	Provides facilities with predetermined types and quantities of stock.
2.6	Repackage into Dispensable Units	Addresses breaking apart large quantities of stock into smaller packages.
2.7	Reporting	
3.	**Tender Management**	Tender management manages the competitive bid process.
4.	**Inventory Control**	Inventory control manages the stock and inventory.
4.1	Receiving	Adds stock to the inventory database.
4.2	Supplier Performance Monitoring	
4.3	Maintaining History of Transactions	Stores and archives transactions for future reference.
4.4	Selling Inventory over the Internet	E-commerce associated with selling inventory over the Internet.
4.5	Establish and Maintain Inventory Records	
4.6	Reporting	
4.7	Forecasting and Order Planning	Forecasting and order planning supports methods and processes used to estimate the quantities of pharmaceuticals needed for your organization.
5.	**Procurement**	Procurement manages the acquisition of pharmaceuticals.
5.1	Purchase Requisitions	Collects and disseminates information about requested items.
5.2	Purchase Orders	Creates and tracks information about a sales transaction.
5.3	Group Purchasing/Pooled Procurement	Manages the procurement for a group with similar purchasing needs.
5.4	Perpetual Purchasing	Manages the procurement of stock-based designated or calculated reorder points.
5.5	Scheduled Purchasing	Manages the procurement of stock on a predetermined purchasing cycle.
5.6	Ordering Online over the Internet	
5.7	Supplier Management	Tracks supplier information.
5.8	Reporting	
6.	**Vehicle and Equipment Management**	Vehicle and equipment management deals with tracking and monitoring the assets in the organization.
6.1	Vehicle Management	
6.2	Equipment Management	
6.3	Cold-Chain Equipment Management	
6.4	Load Building	
6.5	Route Planning	
6.6	Transport Personnel Management	
6.7	Transport Personnel Assignments	
6.8	Vehicle Allocation/Vehicle Tracking	
6.9	Reporting	
7.	**Warehouse Management**	Warehouse management deals with managing the physical stock, whether it is in-house or located in another warehouse.
7.1	Bar Coding and Related Technologies	
7.2	Managing Multiple Warehouses	Manages multiple physical or virtual warehouses.
7.3	Stock Location Tracking	Tracks the physical location of inventory items.
7.4	Reporting	
7.5	Picking	

Management component		Uses
8.	**Transfunctional**	Transfunctional includes requirements that span the entire range of functions and includes some miscellaneous requirements.
8.1	Currency	Supports multiple currencies.
8.2	Languages	Supports multiple languages.
8.3	Interface with WHO Drug Registration Software (SIAMED)	Imports drug registration data from a SIAMED export.
8.4	Master Drug File (from WHO)	Imports the master drug file.
8.5	User Customization	
8.6	Custom Reporting	
8.7	Indicators	Addresses custom thresholds and acceptable ranges for monitoring system.
9.	**Technical**	Technical requirements describe the architectural characteristics of the system.
9.1	Multitier Organizational Structure	Operates in a three- and four-level organizational hierarchy.
9.2	Single-User Environment	Operates in a single-user, single workstation environment.
9.3	Multiuser Environment	Operates in a multiuser, networked environment.
9.4	Software Platform: Microsoft Windows	
9.5	Security	Addresses user authentication and data security.
9.6	System Maintenance	Backs up and archives data.
9.7	Data Exchange	Supports importing and exporting data with other applications.
9.8	System Architecture	
10.	**User Support**	User support deals with technical support facilities you may require for this type of software.
10.1	Online Help	
10.2	User's Manual	

categories). Linking spreadsheets requires an advanced level of proficiency with spreadsheets.

Quantimed is a database tool for forecasting that has been developed by MSH. Users enter consumption data (past and forecasted use) and/or morbidity data (number of expected cases for each age range and for each health problem). When standard treatments are defined, Quantimed generates a table that compares the medicines needed, using both consumption and morbidity methods (see Chapter 20). Quantimed also produces a number of other reports, including some that can help with budgeting and comparing costs among different products and treatment regimens.

Basic data analysis and production of formulary manuals

Basic commercial software can be used for many pharmaceutical management purposes, such as data analysis and publication of formulary and therapeutics manuals.

Data analysis. Spreadsheets are ideal tools for developing a medicines list, because they allow easy manipulation of both text and numbers. Creating a spreadsheet that lists medicines and data on price, consumption, lead time, and formulary category is very easy. Formulas can then be added to perform various analyses, such as ABC analysis, price comparison analysis, and therapeutic category analysis (see Chapter 40).

Formulary manuals. A word processing program can be used to develop a formulary manual with treatment guidelines (see Chapter 17). A desktop publishing program can produce documents ready for printing.

Procurement and inventory management

Spreadsheets can automate aspects of procurement and inventory management, but they are not ideal for processing large amounts of data. Database software is more appropriate for this purpose. Using the same database program for procurement, inventory management, and accounting is preferable, because these activities are interconnected.

Inventory management is often part of a commercial accounting software package, but such packages typically focus on accounting and lack features specific to pharmaceutical management, such as the ability to track multiple products for the same code number, or to track items by lot number and expiry date. The ability to track issues by lot number is important for medicine recalls.

Database programs have been developed by MSH and others specifically to manage procurement and inventory control in public pharmaceutical systems (see References and Further Readings and Box 50-3). Figure 50-1 provides a summary of pharmaceutical supply management software requirements and characteristics. Box 50-4 lists standard reports that should be produced by such software. Country Study 50-3 illustrates how software for inventory management and procurement has been used to improve pharmaceutical management for an HIV/AIDS treatment program in Haiti.

Hospital pharmacy management software

Specialized hospital pharmacy software can support various aspects of a hospital pharmacy (Chapter 45), including—

tBox 50-3
RxSolution

RxSolution is an integrated computerized pharmaceutical management system. The system is used to manage inventory; process purchase orders; handle issues to wards, out/inpatient pharmacy, and satellite clinics; dispense medication to patients; and prepare repeat prescriptions for down-referral at the facility level (down-referral occurs when a higher-level health care facility such as a hospital transfers all or part of a patient's care to a lower-level facility that is more convenient for the patient). RxSolution supports best practices for procurement, storage, distribution, and dispensing of pharmaceuticals and medical supplies, helping to ensure availability of critical products at all times. Users record information on products, suppliers, clients, prescribers, dispensers, and patients.

The program has modules for—

- Budgeting
- Procurement
- Receipts
- Requisitions
- Dispensing
- Down-referrals

Any or all of these modules may be used, depending on the needs of the site and user restrictions. The program includes a wide range of clinical and management reports, which help improve pharmaceutical use, stock availability, and financial and logistic accountability.

RxSolution is currently being used in more than 120 sites in southern Africa. Examples of how facilities are using the software include the following—

- Staff in one South African hospital can now produce the monthly tracer list report for the provincial office with one click, rather than taking a day to count stock and write up the information. They can also track expenditures to come in on budget, and easily determine the amount spent on antiretroviral medicines, which they are required to report. Store management reports now include much more financial information.
- The director of pharmacy services for a South African city reports that RxSolution allows the staff to better manage their system and cost centers, because they can more easily track budgets and monitor clinics. The main depot receives 90 to 95 facility orders each month and can complete all of the orders within two weeks.
- Installing and using RxSolution in eleven hospitals and health centers in Swaziland met the Global Fund's requirements for a reliable antiretroviral tracking system. These facilities use the system to produce regular stock, patient, and prescribing reports for national-level managers. As a result of the successful installation and use of RxSolution, the Global Fund authorized funds for Swaziland to purchase antiretrovirals.
- The chief pharmacist at a South African hospital uses RxSolution to produce ABC analysis reports for the wards and the hospital to support his pharmacy and therapeutics committee work.

See http://www.msh.org/projects/sps/Resources/Software-Tools/RxSolution.cfm for more information.

- Patient medication profile
- Records of intravenous therapy
- Management of total parenteral nutrition
- Unit-dose management
- Medication administration record
- Order entry and inventory management
- Medication interaction checking
- Allergy checking
- Food and medicine interactions
- Duplicate therapy checking
- Laboratory value monitoring
- Outpatient prescriptions
- Patient billing
- Patient adherence

Accounting and financial management

Most public-sector supply systems must abide by government accounting regulations, which differ from country to country. Commercial accounting software is widely available, but it may require modification to correspond with local regulations. If a specialized pharmaceutical management software program is used for inventory control, the inventory software and the accounting software should be modified to communicate with each other.

Learning how to perform basic spreadsheet analysis is now a must for the essential medicines program manager. Spreadsheets can be used for both simple and sophisticated analyses of program finances. See Chapter 41 for examples.

Box 50-4
Standard reports for supply management software

Supply management software should generate standard reports to support decision making, such as the following.

Inventory reports

Stock status report: lists all products in the product master file, including product code and description, unit of measure, quantity in stock, quantity on order, quantity reserved, quantity available.

Reorder report: lists all products that are below the reorder level, with reorder quantity.

Overstock report: lists all products exceeding the maximum level.

Inventory valuation report: lists the current value of the inventory, based on the chosen valuation method (last-in, first out [LIFO], first-in, first-out [FIFO], average).

Expired or soon-to-expire stock report: lists the products that are presently expired or will expire within a defined period.

Order reports

Open order report: lists orders from customers that have been entered and not yet shipped.

Back order report: lists all unshipped back orders.

Order history report: reports on all orders (shipped and nonshipped) on file.

Product reports

Catalog report and price list: lists all products in the product master file. Can contain pricing information and be used as a price list.

Product history report: lists by stock item total quantities and sales values for each fiscal period.

Sales analysis and forecasting reports

Customer analysis report: lists sales made to each customer in a specified period.

Ranked customer analysis report: same as above, but ranked by sales volume, with cumulative percentages.

Functional lists/outputs printed by the system

List of "picking tickets"

List of delivery notes/invoices

List of stock count sheets

Multilocation reports

(If using a system that tracks stock in multiple locations)

Transfer advice report: a reorder advice report that lists products that are over the maximum or under the reorder level. This report makes it possible to determine whether a product that is unavailable or understocked in one location is available in another location.

Financial reports

(If linked to financial information)

Credit hold orders report: lists orders that are on hold because the customer is over the credit limit.

Debtors and creditors report: lists those who owe and are owed money.

Tender reports

Bid evaluation report: for each product in a tender, lists all suppliers that offered bids, with information on the supplier (country, delivery time) and on the quoted product (unit cost, quoted unit price, bid converted to base currency, manufacturer, quality of sample, and any other details).

Supplier performance report: lists, for a given supplier, details of all previous quotations, orders, and deliveries, including both a comparison between date promised and date delivered and the condition of products.

Product quotation record: for each product, lists previous bids, with details of the supplier and the quoted prices. If an order was made, this is indicated with supply timeliness and quality information.

Database listings: lists suppliers and products. The supplier listings can also be available as mailing labels and for mail-merging into a word-processed letter.

Country Study 50-3
Creating an Internet-based information system for HIV treatment in Haiti

The daily administration of several different antiretroviral medicines as part of antiretroviral therapy (ART) requires that each patient is monitored for health status, that results of laboratory tests are tracked and communicated to doctors, and that pharmaceutical supplies are reliably available at each treatment site. Zanmi Lasante, a nongovernmental organization that operated a successful ART site in Haiti's central plateau, was funded to scale up its program to five additional sites. In rural Haiti, where doctors are few, roads are almost nonexistent, and electricity is spotty, creating and maintaining such an information system among disparate sites would be challenging.

On the basis of its experience, Zanmi Lasante decided that the cheapest and most flexible communication strategy would be to establish a small satellite connection to the Internet in each of the five new sites. Instead of placing servers in each clinic, one shared server could be guaranteed a secure environment with stable power and a reliable data backup system. Using Web-based electronic records allows data collection and review from the remote sites, and with one server, the most recent data are accessible to all. The Web-based electronic medical record system in Haiti is built with standard, open source software.

Clinic staff members enter all clinical and medication data using a standardized Web-based patient form. To facilitate data entry, the form has an electronic checklist of patient management items, including requests for laboratory tests, details of treatment regimens, and lists of standard ART medicines. Doctors can check the medicines, doses, and administration schedules. As the medicines are entered into the form, they are cross-checked to the patient record for allergies, inappropriate doses, and incompatible medicine combinations. The system displays warnings about problems—for example, if zidovudine and stavudine are prescribed together. When the form is completed, the user can print out an order for the pharmacy. As new patient information (for example, laboratory results) is added that indicates additional treatment, e-mails are automatically sent to all clinicians with links to the medical records of patients who require follow-up.

Staff members also enter warehouse stock data into Web forms, and those figures are analyzed and monitored against expected use patterns from the treatment regimens in the system.

Source: Fraser et al. 2004.

Drug use reviews

Simple analyses of medicine-use patterns can be done with spreadsheets and commercial database software. Commercial software is available for analyzing data on medicine use from large databases. These software programs are usually fairly expensive (thousands of U.S. dollars [USD] per installation).

Pharmaceutical product registration

Pharmaceutical product registration software can help the drug regulatory authority track the hundreds or thousands of registered products. Registration data can be tracked in a manual card system, sorted by product name or company, but retrieving data needed for specific purposes is very time-consuming. Database programs can automate this procedure, retrieving records meeting specific criteria almost instantaneously. SIAMED, a software program for pharmaceutical product registration, is available from WHO. Computers can greatly facilitate pharmaceutical registration by improving access to information, but they do not provide the enforcement capacity needed to give registration meaningful impact. A legal framework for pharmaceutical registration and a flexible and efficiently functioning drug regulatory authority are prerequisites to successful computerization of drug product registration. Table 50-3 presents the features needed in pharmaceutical registration software.

50.4 Electronic communications and medicine information

Communications and medicine information are discussed together because medicine information is increasingly available through electronic communication systems. An enormous amount of reference information on medicines is available on the Internet. In addition, many organizations now create their own websites to share information internally or to show their progress and activities to the outside world.

Electronic communications

Computers are powerful and relatively cheap communication tools. Computer-based communication is possible

Table 50-3 Select features of registration software

Names and identifications	Pharmacological information	International information	Quality assurance	Administrative tracking
• Registration of products by vendor and manufacturer	• Pharmacopoeial standards applicable to product	• Country of origin	• Certification by regulatory agency in country of origin (WHO certification scheme)	• Duration of license, dates of approval and renewal (or denial)
• Identification by International Nonproprietary Name (INN) and brand name	• Dosage strength and dosage form	• Product status and regulatory action in other countries	• Dates and results of quality tests and assays	• Dates of receipt and action on registration application
• Identification of alternative generic names (U.S. Adopted Name [USAN], British Approved Name [BAN])	• Quantities and functions of active and inactive ingredients	• Variable handling of applications from suppliers based in the registering country	• Summary of results of clinical trials	• Dates and results of agency hearings and regulatory actions regarding products, vendors, and manufacturers
• Cross-indexing between generic and brand names, active ingredients, and authorized vendors and manufacturers • Records of imports and foreign exchange applications and authorizations related to products, vendors, and manufacturers	• Shelf life and storage conditions		• Results of good manufacturing practices or other inspections • Details of inspection program based on user-defined criteria, such as geographical area, company activity, type of products, characteristics of inspectors • Registration and licensing of wholesale suppliers, licensed pharmacies, and other licensed pharmaceutical outlets	• Records of payments and dues regarding application and marketing authorization fees • Variable length of authorization for marketing • Records of price agreements and price control categories and decisions (as applicable)

Source: WHO 2004.

through electronic mail (e-mail), the World Wide Web, computer-to-computer modem connection, or fax.

If a good telephone line is available, computers equipped with a fax-modem can send and receive fax messages or complete documents in just a few seconds. Modern word processing software can send fax messages directly from the computer. The transmission speed and quality depend on the quality of the telephone line, but error protection protocols can help ensure the integrity of the transmitted data.

The most comprehensive computer-based communications medium is the Internet. Most countries have local connections to the Internet, which can send any data (including e-mail messages or computer files) for only a fraction of the cost of a telephone connection. Once the connection is established, Internet use is relatively inexpensive, especially for universities and governments. Increasingly, Internet cafés provide access in many locations. Locations with inadequate telephone-line infrastructure are having success with wireless Internet connections, which do not rely on traditional wires and cables. Other Internet connections are made through satellite and radio transmission.

In recent years, discussion groups have formed to exchange information over the Internet. For example, E-Drug is a discussion group that uses regular e-mail to exchange information on essential medicines management issues. PharmWeb is a website that offers information on worldwide pharmacy and pharmaceutical management issues and organizations. PharmWeb links the user to various websites maintained by organizations active in the field. See References and Further Readings for contact information for E-Drug and PharmWeb. Web-based discussion groups can be helpful sources of information on a wide range of subjects, from computer problems to pharmaceutical information.

Medicine information

Traditional sources of information on medicines are journals and textbooks, such as those listed in Chapter 34. Maintaining an up-to-date library of texts and journals is costly, however, and information is not always easily accessed by users in remote areas.

Computers can greatly facilitate access to pharmaceutical information. For example, PubMed, a nonprofit service of the U.S. National Library of Medicine, provides access to millions of articles from more than 4,800 medical journals on the Web (http://www.ncbi.nlm.nih.gov/sites/entrez). PubMed can also be accessed with a PDA. The more commonly used and readily available computer databases for medicine information are listed and discussed in more detail in Chapter 34.

CD-ROM is relatively inexpensive technology that can store about 680 megabytes of data on one compact disc. DVD-ROMs are similar to CD-ROMs, but they hold about four gigabytes of data. Many products are now available on DVD. It is important that new computers be able to read DVD products.

Through powerful indexing routines and huge storage capacity, CD-ROMs and DVDs permit very fast access to medicine information. Books such as the *British National Formulary* and *USP Drug Information* are available in CD-ROM format. CD-ROMs with medication information or advice for poisoning treatment are used in many pharmacies and medicine information centers in industrialized countries, and their use is spreading quickly around the world as computers become more widely available.

Plenty of websites offer biased information on and questionable sales of medical products, including medications, but reliable, independent information on the quality, regulation, and rational use of pharmaceutical products is lacking. Learning to evaluate website content for accuracy, bias, and timeliness is an important skill. Chapter 34 has more information. See also the list of references in this chapter for some useful websites.

Developing a website

If an organization has information that it needs to communicate, it may wish to consider developing its own website. Websites can be used to disseminate information to the public or can be designed specifically for an organization's internal use (intranet). Although the design and development of the site can be contracted out if staff members do not have the necessary skills, staff should be involved in the review and approval of material for the site, because it represents the organization. Many Internet service providers (ISPs) offer hosting services for websites and can house the necessary files on their servers to make them available on the Internet.

An organization can use an intranet to share information and data if a WAN cannot be established. For example, users can access an intranet to view or submit inventory data for procurement or distribution purposes. An intranet can also be used to share files or disseminate organizational information, such as standard policies and procedures. The intranet site can be maintained at the central level of the system but accessed by other levels in the system as long as the other levels have Internet access and the proper permissions. The intranet allows pooling and sharing of information in a system without requiring a direct connection among the different levels of the system. (See Country Study 50-3.)

A website developer should consider the following criteria when creating a site to ensure that it is useful and informative (WHO 2001).

General criteria to consider for every site include—

- *User-friendliness:* The first impression should include an attractive design and logical organization of information.
- *Site map:* The site map indicates logical links and organization of the site and explains how to navigate through the content.
- *Navigability:* This characteristic allows the user to find information easily.
- *Speed:* The pages should be displayed within four to five seconds.
- *Search function:* The site should have its own search engine.
- *Update:* The website should include its creation date and when the pages were updated. Information should be updated regularly.

Specific criteria to consider for an organization or program site may include—

- Mission statement
- Contact information
- Organizational structure (or management hierarchy)
- Services offered
- News, events, and meetings
- Forms to download
- Hyperlinks to other useful resources
- Publications

Answering the questions in Box 50-5 can help in making a decision about whether and how to develop a new website.

50.5 Maintenance and support requirements

Using computers, like using any electronic tool, requires access to reputable repair services and supplies. Even more important, however, is a reliable, adequately trained staff.

Staff recruitment and training

Discussions about computerization often focus only on software and hardware, but computers are useless without competent staff to run them. Recruitment and training are key in maintaining good computer services, particularly when day-to-day operations such as inventory management and accounting are computerized. Investing in training staff members to use computers effectively is quite worthwhile.

Experienced typists interested in learning new skills can be recruited for word processing and data entry tasks. Computer courses are available in many countries. The

cost of courses should be built into computerization budgets, along with sufficient funds each year to train new staff and retrain existing staff in new software. Online courses are also available if one has an Internet connection. For example, Microsoft offers free, self-paced courses for most of its Office products at http://office.microsoft.com/en-us/training/default.aspx.

When specialized pharmaceutical management programs are installed by an outside organization, the vendor must provide adequate training that is spread out over time so that staff members can raise their own questions as they become familiar with the new system.

Provisions need to be made for staff changes. At least two people need to be familiar with each specific computer program and operation so that sickness, annual leave, or job changes will not bring the computer unit to a halt. Additional training may be necessary from the vendor if personnel leave the unit.

A highly computerized operation that uses software to support critical operations, such as procurement or inventory management, should have the support of an information technologist on-site, if at all possible. If computer hardware or software is disabled by a problem that interferes with the daily business operations of an organization, the problem needs to be resolved as soon as possible. An information technology support unit serves to ensure that the organization's hardware and software remain functional through proper maintenance and prompt attention to errors.

Protecting data

Data in a computer are stored on magnetic media, such as a hard disk, CD-ROM, DVD, or flash drive. Unfortunately, magnetic storage media can lose data, so other precautions must be taken. The computer, along with all data on the hard

Box 50-5
Developing a website or posting materials to the Web

Here are some questions that will be useful to think about to effectively plan for, develop, and maintain a website.

Vision

- What is the purpose for developing a website or for posting materials to the Web?
- What do you hope to achieve?
- What are the intermediate and long-term goals or objectives?
- Do you see this activity as part of an existing website or something new?
- Is it important for this site to have a unique URL or Web address?

Audience

- Who are your primary and secondary audiences?
- What is the anticipated size of your audiences?
- Where are your audiences located?
- What are the information and/or learning needs of your audiences?
- What is the audience's level of comfort and experience using Internet?
- What is the audience's level of Internet access?
- What is the audience's level of computer proficiency?
- Do you anticipate this site being public or private/restricted?

Content

- What type of content do you anticipate for this site?
- What content currently exists?
- What new content needs to be written?
- How often will content be updated?
- In what languages will content be presented?
- Is any of the content proprietary, or is use restricted by any parties?
- Do any donors or partners need to approve posting of content?

Functionality

- What tasks do you want users to perform when they come to the site?
- What specific functions would you like to include on the website (for example, information database, online message boards)?

Marketing

- How will you reach your audience?

Evaluation

- How will you know when you have achieved your goals?
- What evaluation methods will you use (for example, e-mail survey, phone interviews)?

Roles

- Who will develop content?
- Who will update content over time?
- Who will market the site?
- Who will provide technical support to users?

drive, might be stolen or could be harmed by dust or high-voltage electrical spikes.

Data can also be damaged by a computer virus when programs or data are exchanged between computers or when an infected e-mail attachment is opened. This risk increases when illegally copied (pirated) software is used. A virus can result in anything from harmless messages appearing unexpectedly on the computer screen to complete loss or theft of data on the hard drive. To avoid getting a computer virus, accept files only from users who take precautions against viruses, do not open unknown attachment files from e-mail senders, use virus-check software that automatically scans the computer's hard drive every day, and check any media, such as flash drives or CD-ROMs, used to share data . Regular updates of virus protection programs are needed because new viruses are created continually.

CD-ROMs and DVDs can be damaged by magnetic fields (from loudspeakers, telephones, and metal detectors), and by moisture, particles, and scratches. Thus, having only one copy of data is risky, and the importance of making backup copies cannot be overemphasized. Basic rules for maintaining backups are—

- Make at least one backup copy of all important work when it is created.
- Back up routine work daily with separate sets of CDs, DVDs, or external drives used in rotation for extra security, especially for large databases such as inventory control systems.
- Ideally, store backups off-site to guard them from fire or theft. Consider saving and archiving an entire set of data at the end of each month or quarter.

Access to computers should be restricted to authorized staff; most computer operating systems and software can be protected with passwords, which are required to enter the system (and which allow managers to track use of the computer).

Maintaining computers

Computers are adversely affected by humidity, static electricity, power surges, extreme temperatures, dust, cigarette smoke, and food or liquid spilled on the keyboards. Computers are also vulnerable to frequent switching on and off, sudden physical movements while the hard disk is running, misuse by untrained staff, and unprofessional repair attempts. To protect computers—

- Make sure that a reliable firm (or department) is under contract to support hardware and software.
- Train all operators in proper computer handling.
- Protect the computer room with air-conditioning—if possible—against excess heat, humidity, and dust.
- Do not eat or drink near the computer or smoke in the computing room.
- Protect keyboard, monitor, and computer with covers.
- Always use spike/surge protectors (for computer, printer, monitor, and fax) and an uninterruptible power supply. Car batteries with an inverter or a separate fuel generator may also provide safe electrical power.
- Move the computer only when it is switched off.
- Use reliable maintenance and repair services.

Box 50-6
Lessons for successful computerization

- Assess what software is needed before choosing hardware.
- Ensure software and hardware compatibility.
- Secure local support for hardware and software.
- Have a well-functioning manual system.
- Provide adequate staff training and involve staff in the computerization process.
- Computerize in phases, allowing sufficient time for each step.
- Establish and enforce strict procedures for data and equipment protection, using backups, virus checkers, restricted access, surge suppressors, and so on.
- Set aside adequate funds in each year's budget for hardware and software maintenance, supplies, and staff training.
- Plan and budget for timely hardware and software upgrades.

50.6 Lessons for successful computerization in pharmaceutical management

Successful computerization in pharmaceutical management can greatly increase an organization's efficiency, productivity, and capabilities, but it must be carefully planned. Expensive mistakes are easy to make through a lack of knowledge or forethought, hindering rather than helping a project. Following the list in Box 50-6 and considering the issues raised earlier in this chapter will help a manager to avoid or prevent such mistakes. The information presented in this chapter should enable a manager to ask the right questions and effectively plan the computerization of an organization. ■

ASSESSMENT GUIDE

Use of computers in pharmaceutical management

- In which phases of pharmaceutical management will computerization be most useful: medicine selection and formulary development, registration, quantification of pharmaceutical requirements, procurement, inventory control, prescription analysis, other areas?
- Does a product master file exist? Has a coding system been developed to uniquely identify pharmaceutical products? Is the ICD or other coding system used to identify health problems?

Readiness for computerization or expansion

- Are computers currently used for producing correspondence, newsletters, reports? Preparation of tables, graphs, charts? Budgets and other spreadsheet applications? Electronic communications?
- Do good manual systems exist for pharmaceutical management functions?
- Are staff members capable of and interested in learning to operate computers?
- Are resources available for staff training? Supplies such as CDs and DVDs, paper, and printer ink and toner? Computer support and periodic upgrades, as needed?

Computerization planning

- Have needs been identified and the specific tasks, functions, and systems to be computerized carefully analyzed?
- Has appropriate software been identified, for example, for word processing, spreadsheets, database management, and special functions such as presentation graphics, project management, accounting, or electronic communications?
- Is training available for each software package? Are manuals or other instruction books available?
- Have hardware specifications been defined in terms of operating system, microprocessor speed, available RAM, storage capacity, monitor, printer, modem, uninterruptible power supply? Is this hardware capable of running the software identified?
- Has the computerization process been planned in phases, so that experience with computer applications will develop in parallel with broad systems development?
- Have procedures been developed for data and equipment protection, such as restricted access, use of an uninterruptible power supply and surge suppressors, virus checking, backing up data files, and storing backups off-site?

Hardware and software support and maintenance

- Is there a firm in the country or area that sells software and provides support? Does this firm provide training in use of the software?
- Is there a firm in the country or area that sells and maintains computer hardware?
- Is there a government agency or department that can provide support services to the supply system?
- Has someone on the staff been trained, at minimum, in the basics of computer troubleshooting?

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Pharmaceutical-related computer applications

British Medical Association and Royal Pharmaceutical Society of Great Britain. *British National Formulary* (BNF). (Updated every six months; website updated more frequently.) Paperback, CD-ROM, or online. <http://www.bnf.org>

The Electronic Dispensing Tool is a software application for managing essential medicines stock and monitoring details on dispensing to individual patients. The tool was designed to be used by a dispensing pharmacist. Contact cpm@msh.org for more information.

Epi Info is a series of microcomputer programs for word processing, data management, and epidemiological analysis, designed for public health professionals. The software can be downloaded free from a number of websites, including the following: <http://www.cdc.gov/epiinfo>

INRUD (International Network for Rational Use of Drugs). *Medicines Use Bibliography.* (Updated regularly.) <http://www.inrud.org>

The Inventory Management Assessment Tool (IMAT) is a user-friendly, Excel-based instrument designed to collect and calculate indicators of effective pharmaceutical inventory management. <http://erc.msh.org/toolkit>

The Inventory Tracking Tool aids in managing ARV stocks at higher levels than the facility (program, district, or national). The tool monitors aggregated medicine consumption and compares it with projected consumption. Contact cpm@msh.org for more information.

Logistics Support System (WHO/PAHO Supply Management System). Supply management project software for use in disaster relief efforts. PAHO. <http://www.lssweb.net>

The Medical Letter. Adverse Drug Interactions Program. (Updated regularly.) Available for Windows-based PCs, PDAs, and in CD-ROM format. The Medical Letter also has a number of other software products. <http://secure.medicalletter.org/subscriptions_products#5>

PubMed provides access to citations from biomedical literature, including MEDLINE, the U.S. National Library of Medicine's bibliographic database covering the fields of medicine, nursing, dentistry, veterinary medicine, the health care system, and the preclinical sciences. PubMed is accessible online through the National Library of Medicine Database via Datastar, Dialog, or NLM. CD-ROM version through Silver Platter. Contact the PubMed help desk at custserv@nlm.nih.gov or 888-346-3656. <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed>

Quantimed is a quantification database tool that facilitates the generation of realistic estimates of pharmaceutical needs at the facility, regional, or national level, using morbidity and/or consumption data. Contact cpm@msh.org for more information.

RxSolution is designed to manage pharmaceuticals and medical supplies, from procurement to dispensing to patients. Contact cpm@msh.org for more information.

SIAMED: Model System for Computer-Assisted Medicine Registration. <http://www.who.int/medicines/areas/quality_safety/regulation_legislation/siamed/en/index.html>

WHO Model Web Site for Medicines Regulatory Agencies. A tool to help the drug regulatory agencies in WHO member states to develop or review their own websites. <http://www.who.int/medicines/areas/quality_safety/regulation_legislation/model_site/en/index.html>

Vigibase Services is a unique collection of international drug safety data available through WHO's Uppsala Monitoring Centre. <http://www.umc-products.com/DynPage.aspx?id=4910&mn=1107>

PDA-specific applications and resources

Dalhousie University College of Pharmacy. "Drug- and Pharmacy-Related Mobile Technology" <http://dir.pharmacy.dal.ca/pda.php>

Johns Hopkins Point of Care Information Technology (POC-IT). <http://www.hopkinsmedicine.org/poc-it>

University of Kansas Medical Center. Dykes Library. Mobile Resources. <http://library.kumc.edu/m/index.html>

Internet resources

E-Drug (Essential Drugs English) and other global discussion groups in various languages on pharmaceutical issues. See http://www.healthnet.org for information on subscribing to any e-mail forum.

Eldis is an Internet-based information service presenting development information through the Web and e-mail. The Eldis ICT for Development Resource Guide has information and resources specific to using information technology in developing countries. <http://www.eldis.org/go/topics/resource-guides/ict-for-development>

The Information and Communication Technology (ICT) for Development Gateway shares information and promotes ideas on how information and communication technologies can be used to address socioeconomic needs in developing countries, with a special focus on achieving the Millennium Development Goals. <http://ict.zunia.org>

The Information for Development (*info*Dev) Program works to promote better understanding, and effective use, of information and communication technologies as tools of poverty reduction and broad-based, sustainable development. <http://www.infodev.org>

InterConnection works to make Internet technology accessible to nonprofit organizations in developing countries. <http://www.interconnection.org>

Management Sciences for Health (MSH), Center for Pharmaceutical Management (CPM). View the website at http://www.msh.org/cpm. To send an e-mail message, write to cpm@msh.org. MSH freely makes available electronic products for the practice of international health at the Manager's Electronic Resource Center. <http://erc.msh.org>

The Open Source Initiative is an organization that promotes the use and distribution of open source software. <http://www.opensource.org>

PharmWeb is a website with pharmacy-related information and links to other sites maintained by organizations active in pharmaceutical management. PharmWeb sponsors a number of discussion groups and pharmaceutical information mailing lists. View the website and find instructions for subscribing to the lists. <http://www.pharmweb.net>

SATELLIFE is a nonprofit telecommunications organization dedicated to providing health care workers around the world with affordable access to critical health information through the HealthNet network and other communications services. <http://www.healthnet.org>

The World Health Organization's (WHO's) Essential Medicines and Pharmaceutical Policies (EMP) website provides information on EMP's political and administrative components, including its mandate, management approach, and worldwide projects, and on its technical components and services. These include national medicine policies, indicators, medicine information and documentation, rational medicine use, training courses, and publications. Selected documents and publications can easily be downloaded from the EMP website. <http://www.who.int/medicines>

The WHO Medicine Information System Web page lists a number of resources related to pharmaceutical-related information systems. <http://www.who.int/medicines/services/medicines_etools/en/index.html#ED>

Glossary

Apple: Company that made one of the first desktop computers. It now makes the Mac line of computers and iPhones (smartphones).

Backup: An extra copy of software or data, normally kept on file in case the original program or information is damaged or lost.

Baud: A measure of the speed at which data travels (normally between a computer and a peripheral).

Bit: A binary digit (1 or 0).

Bug: A flaw or problem in a software program.

Byte: A sequence of bits that represents a single character. In most small computers, a byte is eight bits.

CD-ROM (compact disc read-only memory): A medium for storing large amounts of data that can be accessed quickly and selectively using a CD-ROM drive. CD-ROMs are less vulnerable to damage than diskettes, which are seldom used anymore.

Chip: A generic term for an integrated circuit, a single package holding thousands of microscopic electronic components. The processor of a computer is one.

CPU (central processing unit): The "brain" of the computer, which directs and processes input and output.

Data: Numerical or verbal representations of facts that are processed to produce information.

Database: A collection of related data that can be retrieved and manipulated by a computer.

Debug: To go through a software program to remove mistakes.

Density (double, high): Describes how much information can be stored on a storage medium.

Disk: A round piece of magnetic-coated material used to store data.

Disk drive: Part of a computer that reads data from, or writes data to, a disk.

Dot matrix printer: A printer that produces lower-quality output than a laser printer. This type of printer is the best for printing on multiple kinds of paper.

Downtime: Any period when a computer is not available or not working.

DVD (digital video [or versatile] disc): A medium for storing large amounts of data that can be accessed quickly and selectively by using a DVD drive. DVDs hold more data than CD-ROMs.

Field: In a database, the basic column unit, in which the same type of information appears.

File: An organized collection of bytes stored on disk, maintained by the operating system, and referenced by name.

Hard disk: A fast-spinning, rigid piece of equipment made of stainless steel with a magnetic layer, which stores huge amounts of data inside a computer.

Hardware: The physical equipment of a computer system, such as the computer, monitor, and printer. Useless without software.

Inkjet printer: A type of printer with print quality between that of a dot matrix printer and a laser printer.

Laptop/notebook/netbook: Small computer that incorporates the CPU, monitor, and keyboard in one unit and can run on batteries. A notebook computer is smaller than a laptop, and a netbook is smaller than either.

Laser printer: A type of printer that uses laser technology to produce very high print quality.

Mainframe: Big, powerful, expensive computer, usually used by universities and the military. Usually not necessary for managing pharmaceutical supplies.

Memory: Circuitry and devices that hold the bits the computer can access. Examples are RAM (random-access memory) and ROM (read-only memory).

Minicomputer: Smaller than a mainframe but still too big or costly for an individual; may be useful for storing large amounts of data in a central medical store.

Modem: An electronic device that allows computer equipment to send and receive information through telephone lines.

Monitor: A TV-like display used with most computers to show the information being input and output.

Motherboard: The board containing the computer's circuitry, onto which all other parts of the CPU are attached.

Mouse: A small, mobile manual device that controls movement of the cursor and selection of the function on a computer display.

Network: An interconnected system of computers. The components do not have to be physically close to one another—they can be connected by telephone, data lines, or without wires.

Operating system: Software that oversees the overall operation of a computer system. It enables other software to communicate with the hardware and must be present for the computer to function. An example is Windows, used by PCs, and OS X, used by Macs.

PC (personal computer): Any general-purpose computer for individual use. Microsoft and Intel dominate the PC operating system market. Today's PCs evolved from PCs standardized by IBM

Annex 50-1 Building a product master file in a database

This section describes essential concepts for building the main reference file (that is, the product master file) in pharmaceutical management database software.

Product master file

Common to nearly all forms of database management is a master file, which includes features for pharmaceutical management, such as product name, strength, dosage form, and therapeutic category. For procurement and inventory control systems, the product master file usually has supplementary information on cost and pack size. The full description of a product can be split into database fields to sort and classify the data.

The following table briefly describes the information commonly contained in a basic product master file. The development of this file should be carefully planned around several issues, including product coding systems, definition of units, and identification of supplier-specific products.

Product master file code

A computer program must be able to identify each product quickly and without confusion. After a coding system has been chosen, it must be maintained without ambiguity, or duplication will occur. Many options exist for coding systems. The simplest system is the "dummy" code, which has no intrinsic meaning—for example, *12345* is assigned to the first item entered in the list, *12346* for the second, and so on. With this system, the only question is how many digits are needed; the key point is that the code should be unique. In most systems, a five-digit code is sufficient for many years. If a large number of different items exist, a six-digit code might be prudent.

A more complex option is an "information-bearing" code, in which each digit has significance—for example, ampicillin 500 mg capsules might be coded as *AMP500C*. In some countries, formal information-bearing codes have been developed at the national level for pharmaceutical products. An example is the nine-digit National Drug Code in the United States, in which the first four digits signify the manufacturer or labeler, the next three digits show the product, and the last two show the package size.

Arguments exist favoring each of these coding options, as well as others. Data entry errors are reduced with more complex coding schemes, but the time required to enter data may be greater. An information-bearing coding scheme takes more time to develop and maintain than a simple numeric code for products. Note that a separate coding scheme will be needed for therapeutic categories. Several international coding systems for medicine categories are discussed in Chapter 16.

Health problem coding

Health problem information must be coded for diagnosis-specific medicine-use analysis and morbidity quantification of pharmaceutical requirements. The accepted standard is the WHO *International Classification of Diseases* (ICD-10), a hierarchical classification based on major and minor disease categories, which is available online, on CD-ROM, and for PDAs and smartphones. Most information systems are now based on the ICD system, although local adaptations often result in different groupings of individual health problems.

Definition of units

When computerizing medicines systems, considerable confusion can arise over the definition of units. For example, in the preliminary quantification exercise for a large essential medicines project, requirements for benzyl benzoate (a topical preparation for skin infestations) were calculated in milliliters, whereas the essential medicines list specified liters. This discrepancy led to a 1,000-fold error that increased estimated pharmaceutical requirements by USD 1 million.

Defining the basic unit, issue unit, defined daily dose unit, pack size, and minimum order can help avoid major mistakes.

Basic or comparison unit. The basic unit is the smallest unit in which a drug product can be conveniently dispensed or administered. It is also used to compare prices of different sized bottles or vials. The total number of basic or comparison units is equal to one issue unit. For example, 100 tablets make up one bottle, with the tablet as the basic unit and the bottle as the issue unit.

Issue unit. The issue unit is used to count and distribute the stock. It allows the comparison of items of different pack sizes

in the 1980s, except for Apple Corporation products, which are not considered to be PCs.

Peripherals: Equipment (usually hardware) that is external to the computer itself. Examples are tape drives and speakers.

Personal digital assistant (PDA): Handheld computing device that can record and store data to synchronize with a desktop computer.

Power spikes/surges: Major fluctuations in electrical current that can disrupt the computer's internal operation and damage hardware.

Printer: A device to produce hard-copy output.

RAM (random-access memory): The main type of memory used in computers, also known as read/write memory because data in RAM can be easily changed.

Record: One entry, or row, in a database.

ROM (read-only memory): Memory where information is permanently stored and cannot be altered. This form of memory is also random access.

Scanner: A piece of hardware that reads information from text or images and converts it into digital form for a computer to use.

Server: The main computer on a network; provides storage and processing capabilities for client computers.

Smartphone: A mobile phone that offers more-advanced computing ability and connectivity than a basic mobile phone. Smartphones allow the user to install and run more-advanced applications and transmit data easily.

Software: Programs or segments of programs.

Spreadsheet: A program for calculating and linking numbers.

Virus: An undesirable program that displays bizarre messages or destroys data on the computer. Transferred mainly by sharing files without testing them first with antivirus software or by opening infected attachments to e-mail messages.

but the same issue unit. The total number of issue units per pack is equal to one pack size.

Pack size. In procurement, the pack size is used to request bids. Suppliers usually give the product cost for a pack size.

See the table on the following page for more examples of units. Individual computer systems may handle these concepts differently, but managers of pharmaceutical programs must be thoroughly familiar with the problems of defining pharmaceutical units. Unambiguous local definitions must be established, and everyone involved in recording, entering, verifying, or using the computer data must be trained to use these definitions.

Standard information in a master product data file

Description	Example	Explanation
Product code	AMP250C	Each entry in the product data file must have a unique code. (See text for discussion of coding options.)
Generic name	Ampicillin	The official International Nonproprietary Name (INN) is generally preferred. The WHO Model List of Essential Medicines, which is regularly updated, uses the INN.
Strength	250 mg	The International System of Units (SI), with related SI abbreviations, should be used. "Strength" can be split into "strength number" (250, for example) and "strength unit" (such as mg), but this method often creates unnecessary confusion and coding difficulties.
Route of administration	PO	Standard abbreviations should be used. For example, PO = per os (oral), IV = intravenous, TOP = topical.
Dosage form	CAP	Standard abbreviations should be used. For example, CAP = capsule, TAB = tablet.
Issue unit	CAP	The issue unit is the smallest unit by which a drug product can be conveniently distributed. (See text for further explanation.)
Defined daily dosage (DDD)	4	The DDD represents the usual total daily therapeutic dosage for an adult. In computer systems, it is best defined in terms of issue unit per DDD.
DDD unit	g	The unit in which the DDD is measured.
National essential medicines list (EML)/formulary status	Y	Is the medicine listed in the national EML or formulary? Y = yes, N = no.
Therapeutic class	44:29	Categorizing medicines by therapeutic or pharmacologic class can be useful. Several systems exist, including the ATC, BNF, AFHS, and PAHO systems, and that used for the WHO Model List of Essential Medicines. (See Chapter 40 for further discussion of therapeutic category systems.)
Prescription status	POM	Status for retail sales. For example, POM = prescription-only medicine, OTC = over-the-counter.
Level of care	A	National EMLs may categorize medicines according to level of care. For example, A = all levels, B = all levels except dispensary, and so forth.
ABC classification	A	Classification of a product as A, B, or C according to the volume consumed and unit cost. (See Chapter 40 for discussion of ABC analysis.)
VEN classification	V	Classification of a product as V, E, or N, according to its therapeutic value as vital, essential, or nonessential. (See Chapter 40 for discussion of the VEN system.)
WHO status	M	Is the medicine on the WHO Model List of Essential Medicines? This entry can be listed as Y (yes) or N (no). It can also be listed as M (main), C (complementary), E (therapeutically equivalent), or N (not on the list).

Annex 50-1 Building a product master file in a database (continued)

Units in pharmaceutical management

				Issue unit		Pack size		Miniumum order					
Code	Description	Strength	Form	Comparison units per issue unit	Comparison unit	Issue units per pack size	Issue unit	Pack size units per minimum order	Pack size	Pack size cost	Minimum order cost	Cost per issue unit	Cost per comparison unit
AMP250T	Ampicillin	250 mg	Tablet	1	Tab	1,000	Tablet	5	Bottle	34.00	170.00	0.0340 per tab	0.0340 per tab
PIL2OD	Pilocarpine	2%	Drops	15	mL	12	Dropper	1	Box	17.52	17.52	1.4600 per dropper	0.0973 per mL
BNT0T	Bacitracin + neomycin	USP	Ointment	3.5	g	100	Tube	1	Box	100.00	100.00	1.0000 per tube	0.2857 per g
NACL09I	Sodium chloride	0.9%	Injection	1,000	mL	12	Vial	10	Box	1.56	15.60	0.1300 per vial	0.0001 per mL
AMP500I	Ampicillin	500 mg	Injection	1	Vial	100	Vial	1	Box	30.00	30.00	0.3000 per vial	0.3000 per vial
PEN5MI	Penicillin	2 MU	Injection	1	Vial	12	Vial	6	Box	6.00	36.00	0.5000 per vial	0.5000 per vial
COD0S	Codeine	USP	Syrup	500	mL	1	Bottle	6	Box	7.00	42.00	7.0000 per bottle	0.0140 per mL
SAL200S	Salbutamol	100 mcg per dose	Inhaler	200	Doses	1	Inhaler	100	Box	2.70	270.00	2.7000 per inhaler	0.0135 per dose
COND0L	Condom	—	Disp	1	Condom	100	Condom	10	Box	1.50	15.00	0.0150 per condom	0.0150 per condom
BIS10S	Bisacodyl	10 mg	Suppository	1	Suppository	12	Suppository	10	Box	10.00	100.00	0.8333 per supp	0.8333 per supp
AL90L	Alcohol	95%	Liquid	1	Liter	210	Liter	1	Drum	100.00	100.00	0.4762 per liter	0.4762 per liter
JEL0J	Jelly, lubricating	BP	Gel	142	g	12	Tubes	1	Box	100.00	100.00	8.3333 per tube	0.0587 per g
GLOV7D	Glove	7	Disp	2	Glove	50	Pair	1	Box	100.00	100.00	2.0000 per pair	1.0000 per glove
NED21G	Needle	21 g	Disp	1	Needle	100	Needle	10	Box	10.00	100.00	0.1000 per needle	0.1000 per needle