As many hospital systems can attest, packaging medication into unit dose, while often complex, ultimately brings a necessary order and reliability to medication administration. In this regard, high volume packagers have been shown to improve efficiency, decrease costs, improve quality, and facilitate better use of other technology.

At the University of Michigan Hospitals and Health Centers, including tertiary care hospitals and associated clinics, we have 913 licensed beds with 256,000 inpatient days, 75,000 emergency department visits, and 1.6 million clinic visits yearly, realizing operating expenses of $1.5 billion. Serving a population this large, we found it necessary to streamline the process of administering such a high volume of medications.

**Finding the Right Solution**

Prior to employing a high volume packager, we used multiple systems for packaging medications. We purchased medications in unit dose when possible to avoid having to package the product ourselves, and we purchased “robot-ready” products to stock our robot. As a supplement to this, we used a bulk packager to package certain products for the robot. In the past we had packaged ciprofloxacin 500 mg tablets, levothyroxine 0.1 mg tablets, gabapentin 300 mg tablets, and metronidazole 500 mg tablets, to name a few. As for items that were to be dispensed from satellites (or stocked in automated dispensing cabinets), commercially available unit dose products were used when possible. If no unit dose product was available, we would package product using the Medi-Dose packaging system, and did our labeling using a home grown labeling system.

Our packaging needs evolved when we decided to barcode all medications in the health system to support safe, correct, and timely dispensing to patients. Previously, scanning had been used primarily for robot dispensing, so a robot over-wrap packager was used. However, bar codes were affixed to all products for use in our central pharmacy carousel and for stocking our unit-based cabinets. In expanding the number of bar coded products we wanted to have available, we quickly realized the over-wrap packager was incapable of keeping pace. Additionally, bar coded products not being used in the robot had to be packaged by a bulk package machine that required human interaction with each dose.

We considered using a third party packager, however, with concerns as to shifting volumes in medication use, turn around times, and coordination requirements, we determined this was not our best option. The other alternative was purchasing a high-volume packager.

Given the variety of high-volume packagers on the market, we had to determine our selection criteria. Our requirements included the ability to package a large number and variety of oral solid medications, a footprint that was feasible in our central pharmacy operations, the capacity to provide reliability data and customer references, the ability to put non-standard medications through the system, and compatibility with our robot.
Tips for Using a High Volume Unit Dose Packaging Machine

1. Cleaning and maintenance are extremely important. For the difficult-to-reach chutes within the inner pull-out cabinet, use a flexible dryer vent brush with a washable dust cover, cleaning from the bottom to the top of the chutes.

2. Canisters with “dusty” pills should be placed on the inside and in the middle of the machine. We affix a label onto all of our dusty pill canisters reminding staff to complete a cleaning before refilling. The cleaning should include both the canister and the sensor on the base.

3. Familiarize staff with canister placement and shaker usage. While the installation team will initially place the canisters, the facility subsequently will be responsible for this. Follow these basic rules:
   - If an empty package is followed by a package with two pills, the canister should be lowered and placed in a central location.
   - If a package with two pills is followed by an empty package, move the canister up and out within the machine.

Cost Justification

Though a new bulk packager was initially more expensive than outsourcing, we felt the security of having the process in-house and the ability to customize our packaging volume to efficiently meet demand justified the cost. In addition, cost savings were anticipated over time as we transitioned from purchasing costly, manufactured unit dose products to a process where all unit dose packages were produced on-site. We were able to justify the cost to administration based on a return on investment calculation that took into account cost savings from the purchase of bulk products. For the first year we projected a savings of $93,000, and that year we exceeded our goal—reaching a cost savings of $100,000.

Packager Operations

Prior to purchasing a high volume, unit dose packaging machine, we were packaging approximately 3,500 doses daily using two legacy robot packagers. Since the implementation of the new packager, and including some operational changes, we are now packaging 5,000 doses daily. The new packager has the ability to package three inch and one and a half inch packages, and has an STS (special tablet system) drawer for any drug that does not meet the criteria set by the facility subsequently will be responsible for this. Follow these basic rules:

   • If an empty package is followed by a package with two pills, the canister should be lowered and placed in a central location.
   • If a package with two pills is followed by an empty package, move the canister up and out within the machine.

We began using the packager to replenish only the robot; then, we slowly integrated those medications packaged as unit dose into stock for our carousel inventory system, which supplies our automated dispensing machines, pharmacy satellites, and clinics. The packager has the ability to hold up to 500 canisters, with 316 canisters currently assigned. The pharmacy is no longer buying additional unit dose products for 99.7% of our packager canisters.

Since there is currently no interface between our carousels and the high-volume repackager, we developed a process to identify what oral solids needed to be packaged daily to replenish the carousels. Our carousels were configured to identify the repackager’s products as two separate items—a bulk bottle and a unit dose product. Pars and reorder points are defined and a vendor order is processed to indicate what unit dose product should be packaged for replenishing the carousels. The report is run once or twice a day, and we replenish stock manually using this report. Once the product is packaged, the technician checks both sides of the product for any miss fills or labeling issues. If the technician spots a package without a pill, a crushed pill, more than one pill, or print issues, the bar code is crossed out with a vertical line so the product cannot be scanned by the robot or other scanners.

How the System Works

When there is a request for a new canister to be assigned based on need within the institution, the proper product is assessed and a manufacturer is chosen based on product availability and cost. Once the product line is determined, a new canister is ordered. To manage the implementation of new canisters, we developed a process to ensure the product is entered into all of the databases with its NDC and to train the bar code proactively. The amount of bulk bottles in storage has been reduced as inventory is available and easy to monitor in the carousels. We make a point to maintain sufficient quantities of online and offline inventory in the robot to provide enough time to order bulk bottles of replacement product when needed. We created a custom report that we use daily to determine which medications need to be reordered to replenish the carousels. This report contains a combined par from our robot and carousel. When the par for the medication falls below the minimum, the drug shows up on the report. Bottle size and recommended order is stored in a specific field in the drug database, and this information shows up on the custom report as well, making for a smooth reordering process.

The process for packaging products for the robot requires more lead time than non-robot items, including the time needed to manually add product information to the online inventory. As we wanted to maintain flexibility due to the daily fluctuations in our staffing model, we run a custom, two-day robot repackaging report that forecasts our repackaging needs two days in advance. With this two-day forecast report, we also are able to anticipate those medications that need to be packaged first.

By using a high volume, unit dose packager, we have been able to streamline our workflow with a single system to manage the majority of our tablet packaging. In the past it was always a challenge for staff to determine which method to use in packaging each product. Now, consolidation has allowed packaging
to occur in one machine for most of our products. We were also able to reduce stock levels by only having bulk bottles for the canisters and STS trays. Inventory was reduced for the robot and carousels since bulk product is readily available in a canister that we can package “on-demand.” Bottles of slower moving products no longer have to be ordered in duplicate to allow for packaging two different ways. This saves inventory-carrying costs. Our implementation of a high volume packaging solution has resulted in increased efficiency and safety as well as cost savings.

John S. Clark, PharmD, MS, BCPS, earned a doctor of pharmacy degree from the University of Toledo and a master’s degree from the University of Wisconsin, where he also completed a two-year residency in health-system pharmacy administration. John is a board certified pharmacotherapy specialist. He is the associate director of pharmacy and residency program director at the University of Michigan Hospitals and Health Centers, and clinical assistant professor at the University of Michigan College of Pharmacy.

Kimberly M. Landini, PharmD, graduated from the University of Illinois at Chicago with a doctor of pharmacy degree in 1996. That same year she began her position at the University of Michigan Medical Center as a pharmacist. She was promoted to pharmacy supervisor of the inpatient pediatric pharmacy satellite in 1998. In 2004, she became the pharmacy supervisor of the adult inpatient satellites. Since 2006 she has been the pharmacy manager of the medication use systems where she is responsible for overseeing the central operations of the medication distribution system.

Diane S. Shoemaker, CPhT, has been working at the University of Michigan since 1986. She is a pharmacy technician coordinator who has oversight responsibilities for the University of Michigan’s high-volume packager.