

# Combined Medication-and-Supply Automated Delivery System in an Ambulatory Setting

James A. Jorgenson, RPh, MS, FASHP,\* Tess K. Leiker, CPA,† and Craig C. Herzog, RPh, MBA‡

**Abstract** — *This article describes the implementation and analysis of an automated system for the distribution of medications and supplies in an ambulatory clinic setting. Distribution, charging, and control of medications and supplies provided to ambulatory clinics is an issue that presents numerous problems for hospital pharmacy departments. A combined automated unit to handle both supplies and medications was studied as an alternative to traditional manual systems. Problems with our manual system were identified. A comparative analysis of revenue, medication and supply cost before and after automation is presented. Increases in revenue, decreases in supply cost, and improved medication expense documentation were noted with the automated system.*

**Key Words** — Au: Please list 3 or 4

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The use of automated technology in the health care field continues to increase. Such technology ranges from handheld scanning devices used at the point of care to decentralized automated systems that can store and dispense both medications and supplies. Studies have shown that new technologies have provided health care institutions with benefits such as reductions in medication errors and greater efficiency in the drug delivery process.<sup>1-4</sup> However, the published information relates pri-

marily to the use of automated technology in the inpatient setting. This article will describe one institution's experience with an automated system (*OmniSupplier* with Pharmacy Module, Omnicell, Inc.) for the distribution of medications and supplies in the ambulatory care setting.

## BACKGROUND

The University of Utah Health Sciences Center is a 400-bed academic medical center located in Salt Lake City, Utah. The inpatient facility has annual admissions of approximately

17,000 patients and provides tertiary/quaternary care, including neurology intensive care, bone marrow transplant, neonatal intensive care, and solid organ transplant. The facility also serves as a regional burn care center.

In addition to its inpatient services, the Health Sciences Center has 20 clinics on campus that provide a wide range of services. The clinics provide care to approximately 396,000 patients annually. The clinics are owned and operated by University Hospital and receive medications and supplies from the hospital's pharmacy and materials management departments.

Although the inpatient facility had implemented an automated dispensing system, the clinics depended on a traditional method for storage and delivery of medications and supplies. Each clinic was responsible for its own inventory of medications and supplies, and handwritten requisition and billing systems were used in the clinics. The clinics would send a requisition to pharmacy or materials management when medications or supplies needed to be replaced. After the requested items were sent, the pharmacy or materials management would charge the clinics using a manual interdepartmental billing system. The clinic was then responsible for billing the patient to capture revenue for the Health Sciences Center.

In the clinics, medications were stored in a designated room either on

\*Director of Pharmacy Services, Associate Dean for Clinical Education, University of Utah Hospitals and Clinics, 50 North Medical Drive, Salt Lake City, UT 84132; †Financial Analyst, Department of Pharmacy Services, University of Utah Hospitals and Clinics, 50 North Medical Drive, Salt Lake City, UT 84132; ‡Manager Pharmacy Services, University of Utah Hospitals and Clinics, 50 North Medical Drive, Salt Lake City, UT 84132

**TABLE 1**

Business Plan Components
<b>Patient and clinical objectives</b>
<ul style="list-style-type: none"> <li>• Avoid stock out situation</li> <li>• Creation of complete and accurate patient bills</li> <li>• Improve pricing consistency</li> </ul>
<b>Internal business processes</b>
<ul style="list-style-type: none"> <li>• Establish a single price file for all clinics</li> </ul>
<b>Strategic planning objectives</b>
<ul style="list-style-type: none"> <li>• Development of a system that would fit into overall organization informatics and automation architecture</li> </ul>
<b>Growth objectives</b>
<ul style="list-style-type: none"> <li>• Accommodation of future clinic expansion</li> </ul>
<b>Financial objectives</b>
<ul style="list-style-type: none"> <li>• Capture of lost margin costs</li> </ul>

an open shelf or in a drawer. Supply items were kept on an exchange cart, with the cart replaced on a routine basis.

This longstanding system was a source of frequent problems. Timely ordering and receipt of medications and supplies was a continual issue. There were routine reconciliation problems with requisitions, that is, discrepancies between what was ordered by the clinics and what pharmacy or materials management sent. The system was also labor intensive and had negative effects on inventory, as evidenced by high inventory levels and low inventory turnover. It was not uncommon for dated items to expire on clinic shelves, because stock was not routinely rotated and there was no real inventory control to determine what items had little or no use.

The most critical shortcomings of the existing system were found following a financial analysis of the billing practices of the pharmacy,

**TABLE 2**

Infusion Clinic Medication Stock	
Acetaminophen 325 mg 150/box	Ibuprofen 200 mg, 500/bottle, tab
Alprazolam 0.5 mg tab	Immune Globulin IM 0.2 mL, INJ
Alum/Magn/Simeth 5 oz bottle	Lidocaine 100 mg/5 mL, SYR
Bupivacaine 5 mg/mL 50 mL, MDV	Lidocaine 10 mg/mL, 50 mL, MDV
Calcium Carbonate 500 mg tab	Lorazepam 0.5 mg tab
Dexamethasone 4 mg tab	Lorazepam 1 mg tab
Dexamethasone 4 mg/mL, 1 mL, MDV	Lorazepam 2 mg/mL, INJ
Dextrose 50% 500 mg/mL, 50 mL, SYR	Meperidine 50 mg/mL, INJ
Diazepam 5 mg tab	Metoclopramide 5 mg/mL, 2 mL, vial
Diazepam 5 mg/mL, 2 mL, INJ	Morphine 10 mg/mL, 1mL, INJ
Diphenhydramine 25 mg tab	Morphine 2 mg/mL, 1mL, INJ
Diphenhydramine 50 mg/mL, 1mL, INJ	Morphine 4 mg/mL, 1mL, INJ
Dolasetron 12.5 mg/mL, AMP	Naloxone 0.4 mg/mL, 1mL, AMP
Droperidol 2.5 mg/mL, 2 mL, AMP	Nifedipine 10 mg, cap
Epinephrine 0.1 mg/mL, 10 mL, SYR	Ondansetron 2 mg/mL, 2 mL, INJ
Epoetin Alpha 10,000 units, INJ	Oxydodone/Acet 5/325, tab
Ergocalciferol 500,000 units/mL, AMP	Promethazine 25 mg, INJ
Ergocalciferol 50,000 units, cap	Sod. Bicarb. 1 mEq/mL, 50mL, SYR
Famotidine 10 mg/mL, 2 mL, INJ	Sod. Chloride PF 0.9%. 10 mL, vial
Furosemide 10 mg/mL, 2 mL, Vial	Sod. Chloride 0.9%, 30 mL, vial
Granisetron 1 mg/mL, INJ	Tubing IVIG w/15 micron filter
Granisetron 1 mg, tab	Tubing-Low Adsorbtion
Heparin 1,000 units/mL, 10 mL, vial	Verapamil 2.5 mg/mL, 2 mL, vial
Heparin 100 units/mL, 30 mL, MDV	Filter Set, IVEX-HP, 0.22 micron
Hydrocodone/APAP 5/500 tab	Hydrocodone/APAP 7.5/500 tab

clinics, and other departments. This analysis was prompted, in part, because of concerns within the Health Sciences Center about decreasing reimbursement, decreasing gross margins, and increasing costs associated with patient care.

Conducted by a certified public accountant from pharmacy services, the review analyzed how revenues were being recorded and how costs were allocated between the various departments. It was found that patients were sometimes not being billed for medications and supplies used, and there were discrepancies as to what was being charged for the

same item from clinic to clinic. At times, patients were not being registered in the computer system for their clinic visit, making billing for items used impossible.

In addition, interdepartmental cost transfers were not consistently being performed. This made the operating expenses for pharmacy and materials management appear high, compared with the lower expenses of the departments actually using the items. More importantly, since patients were not being billed, the Health Sciences Center was losing potential revenue and absorbing some of the costs associated with

TABLE 3

Features Required of Automated System
• Secure storage of medications and supplies
• Controlled access
• Inventory tracking
• Usage reports
• Cost transfer and automatic patient billing

TABLE 4

Economic Impact of Automated System Over 11-Month Period
• 7% increase in revenue (\$26,867)
• 20% improvement in expense allocation (\$41,160)
• 26% reduction in supply costs (-\$11,545)

clinic visits. Finally, there was a lack of control over items stocked in the clinics. Medications and supplies could easily be removed and utilized in other clinic or office settings with no documentation.

After reviewing the clinic processes for managing medications and supplies, it was determined that there was the potential to capture revenue, reduce expenses, and improve the operating margin by \$353,000 annually.

Based on these findings, the nurse managers for the ambulatory clinics designated an improvement project for this system as a top priority. The Department of Pharmacy Services and the Materials Management Department at the Health Sciences Center conducted a rapid cycle quality improvement project, centered on a pilot program for implementation of an automated dispensing system in the clinics.

Automation was seen as a viable solution, primarily because automated systems in the inpatient facilities of the Health Sciences Center had been successful. The hospital had employed point-of-care dispensing technology for medications and supplies on all of the nursing units for the past 6 years, utilizing the *Sure-Med* system and the *OmniSupplier* system, both from Omnicell, Inc. In analyzing the 5-year performance with the *Sure-Med* system, the hospi-

tal had been very satisfied with both the operational as well as the financial performance of the systems.

To summarize financial performance, a cost benefit analysis of the inpatient automation was conducted. The benefit-to-cost ratio (B/C), the net present value of investment (B-C), and the return-on-investment ((B-C)/C) were calculated. The cost of the system in present day value was \$1,007,689. The benefit to the system in present day value was \$6,411,023. These figures produced a benefit-to-cost ratio of 6.36, a net present value of \$5,403,366, and a return-on-investment of 5.36. All of these calculations supported the inpatient automation decision and encouraged us to extend this success to ambulatory operations.

**PLANNING FOR AUTOMATION**

The first step taken in the implementation of automation was to form a committee of representatives from departments affected by problems with the existing system and the individuals who would be involved in automating the clinics: clinic managers, computer and technical support services staff, pharmacy services, supply and distribution personnel, and representatives from the manufacturer of the automated system. The committee then developed a business plan to address the goals and objectives of the system (see Table 1).

Based on the Balanced Scorecard,<sup>5</sup> the committee prepared the business plan to include patient and clinical objectives, internal business processes, strategic planning and growth objectives, and financial objectives. The clinics selected had very low gross margins and disproportionately high drug expenses.

In establishing the business plan, specific targets were created for each of the five components identified. For patient and clinical objectives, a system was needed that would help avoid stock “out” situations and resulting delays in patient care. The system would also have to help produce more complete and accurate patient bills to help patients generate “clean” insurance claims for their visits.

In addition, pricing consistency needed to be improved for patients. The internal business processes focused on developing a system that would allow for the establishment of a single price file for all of the clinics. Under the old system, each clinic kept an individual price file, which was extremely difficult to maintain and resulted in a myriad of pricing discrepancies that contributed to reduced financial performance. The strategic planning objectives centered on developing a system that would fit into the organization’s overall enterprise-wide informatics and automation architecture.

The Health Sciences Center was in the process of upgrading the entire informatics system; the clinic operations were a large portion of that project. In terms of growth, the system had to have the capacity to quickly and easily accommodate any future clinic additions. The Center had been pursuing an active program of vertical integration with the addition of a number of clinic operations over the previous 3 years. This continued development had to be considered and consistently supported by any

technology implemented. Finally, after financial review of the medication and supply portion of the clinic operations, it was apparent that there was an opportunity to develop a system that would help capture \$353,000 in lost profit margin.

### SELECTION OF AN AUTOMATED SYSTEM

A number of factors were considered in the selection of an automated system. First, the system had to accommodate both medications and supplies. The Center has a strict "no sample" policy, so only medications that were approved and stocked through the pharmacy needed to be controlled. The number of medications used by the clinics was low, about 30 to 50 items. The medications provided to the infusion clinic are presented in Table 2. Supply use was variable and depended on the type of services offered by the individual clinics. Therefore, the system had to be configured for the needs of each clinic.

Security was also an issue. Although few narcotics were stored in the clinics, medications and supply items needed to be safe from unauthorized use — the system needed to have controlled access, limited only to those authorized to administer medications or use supplies. Problems with ordering and restocking of medications and supplies needed to be solved by the automated system. Therefore, the automated system had to provide inventory tracking and lists of items needed for restock, and generate reports describing usage patterns.

However, the most important feature of the system related to billing. The automated system had to be able to transfer the applicable costs from one department to another for items sent from pharmacy or materials management and also bill patients appropriately for items used.

Although a number of automated systems are available, the success of the current inpatient automated system was considered, and the same vendor was selected to provide an automated system for the clinics.

### SYSTEM IMPLEMENTATION

Based on the initial gross margin analysis of the clinics, the pediatrics clinic and the infusion clinic were selected as sites for the pilot program. Because of space considerations, some remodeling was needed in the pediatrics clinic before the automated system could be installed. This minor construction resulted in an additional expense of \$500. Installation of the automated systems was completed within 90 days.

The pediatric clinic system was configured with a single cell: two-thirds dedicated to pharmacy items and the remaining one-third for supplies. A three-cell configuration was used in the infusion clinic: The first two cells were dedicated to supplies; the third cell used a two-thirds pharmacy and one third supplies set-up.

### SYSTEM OPERATION

The automated systems installed in the pediatric and infusion clinics are combination units that store both supplies and medications. The units are configured to meet the needs of each clinic and have from one to three cells for supplies and anywhere from three to nine drawers for medications. Access to the medications and supplies is restricted by password and user identification codes. When a medication is needed, the patient profile is accessed and the order is recorded in the profile.

An interface with the hospital computer system allows for direct patient billing, eliminating the need for manual billing. For supplies, each item removed is recorded by the automated system to keep an accurate count. Patient charging for bill-

able supply items is also done automatically. A restock list for both medications and supplies is generated on a daily basis. This reduced the number of expired items and the inventory levels kept in the clinics. It also eliminated the need for the clinics to be involved in any ordering or billing activities.

Under the manual system for clinic medication restocking, a pharmacy technician was assigned to fill and process all the clinic medication requisitions daily. With the automated system, this same technician is now able to run restock reports and plan the workday, rather than reacting to the clinic requests.

### OUTCOMES

Overall, the automated system was well accepted by nursing and has resulted in significant economic benefits to the Health Sciences Center. The implementation team met on a biweekly basis to review the pilot program performance. The pilot program ran for 11 months to ensure that there were enough data available to support an accurate decision on the effectiveness of this system.

When the pilot phase was completed, the nurse managers concluded that the automated system met their needs with respect to patient and clinical objectives. Issues with stock outs were resolved. Overall, nursing was pleased with the documentation and billing support provided by the system. The business office was satisfied that this system would allow them to compress all of the clinics into a single price file. The information technology department felt that this system effectively fit into their overall architecture and could be easily expanded to meet future growth needs.

A financial analysis of the automated system was conducted after 11 months of use. A \$26,867 or 7% increase in gross revenue compared

with the same period in the previous year matched for patient visits was realized with the automated system. This was due to the enhanced charge capture provided by the automated system, representing actual revenue to the Health Sciences Center from charges for medications and supplies billed to the patient from the two clinics.

During this same time period, a 20% improvement in drug expense allocation was documented — the result of enhanced transaction documentation of both patient charge and nonpatient charge medications by the automated cost tracking system. Previously, these costs went unreported and resulted in an overstatement of pharmacy drug expenses and an understatement of clinic drug expenses.

On the supply side, an \$11,545 or 26% reduction in costs was observed. This reflects tighter security and enhanced inventory control gained through the use of the automated system. In their analysis, the

nurse managers indicated that they experienced lower inventory levels, more rapid inventory turnovers, and less inventory “shrinkage” with the automated system.

#### SUMMARY

Overall, implementation of an automated system for medications and supplies in an ambulatory care setting has resulted in significant economic benefits. Cost for the pilot program totaled \$18,749 (\$18,249 in system costs plus \$500 for remodeling). The system produced an additional \$26,867 in revenue and reduced expenses by \$11,545 for a combined benefit of \$38,412. This produced a benefit-to-cost ratio of 2.05 and a return-on-investment of 1.05.

Increases in revenue to the Health Science Center were observed as a result of an improved patient billing system and increased pricing consistency. Expense documentation was also improved, allowing for more accurate transfer of costs between departments. The

inventory resupply process has also been streamlined, with automatically generated restock lists accurately reporting what items have been used. Based on balanced scorecard results, we are currently acting to implement the automated system in all of our other clinics.

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