

Challenges of the Cartfill and Cartless Models of Drug Distribution

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Abstract

Hospital pharmacies are responsible for ensuring that every step of the medication cycle—storage, preparation, distribution, and safe administration to patients—is managed effectively. They are also responsible for prescription processes and patient record keeping, in addition to their expanding clinical responsibilities. And in the age of managed care, the pharmacy is under constant pressure to enhance productivity and minimize costs and waste.

One of the ways in which hospital pharmacies are achieving these goals is through advances in medication management technologies. These technologies have evolved over the past 40 years into sophisticated systems that help minimize costs, maximize patient safety, and ensure medication security. This report identifies and compares the two major medication distribution models—“cartfill” and “cartless”—with respect to patient safety, cost, and productivity.

Background

Pre-1960s

Before the creation of modern distribution systems in the 1960s, medication dispensing in hospitals was essentially similar to the outpatient model. There were two main methods for delivering medications to the patient care unit (PCU) for administration to patients.

One method was the “floorstock system,” in which the pharmacist dispensed non-patient specific stocks of medications to the PCU from a central pharmacy. Medications were not labeled for specific patients, and 150-200 medications were commonly stored in a “mini-pharmacy” on the PCU. Nurses were responsible for nearly every step in the medication cycle, including estimating weekly or monthly inventory needs, issuing bulk medication requisitions to the pharmacy, receiving and interpreting physician orders, transcribing the orders to medication administration records, preparing medications for administration, and administering individual doses to patients.

The other distribution method was the “patient prescription system,” under which the physician wrote the prescription, and then a nurse transcribed the prescription to a medication administration profile and generated a medication order for the pharmacy. The pharmacist then dispensed an adequate supply of the medication to cover a specific period, usually several days.

This method allowed the pharmacist to review prescriptions before medications were administered, but did not allow them to review patient diagnoses, allergies, and previous medication orders. Hence, the pharmacist did not have the opportunity to monitor drug therapy or enhance prescribing practice, leaving the nurse with the majority of drug preparation and prescription evaluation responsibilities. Both systems were highly error prone, resulting in medication error rates as high as 25 percent.

1960s – 1980s

24-hour unit dose cartfill

Beginning in the mid-1960s, the introduction of unit-dose packaging and 24-hour cartfill represented the first major shift away from variations on the outpatient model.

The “unit-dose” or “unit-of-use” method refers to placing individual doses of medications into a separate package, with each package listing the drug name, strength, lot or batch number, and expiration date. Compared with storing bulk containers of drugs on PCUs for use by several patients, unit dose distribution allowed the pharmacy to dispense the number of doses needed by individual patients during specific periods of time, usually 24 hours.

The unit dose system was developed partially in response to the existing system's failure to take advantage of pharmacists' extensive education and training to enhance patient safety and contribute to more effective overall medication practices.

Increased safety

Patient safety improved significantly with the introduction of the unit-dose / cartfill system, which allows multiple checks for each dose of a given medication before its administration to the patient. Clinical trials showed medication error rates dropping from 20+ percent to approximately 16 percent. Under this method, the pharmacy receives a copy of the physician's original medication order form, which the pharmacist reviews along with previous drug orders and enters into the patient's medication profile. If any problems or contraindications are identified, the pharmacist can intervene with the prescribing physician to suggest appropriate alternatives.

After the pharmacist approves the medication order, a pharmacy technician issues the doses needed for the patient for the next 24 hour period. The pharmacist checks the order for accuracy and then authorizes delivery of the medications to the PCU.

Once the medication is delivered from the pharmacy to the PCU, it is stored securely in a unit-dose medication cart. This piece of equipment, developed as an integral part of the unit-dose distribution method, consists of a lockable cart with a multiple sliding drawers and removable trays. It contains patient-labeled bins, each of which holds a 24-hour supply of medications. The bins can only be accessed by authorized pharmacy and nursing personnel.

More active role for the pharmacist

The unit-dose / cartfill system differs from previous distribution methods mainly in the pharmacist's more active role in the medication cycle. Patients benefit by having 1) a trained clinical expert directly responsible for reviewing and approving medications and 2) more nurses' time available for patient responsibilities.

The pharmacist reviews an actual copy of the physician's medication order, oversees every step of the medication preparation, and maintains patient drug profiles, thereby minimizing the chances of allergic reactions and conflicts with existing medications. The pharmacist also monitors patient response and makes recommendations to the physician as to effective alternative medications if necessary. The unit-dose method also reduces costs by eliminating excessive PCU floor stock inventories and waste.

The primary drawback of the unit-dose method is the labor-intensity and inefficiency of the process. Every 24 hours, a pharmacy technician must prepare all medications needed during the next 24-hour period and place them in the medication cart, resulting in substantial duplication of effort. On average, a typical hospital pharmacy using the cartfill method could experience up to 35-40 percent duplication of effort, particularly due to PRN medications that are not used, but must still be returned to the pharmacy and reissued. Moreover, while medications are more secure when stored in locked carts—especially high-risk controlled substances—they are still not safe from diversion once an authorized user gains access to the cart.

1980s – 1990s

Cartless medication distribution

Beginning in the 1990s, a new "cartless" medication system was introduced for hospitals: PCU-based automated dispensing cabinets. The cartless system is essentially a high-tech upgrade of the old floorstock system, involving use of medication dispensing cabinets with multiple secure compartments, each of which is designed to contain a supply of one specific medication. Pharmacists can store the most commonly used medications in the cabinet,

controlling access via a computerized interface to the pharmacy information system, commonly called patient profiles.

The automated dispensing cabinet allows access only to the specific medications prescribed to an individual patient, according to the patient profile stored in the system. The cabinet allows access only to compartments containing the specific medications that have been prescribed to a given patient and that are due for administration.

Cartless vs. cartfill

The cartless system has a number of advantages over the unit-dose / cartfill method, including:

- 1) Patient safety—studies have shown an additional 5 percentage point reduction in medication errors moving from cartfill to cartless;
- 2) Greater medication safety and security—nursing personnel can only access the medications allowed by the patient's profile;
- 3) Greater pharmacy productivity—pharmacy personnel no longer need to perform labor-intensive cart-stocking and redundant re-stocking;
- 4) Immediate availability of new medication orders—commonly used medications can be pre-stocked in each PCU's dispensing cabinet; and
- 5) Discontinued medications no longer available for patient administration once the medication is removed from the patient profile.

One of the objections to the cartless model is based on the belief that any efficiency gains will be lost because of "nurses standing in line at the cabinet." However, Wise et al (1996) reported "reduced nurses' time spent administering medications, as well as travel time between locations in the nursing unit," even though nurses' time spent removing medications from automated cabinets was greater than that spent on the same task using the unit-dose / cartfill system, for "a net gain of 4.4 minutes per nurse per shift, or 230 hours per year."¹

Despite its advantages, the cartless system is not the ultimate solution. Cabinets do not contain 100 percent of patients' medications, requiring nurses to locate non-cabinet doses from multiple other locations. Potentially critical problems can arise from patients bringing their existing prescription medications along to the hospital and self-administering them without regard to contraindications or potential reactions with hospital-administered medications. There is no secure storage for pharmacy-prepared patient-specific intravenous admixtures. Patient transfers often result in delays in therapy as ordered medications may not be stocked at the patient's new location.

Unfortunately, the 10-15 percent of medications not stored in the cabinet require disproportionate effort from both nursing and pharmacy. Hence, a more adaptable system is still needed to cover every patient contingency and ultimately lead to true storage and control in the cabinet of 100 percent of the medications needed for each patient.

1 Wise, L. C., Bostrom, J., Crosier, J. A., White, S., & Caldwell, R. (1996). "Cost-benefit analysis of an automated medication system." In Nursing Economics. Jul-Aug 1996

Hybrid systems

Many hospitals use a hybrid unit dose / cartless system, i.e., using a cartless model as the primary medication use system and supplementing it with a daily mini-cartfill. Management is often hesitant to eliminate existing unit-dose systems entirely as nursing staffs are reluctant to cede the flexibility it affords. Hybrid systems could ultimately act as a bridge from cartfill to cartless, depending on the pharmacy's philosophy and nursing's perspective. Hybrid systems may also be viewed by nursing as more supportive for bedside point of care systems.

Challenges

Despite advances in patient safety, medication security, and labor productivity, challenges remain in creating a standardized system with performance that is demonstrably superior enough in every respect that hospitals will adopt it exclusively.

As mentioned above, some medications still have to be managed, dispensed, and administered outside of cartfill and cartless systems. Moreover, there is still no single place for all medications to be stored, (e.g., those with specialized delivery apparatus such as inhalers, and medications that require refrigeration). Hence, additional medication cycle efficiency gains and patient safety improvements have yet to be achieved. Regardless of whether any given facility prefers cartfill or cartless, medications continue to be stored in a number of locations on nursing units. Hence, to varying degrees, centralized, secure storage continues to be an issue for both methods. An optimal method of providing medications that satisfies both pharmacy and nursing has yet to be found. Hence, the goal for companies that make medication-use automation systems will be continued improvement to address these shortcomings.