The Hospital Pharmacy — Now a Sophisticated Manufacturing Plant

By Cynthia Hayward

Automation — with the barcode as the foundation — has transformed the hospital pharmacy into a high-tech manufacturing plant that allows pharmacists to focus on direct patient care. Although automation in the pharmacy requires a significant capital investment, it reduces labor costs, lowers the risk of dispensing errors, optimizes inventory control, and provides better security, among other benefits.

UNDERSTANDING PHARMACY WORKFLOW

The barcode is at the foundation of pharmacy workflow as the hospital pharmacy tracks the flow of drugs from their receipt at the hospital to their administration at the patient bedside. Key steps in the workflow include:

Receiving, breakdown, and storage. The pharmacy staff receive bulk supplies — which are usually shipped directly from the wholesaler — in the receiving/breakdown area. Items are held in a bulk storage area or broken down and sent to the packaging area, where barcoding and stocking take place. Medications are then sent to the unit dose order processing area, or the intravenous (IV) preparation room, or prepared to be used with automated dispensing equipment.

Medication dispensing. The primary activity of the hospital pharmacy is dispensing medications to patients in response to physician orders or prescriptions, which may be faxed, sent electronically, or delivered via a pneumatic tube system or courier. When order verification is completed, the pharmacy sends an initial “first dose,” or “stat” order which, denotes its urgency, to the patient care unit. It is packaged as an individual unit dose with the patient’s name, drug name, strength, expiration date, and barcode affixed to the package. The nurse administers the initial dose to the patient prior to delivery of the remaining medications needed for the patient within a 24-hour period. Barcoding technology allows the nurse to scan his/her identification badge, the unit-dose packet, and the patient’s wrist band.

Hospital-wide distribution. The process of stocking an adequate supply of the required medications on the patient care units varies depending on the size and physical layout of the facility. The most common distribution process used by hospital pharmacies is an exchange cart system. A medication cart is stocked in the pharmacy with all the medications required for the patients on a specific nursing unit for a 24-hour period. The cart contains multiple secure compartments to house individual drawers, cassettes, or bins for each patient’s medications in unit-of-use form — a tablet, a vial of liquid, or a prefilled syringe. The depleted carts are then exchanged with newly replenished ones and unused medications are put back into inventory in the pharmacy. Medication carts may be supplemented with automated medication dispensing cabinets or carts that contains floor stock — high-volume medications such as pain relievers, gastrointestinal drugs, and cough suppressants. The hospital pharmacy also provides IV medications or fluids that are administered directly into the patient’s vein. Most IV solutions are purchased commercially and are administered to patients by nursing personnel.
PHARMACY AUTOMATION TODAY
A high-volume pharmacy today looks more like a sophisticated manufacturing plant than a clinical department. Over the past decade just about any pharmacy task — that once was performed at a hands-on workstation — has been automated. Some large hospitals have automated the entire process from electronic physician orders to individual patient cassettes ready for cart loading and delivery to the patient care unit as shown in figure below. Using barcode technology, sophisticated software, and automated storage and dispensing systems, robotic arms pick, package, and dispense individual doses of pills, compound sterile preparations, and fill IV syringes and bags. An automated inventory management system keeps track of all the products and automated pharmacy warehouses provide refrigerated and nonrefrigerated storage and retrieval of medications and supplies. In addition to filling medication orders, autonomous mobile robots are being used to make secure deliveries throughout the hospital.

Traditional Pharmacy Workflow

Automated Pharmacy Workflow

A NEW SPACE PLANNING APPROACH
Historically, the size of the hospital pharmacy department was based on the scope of services, workload, and corresponding staffing and number of workstations required for product preparation, compounding, and dispensing. Specific data to be reviewed included the number of inpatient prescription orders received, IV admixtures prepared, and doses packaged. Today, the degree of automation, method of medication distribution, and specific equipment to be used are the major determinants of the space required in the hospital pharmacy. This space planning process begins with selecting the equipment components and assessing their space requirements. Some types of equipment that may be used in pharmacies include the following:

- *Rotating vertical storage carousels* allow easy access by the pharmacy staff to provide automated unit dose picking and optimize the space required for storage.
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- **Controlled substance towers** are secure vending cabinets for dispensing labeled unit dose narcotics via computer access — often used in the hospital pharmacy in lieu of a narcotics vault or secure storage room.

- **Unit dose packagers** can package and label dosages of oral solids or liquids, use overwrappers for large items (vials and syringes), and fill multiple cassettes of bulk tablets or capsules. Some of these machines can accommodate more than 300 medication canisters and can interface with multiple devices to streamline inventory management and simplify workflow.

- **Automated storage systems** allow hospital pharmacies to securely automate the storage and retrieval of refrigerated and non-refrigerated medications and narcotics within a single unit. These high-density pharmacy warehouses eliminate the need for pharmacy refrigerators and increase security by controlling access to the stored substances.

- **Automated packaging, storage, and dispensing systems** provide unit dose packaging, storage, and dispensing in a single machine — completely automating the workflow from the manufacturers’ packaging to patient-specific dispensing. Robotic arms pick unit dose products in response to a request, dispense large items that are overwrapped, fill daily batches as well as stat orders (non recurring medications), and prepare oral and injectable medications such as toxic chemotherapy drugs.

- **Automated dispensing cabinets or mobile carts** allow safe, secure medication storage with multiple computer controlled drawers that are accessed as requested by the operator. These are commonly deployed on patient care units (in alcoves or medication preparation rooms), emergency departments, surgical suites, and other clinical areas throughout the hospital.

Once the equipment is specified, the administrative workstations for the staff who support the automated equipment can be identified — including workstations for order verification and inventory control and equipment operation, maintenance, and troubleshooting. Finally, additional workstations and pharmacy support space can be determined. For example, additional manual workstations for extemporaneous compounding may be required as well as space for medication cart filling and receiving and bulk storage.

**SUMMARY**

All hospital pharmacies should be developing a strategy for eventual automation of the entire workflow from the receipt of an electronic medication order to a unit-of-use medication ready for administration to the patient. To accommodate automation, traditional hospital pharmacies need to be redesigned to provide the large open space needed to accommodate new robotic equipment and equipment components. Many tasks traditionally performed in, or in conjunction with, the pharmacy — pharmacist order entry from the hard copy, label generation, medication filling, compounding, medication checking, delivery to nursing units, locating misplaced medications, and administration from a manual medication administration record — will no longer be necessary. Space for these activities can be shifted to support new technologies or eliminated as needed.

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