A Primer on Pharmacy Information Systems

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This article will define the basic functions commonly needed in a pharmacy department information system. It also will explain why those functions are needed, how they are used, and important features related to them. In general, the article will be directed toward information systems professionals who have limited understanding of the pharmacy department or pharmacy information systems.

The following section will explain all of the information systems functions and features used by inpatient and outpatient pharmacy departments. Though not all capabilities may be used by every pharmacy, it is important to be familiar with the entire system in order to best determine the specific requirements of your institution and search for a system that best meets those needs.

Functions and Features

A pharmacy system should provide support for the following activities performed in the pharmacy:

- Inpatient order entry, management, and dispensing
- Outpatient order entry, management, and dispensing
- Inventory and purchasing management
- Reporting (utilization, workload, and financial)
- Clinical monitoring
- Manufacturing and compounding
- Intervention management
- Medication administration
- Connectivity to other systems
- Pricing, charging, and billing

**Inpatient Order Entry.** Typically there are three steps in initial order entry. The first is the physical entry of the order (which may involve persons outside of the pharmacy department). This may come from an order communications
system where a physician, nurse, or ward clerk has entered it, or may be directly entered into the pharmacy system. The differences between orders entered by pharmacy department personnel and orders entered by other parties are explained at subsequent points in this article.

The second step is the pharmacist’s validation of the order. When an order is entered by anyone other than a pharmacist, it must be given a conditional or pending status. These orders are subject to review by a pharmacist prior to being dispensed to a patient.

The third step is the initial dispensing of the medication in preparation for administration to the patient.

Order entry in the pharmacy is typically used to identify a pharmaceutical product that is suitable to meet the physician order. This includes identification of crucial aspects of the order such as item strength, package size, method of administration, as well as the ingredients that must be prepared by the pharmacy. In order to ensure a continuing supply of the medication to the patient, the location, method of distribution, and supplier must also be specified. This allows for an efficient, ongoing automated resupply of the medication. Typically, there are six types of orders that may occur in relation to the specific product being used in an inpatient setting, the schedule of the administrations, and the method of resupply:

Unit dose medication—Individually packaged item, such that one or more dispensing packages is used in a dose
Intermittent IV—IV medication that is given on an intermittent basis (for example, every six hours, or daily)
Continuous IV and TPN (Total Parenteral Nutrition)—IV medication or fluid that is given on a continuous basis (for example, 125 ml/hour)
Multidose medication—Dispensing size that is larger than a dose, such that the package is used for multiple doses
Variable dose/dosing schedule—Medication that is dispensed on an as-needed basis (for example, every 3–4 hours, or as needed)
Order sets—Combinations of the five order types listed, whose orders may or may not retain relationships (for example, have their times change or be discontinued together) throughout the cycle of the order.

The resupply of a pharmaceutical to the patient care area may occur by any, or all, of several methods. There may be periodic shipment from a pharmacy to the patient care location, with the product intended for a specific patient, or periodic shipment from a pharmacy or other supplier directly to a patient care location for storage in general stock, floor stock, or an automated dispensing device (such as Pyxis). Once the medication is stored in a location near the patient, it can be administered as specified.

It is critical that the pharmacy information system facilitates the definition of the order and resupply parameters to expedite order entry. Because the system should be capable of calculating the supply and resupply parameters in
the following list at order entry, the program user is only required to verify orders and make minor changes, as needed.

- Number, format, and printing location of labels
- Price of medication and service fees
- Amount of medication to be dispensed immediately
- Order start and stop times and dates
- Administration schedule based upon patient location, other medications and IVs, and physician order
- IV rate and duration
- Preferred quantities to dispense for variable dose, variable administration schedule, and as needed (PRN) orders
- Schedule for inclusion of ingredients in an IV order
- Relationship between orders in an order set
- Supply and resupply location and method

During order entry, the information system should provide assistance in reviewing the order for clinical problems such as drug interactions and allergies. (This feature is covered under the heading “Clinical Monitoring.”)

**Inpatient Order Management and Dispensing.** Because physicians or pharmacists frequently must change pharmacy orders, it is important that a pharmacy be able to change the orders quickly and easily, while maintaining a complete and easily accessible audit trail.

The patient profile is the primary order review screen used in most pharmacies. This screen provides a summary-level view of the patient's orders. It is desirable to have a number of options for sorting and displaying orders and subsets of orders. This allows the pharmacist to have a full understanding of the patient's orders, and to focus on those of a specific type, such as IV, antibiotic, or those of a certain drug. The profile should provide easy drill-down to the detail of the orders. This detail should include the entire history of the order, audit trails, drug interactions, dispensing history, charges, and any other comments or notes. Easy access to pharmacy order details is also important; the program user should be able to access specific pieces of information directly and with little effort.

The status of an order is one of the most critical pieces of information for a pharmacy. The status indicates the completeness and availability of the order, and what types of processing can be performed on it. Typical status conditions are as follows:

- Conditional (unverified, pending)—Orders that have been entered by anyone other than a pharmacist and are waiting for approval by a pharmacist
- Active—Fully operational orders being used by the system for automated processing
- Held—Orders that were once active but have been put in a suspended state, due to a physician instruction, or questions about the order by the pharmacy
Discontinued—Active orders that have been manually ended by the program user; very little can be done with these orders except retrospective charge or credit adjustments.

Completed—Active orders that have run their scheduled life and are otherwise categorized as discontinued.

In addition to status changes, there are several other types of “edits” that can be performed on pharmacy orders. It is common for these edits to be performed on multiple orders simultaneously. For example, a physician may order the discontinuation of all oral medications, or convert IV medications to oral medication. It is important for the system to perform changes to multiple orders in one step. It is also important that the system allow changes to most, if not all, of the fields in an order. The alternative is the creation of a new order for each order change, which makes it more difficult to determine the progression of the course of therapy. Following are some of the types of edits that can be performed on pharmacy orders.

Edit—A change in the value of almost any field.

Dispense additional dose—It is often necessary to provide a patient with an additional dose of medication beyond that which has been scheduled. This may occur due to the “loss” of the dose, or the dose may become unusable due to mishandling (dropped, spilled, and so on). It is important that the option exists to charge the patient or the patient care area, or not to charge at all. It is also desirable to allow the user to indicate the reason for additional dose, to facilitate quality assurance activities.

Print patient counseling information—Pharmacists are becoming more involved in providing patients information about their medications. The information system should allow them to inquire into the information to be given to patients, customize that information, and print it in a patient-friendly form.

Adjust administration times—Pharmacy orders, especially IV orders, have frequently changing administration times. These must be kept current in the pharmacy information system to allow the automated medication administration record to accurately reflect those times. This document is often provided by the pharmacy system and used by nursing to administer and record administrations of medications. The system must allow the quick updating of all subsequently scheduled administrations when a single administration is edited.

Dispense leave of absence medications—The system facilitates the processing of patients who are in subacute care areas, and who may be sent home for brief periods during their stay in the institution, by handling the labeling, charging, and dispensing of these medications while altering the automated dispensing in the inpatient areas to reflect the inpatient or outpatient status of the patient.
Computerized dispensing work lists are among the most important outputs of a pharmacy system. These work lists provide the pharmacists with up-to-date quantities of medications and IVs that are to be prepared and dispensed for individual patients and patient care areas. It is imperative that these work lists have the flexibility to be run or rerun as often as necessary in various configurations, and to reflect the dispensing work flow and staffing on any given shift, weekday, weekend, or holiday.

There are four types of work lists.

Fill lists—Used to fill exchange carts or prepare IV solutions for individual patients.

Update fill lists—Used to determine any changes that have been made to any new or existing orders that were entered after the last fill list had been run.

Preparation (compounding) lists—Used to determine which items require advance or special preparation.

Bulk fill lists—Used to determine which bulk items need to be transferred from one pharmacy location to another in preparation for dispensing to patients. These lists are typically not patient specific, but include the needs of patients in specified care areas.

The use of automation in the inpatient setting to perform routine dispensing has become quite common. There are principally two types of pharmacy dispensing automation systems, centralized and decentralized. The pharmacy computer system must be able to handle both types of systems jointly or separately.

The centralized dispensing device is typically a large robot that has access to the most frequently used medications. It can perform labeling of medications for patients or place medications in patient-specific drawers in an exchange cart. The interface to the centralized automation is generally a one-way, periodic interface used to handle refills of ongoing orders and, less frequently, the initial dispensing for orders recently entered into the system.

The decentralized dispensing device is analogous to an ATM. These devices generally contain two-way interfaces and are located near the patient care area. The pharmacy information system may send a list of verified orders for each patient to the device. This permits some devices to provide a check on the person requesting the medication for a specific patient. If the patient does not have an order for the medication, the requestor is notified and may even be prohibited from obtaining the medication. There is a billing interface from the dispensing device, networked to the pharmacy system, to log which medications have been dispensed for which patients.

**Outpatient Order Entry, Management, and Dispensing.** Outpatient dispensing includes the preparation of medications for several types of environments: home, clinic, discharge from inpatient, some long-term care environments, and the traditional retail environment. It has become common for
pharmacies to provide home infusion, outpatient chemotherapy clinics, and other types of services that were traditionally available only in the inpatient arena.

Most of the order types that exist in the inpatient areas can be used in the outpatient areas as well. This system can save significant outpatient order entry time if the pharmacist is able to copy these from the inpatient orders. It is useful for the pharmacist to be able to see some combination of the inpatient and outpatient orders, providing a complete picture of a patient’s therapy throughout multiple inpatient stays and outpatient care episodes.

The dispensing of the common prescriptions raises many issues for pharmacy systems that do not exist in the inpatient setting. Full-service retail operations find that they must be prepared to deal with a host of insurance plans, each with their own requirements in terms of co-pays, covered items, allowable charge structures, and preapprovals. The pharmacy system must allow for rapid online claims processing while the prescription is being filled. The use of charge accounts is not uncommon, especially for physicians affiliated with hospitals. This means that billing and accounts receivable follow-up also must be an integral part of the system.

Most of the same issues that exist in inpatient order entry and management also apply to the outpatient environment, made more complicated by the increased flexibility of dispensing in the outpatient setting. A doctor may prescribe a thirty-day supply of medications, with six refills of an additional thirty-day supply. But the patient may request to take only a fifteen-day supply at one time. Thus, the system must keep track of how much medication the patient is able to receive and how much has actually been received.

Clarity of labeling takes on an added significance, because the label must be read and interpreted by the patient. Additional warnings and patient information must be given in the outpatient setting.

It is essential for the system to recognize and display administration instructions in a simple and accurate form. This is commonly done in two ways. The first is to associate instructions with each drug item that default into order entry, and may require only minimal modification. The second is to use codes that the user enters to refer to a text string that represents the instructions. For example, “T1T” may refer to “take one tablet.” Appended to this is the remainder of the instruction, “PO BID,” which represents “twice daily by mouth.” The use of codes facilitates the provision of the label output in multiple languages, as the code could also be linked to a version of the same phrase in, say, Spanish.

There is extensive use of dispensing automation in the outpatient setting. Devices in this setting are typically less intelligent than inpatient devices, and are primarily used to count out the tablets or capsules to be dispensed. A simple one-way interface is used from the information system to the dispensing device.

Many high-volume facilities are using more sophisticated forms of automation to receive and manage patient requests for refills. Interactive voice response (IVR) technology is used to receive patients calls for refills.
and questions. The IVR system can confirm the refill request or indicate that the prescription can not be refilled. The IVR system then transmits those requests to a queue in the pharmacy system to allow the processing of the refill.

**Inventory and Purchasing Management.** Inventory management is a primary function in the pharmacy. Most pharmacies stock more than two thousand items and require continuous inventory management.

In many cases, pharmacies maintain a perpetual inventory in limited-access storage areas, decentralized dispensing devices, and narcotics vaults on their pharmacy information system. Due to the numerous “off-the-books” transactions, it can be difficult to maintain an accurate online inventory. Information the usage patterns from each of the dispensing areas can assist the pharmacy materials managers in making informed decisions about the levels of inventory needed in any given area (PAR level).

Pharmacy systems typically rely on a PAR level system that helps them determine quantity orders. Though few systems do, it is helpful for a system to calculate PAR values based on usage. Another important function for systems is to provide direct electronic ordering capabilities that allow the system to recommend an item and a quantity to be ordered, provide limits or warnings when the quantities requested are excessive and, after human confirmation, place the order electronically with vendors.

In order to eliminate manual online processes, requisitioning within an institution is also useful. This allows users at inventory locations to request stock refills from the centralized materials area.

The other major inventory challenge is controlled substance management (narcotics). These items are subject to abuse and must be stored securely and monitored down to the individual dose. Pharmacy systems should support the user in receiving, storing, and tracking these items from their entry into the system through administration to the patient. Typically there is a dual-user validation system, which allows a cosigner at significant points in the process. Also, there is a need for tracking the unique package number (assigned by the vendor) to the patient.

**Reporting.** Extensive reporting capabilities are a necessary by-product of the massive amounts of information in any pharmacy system. Reports can be grouped into three types: utilization, workload, and financial.

**Utilization.** Utilization reports are used to determine medication usage patterns within an institution. They are available at two different levels: item level and patient/physician level. Item level reports are high-level (aggregate utilization across the entity) overviews of the usage of items in the institution. They indicate the amounts and dollar values of individual products, generic items, and therapeutic classes being used. This high-level information allows the pharmacist to determine which data requires further review. Patient/physician level reports provide detailed information on the prescribing habits of physicians. This should be in a layered format to facilitate viewing of the patterns of a particular physician or a patient’s medical history.
Workload. Workload reports show the volume of transactions performed for any specified time period (hour, day, and so on). The key to the use of these reports is flexibility. The user must be able to request any time period covered in the report, in a variety of definitions including certain hours of the day, across multiple days, certain days of the week, months of the year, or multiple years in comparison. These reports are used to schedule staffing. The best systems go beyond merely counting transactions (doses dispensed, orders entered, and so on) and assign a resource intensity factor. That factor should vary by type of order (medication versus IV) and activity (entry versus edit) and reflect variations and difficulties in requesting and dispensing medication, producing a more comprehensive picture of the departmental workload.

Financial. Financial reports are fairly standard budgeting and actual costing reports. Most pharmacy systems track actual costs and some standard patient charge information. This can allow the system to report revenue and actual costs of goods dispensed, versus budgeted figures.

Clinical Monitoring. A critical function that pharmacists provide to patient care givers is the monitoring of drug interactions, drug allergies, and other possible medication-related complications. The pharmacy information system is important in the successful execution of this activity.

During order entry and order management, the pharmacy system assists the pharmacist in monitoring for the following clinical issues:

- Drug interactions—Interactions between two or more drugs being taken by the patient simultaneously
- Allergies—Reactions due to patient allergies to a drug or ingredient
- Food interactions—Interactions between drugs and typical foods
- Lab test interference—Impact of drugs on lab test values
- Dosing—Appropriateness of dosage based upon patient age, weight, and other physiologic parameters
- Disease state effects—Impact of certain disease states on the body's ability to handle drug therapy

System monitoring should be performed almost immediately to avoid having a negative impact on the order-processing throughput of the pharmacy. It is also important that the system provide the following information on each interaction: the items involved, the severity, recommended action, references, and the capability to record background and notes while investigating drug interactions and determining action that should be or has been taken.

Rules-based checking is a more sophisticated form of clinical monitoring. It allows users to define rules, using any clinical parameters in the system, that can be triggered by system events defined by the user. This is commonly used when other data, such as lab results or patient clinical demographics (height, weight, and disease states, for instance), are stored in the pharmacy system. For example, if an out-of-range lab result is received by the system, it may alert the user that the dose of a medication should be reduced.
**Manufacturing and Compounding.** Most pharmacy operations perform some type of compounding, in which they take commercially available products and change their strength or dosage form. The pharmacy system should support this activity by providing automated logbooks in which the pharmacy can record information such as quantities, expiration dates, and lot numbers on the ingredients and final products. This should be integrated with the materials management system and dispensing systems to facilitate the tracking of these items, from the purchase of raw ingredients to the dispensing to patients. In the event of a recall of ingredients it becomes extremely important for the information in these logbooks to be easily accessible.

**Intervention Management.** As pharmacists have become more active members of the patient care team, they are initiating changes to medication therapy. An intervention management module is used to document such activities and their effects. This module allows the pharmacists to indicate the issues that they have identified, the action taken, and the impact on the quality and cost of care. The intervention module should be an integral part of the pharmacy information system. It should automatically capture the demographic and clinical information on the patient relevant to the intervention that was performed.

This module also should allow for flexible aggregate and individual reporting to help the department identify the value of its efforts. It should allow a follow-up intervention to be scheduled, and provide a work list that can be used to identify the interventions that should be performed in a given time period.

**Medication Administration.** Although pharmacy departments are not usually involved in medication administration, most pharmacy systems do provide medication administration documentation forms. These are often used by nursing staffs to assist them in determining when to administer medication. Most systems provide printed documentation, and have online work lists that include information supporting reasons for administering or not administering medication.

**Connectivity to Other Systems.** One of the most desired interfaces to a pharmacy system is with order entry. Theoretically, orders and order changes could be entered by the physician and transmitted to the pharmacy instantly without confusion. Though advantageous, this function is rarely used in entry systems, in part because physician order entry has not gained widespread acceptance outside of academic medical centers.

Another obstacle is the differing viewpoints of physician and pharmacist regarding the requirements of a complete order. A physician orders a drug entity with several parameters such as dose, route of administration, and number of doses (for example, Ampicillin, 750 mg, by mouth, three times daily for ten days). The pharmacist must translate that into a specific product (for example, 250 mg capsules by Barr) and enter a number of other parameters related to the order, such as where it is to be dispensed from, and what quantity must be sent to the patient now. The pharmacy system must be able to take
information from the order entry system and translate that into a legitimate pharmacy order with a final review by pharmacy personnel.

If this were the only point at which the two systems shared information, there would be little problem in writing an interface. However, orders change frequently; as a result, a continual interchange between the two systems is necessary to keep orders synchronized.

Many pharmacy systems have been designed to receive laboratory results, enabling pharmacists to review them and use rules engines (software which initiates certain action on a computer when specified conditions are met). It is important that the pharmacy system be able to display accurate, detailed results. Not only is the most recent result important, but the trend of the results is also instructive, and it is valuable for the system to display multiple results and graph trends as well.

**Pricing, Charging, and Billing.** It is almost universal for pharmacy systems to have one-way interfaces from ADT systems to track patient admissions, discharges, and current locations. Billing interfaces from pharmacy to hospital billing systems are also almost universal. These interfaces most commonly take the form of daily batches in which items, quantities and, in some cases, patient charges are sent from the pharmacy system.

**General System Considerations**

The line that once existed between inpatient and outpatient practice settings has been blurred as providers seek to manage patient care throughout the continuum. This is also true within the pharmacy. Unfortunately, many pharmacy information systems have not made that leap. They still consider inpatient and outpatient as separate systems, sometimes with separate databases.

It is important for pharmacists to be able to aggregate inpatient and outpatient data for viewing, reporting, and monitoring patient therapy. But it is equally important that the medication therapy be separable in a variety of ways, to allow the pharmacist to see the therapy from one or more inpatient visits or a series of outpatient encounters, for example.

**User Interface.** There is an ongoing controversy over whether it is faster to use a character-based user interface or a graphical user interface (GUI). The distinction has important ramifications because of the high volumes of pharmacy activity during order entry. Ultimately, the pharmacy information system must support and enhance the user's ability to process orders rapidly. The answer is obvious. A well-designed system, whether it is a GUI or not, will be the best one. There is no guaranteed superior user interface. Both systems have their advantages and disadvantages.

The most important things to look for in the user interface are: flexibility in the sorting and selection of orders in the order profile; complete and readable patient profile displays; the ability to work with multiple orders simultaneously, directly from the patient profile display; minimal paging and use of
multiple screens to perform any activity; the ability to target the precise screen to identify requested patient profile information; the ability to enter multiple orders on a single screen; and the use of defaults to predefine order, groups of orders, and order sets to facilitate order entry.

**Security.** Security is vital for a pharmacy information system, as it is for all systems that contain patient information. There are typically three types of users in a pharmacy system, the pharmacist (who can perform any activity, produce active orders, and verify other orders), the technician (who can perform a limited number of activities and produce only unverified/conditional orders), and others (for example, nursing or other care providers who can only view information in the system).

The most robust security system is one in which the system administrator can determine which of the order entry and order management activities can be given to a specific user. It is also useful to be able to restrict certain users, or groups of users, from accessing or ordering certain items. This application of security down to the item or activity level can be a nightmare to maintain. Thus, the system should provide a way to set up groups of like users for which it is possible to modify the access of everyone in the group by modifying one central template or profile.

**Data Retention.** Pharmacy systems should be capable of purging and archiving data. Pharmacy orders are typically used while they are active and the patient is taking the medication (usually during the period of inpatient care, and lasting no more than a year for outpatient prescriptions); however, most states have regulations that require this information to be kept online or in hard copy for three to five years after that time.

The history of a patient's medication therapies is valuable in helping physicians and pharmacy staffs understand drug usage and cost issues. It is important that the pharmacy system has the capability to keep patient information for at least one year beyond its active state, if not longer. Ideally, information should be purged from the daily transaction system and archived onto other media or a data warehouse, to allow the information to be used in review analysis without having an adverse impact on the production system.

**Conclusions**

Automated pharmacy information systems have been in use for many years. These have evolved into very sophisticated and complex systems to meet the many needs of pharmacy departments. The department has come to rely on information systems and related automation to provide tremendous efficiencies in the distribution of medications.

There is significant variation between the needs of different pharmacy departments, so it is important that the present and future needs of a department (and of others who are involved in the medication use process) be well understood before a selection process begins.
There is also significant variation between available systems. Careful review of all system details is necessary to ensure that the system best suited to specific needs is selected. The ramifications of selecting a system that does not enhance operations can be quite severe, with the possibility of loss of efficiency and reduction in the quality of patient care.

Of course, information services departments can greatly assist pharmacy departments in the identification of their needs, with technical issues, and by ensuring compatibility with the plans and infrastructure of the organization as a whole.

About the Author

David Troiano is senior consultant with InSource Management Group, and has been involved in the design, development, selection, and implementation of pharmacy and other clinical information systems, as both vendor and consultant.