Executive Summary

The Children’s Medical Center (Children’s) pharmacy was able to use Electronic Health Record (EHR) technology with a redesigned medication administration process to save the organization $5.2M over three years and decrease the time for dose availability. Children’s achieved an added bonus by complying with the Environmental Protection Agency’s (EPA) initiative for pharmaceutical waste destruction and becoming the first hospital in its region to meet the EPA’s medication destruction requirements. The pharmacy has a long history of innovation with medication management starting in 1980s. With the implementation and organizational integration of the EHR at Children’s, it was a natural progression for the pharmacy to explore options that improve care delivery and decrease cost.
Background knowledge

Children’s serves the fourth largest metropolitan area in the U.S., and has the highest projected pediatric population growth expected over the next 20 years.

The footprint consists of three locations totaling 200+ acres. The organization serves two full-service inpatient hospitals, licensed for 595 beds (418 operating of which 100 are intensive-care beds), 54 specialty care clinics, and six pediatric primary-care physician offices/medical homes. Over 2,100 medical staff members, as well as day-to-day staff of over 5,000 full-time employees support the various locations.

Children’s EHR implementation was essential to improving the quality of care delivery and patient safety, meeting population growth demands, and complying with continuing complex regulatory requirements.

The history of dose distribution at Children’s started pre-1980 with bulk bottles stored on nursing units, or patient-specific bulk bottles dispensed from the pharmacy. During the evening, nursing staff had access to the pharmacy to dispense patient-specific medications. At that time, the bottles were stored in a medication cabinet with other pharmaceutical agents stored on shelves. In the mid-1980’s, Children’s implemented a unit dose cart fill system with an in-house, pharmacy-developed application: Cart Fill – Delivery. With this system, medications were stored in the cart and delivered to the unit on a daily basis. Each cart had a drawer designated for each patient. Within that drawer, medications were organized to ensure the patient received the appropriate medication and dosage at the right time.

Children’s continued to innovate from 1990 through 2000 with the implementation of a pharmacy application that automated packaging and bar coding of medications, patient-specific syringes and a robot (Zippi) that completed the cart fill and unit dose processes. With this long history of innovation under its belt, the Children’s pharmacy was ready for the next wave of innovation to improve pharmacy distribution with increased efficiencies and benefits to care delivery.

Local Problem Being Addressed and Intended Improvement

Children’s was faced with a large number of medications being returned unused on a daily basis to the pharmacy. Because many of these medications could not be reused, approximately 75 percent of the medications had to be destroyed each day. The financial impact to Children’s was significant. The inefficiency of the process cost the organization approximately $2M per year in product alone and did not account for lost revenue, labor and supply impact.

The medication distribution process was the first area identified for focused improvement efforts. At the time, Children’s distributed medication to nursing units twice daily at 7 a.m. and 7 p.m. All medications were dispensed via Cart Fill except “as needed” medications and controlled substances, which were available from a unit-based automated dispensing cabinet. The cost of the drugs included in the initiative ranged from $0.01 to $45,000 per dose. This process was inefficient because it resulted in events where dosages were delivered to the wrong location on a floor, could not be located at all or
were not received in time, and medications were requested and dispensed again. As such, nursing and pharmacy staff spent an inordinate amount of time searching for medications, requesting replacement medication, etc., leaving Children’s with an abundance of unused medication that had to be returned to the pharmacy and destroyed. There was significant work effort (0.5 FTE on average) required to credit patient accounts for medications that were not administered.

There were approximately 500 to 600 dispensed doses returned to the pharmacy on a daily basis, or 14 to 18 percent of total daily doses dispensed. This problem translated to an average cost of $6,300 per day (or $2M annually) in medications alone. The graph below illustrates the magnitude of the issue and the diversity of discarded medications.

Figure 1

![Discarded Dollar Value by Dosage Form (Daily Average: $6,300)]

<table>
<thead>
<tr>
<th>Dosage Form</th>
<th>Dollars</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion</td>
<td>$4,299</td>
<td>76%</td>
</tr>
<tr>
<td>Suspension</td>
<td>$501</td>
<td>83%</td>
</tr>
<tr>
<td>Solutions</td>
<td>$451</td>
<td>89%</td>
</tr>
<tr>
<td>Other Dosage Forms</td>
<td>$292</td>
<td>94%</td>
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<tr>
<td>Aerosol</td>
<td>$286</td>
<td>99%</td>
</tr>
<tr>
<td>Tab</td>
<td>$44</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Design and Implementation**

A team of pharmacy professionals consisting of directors, managers, imbedded information technologists and front line staff began assessing the drug waste problem. A consultant from the Performance Improvement Department participated in the project as a facilitator and data analyst. The team was expanded to include nurses, health unit coordinators and information technology professionals. Together, the team used Lean Six Sigma / DMAIC (Design, Measure, Analyze, Improve & Control) methodology, focused GE Work-out sessions for specific processes, and the A3 reporting summary.

The team began by studying the cart fill process, which was as follows:

Every day at 7 a.m. and 7 p.m., a Cart Fill medication cart was taken to the nursing floors (first doses of medication for patients were sent by runners on an as-needed basis). Each cart contained a medication drawer for every patient.
Analysis showed preparation time ranged from two to 24 hours and that there were multiple storage areas to maintain: medication drawers, refrigerator, first dose bin, Return to Pharmacy bin, counters and clinicians’ pockets. The control process was less than optimal.

The team also reviewed pharmacy and nursing work effort around the existing process and found there was a large number of missing dose request calls to the pharmacy. Though these calls were needed to ensure patient care, they impacted the efficiency of staff and created potential delays in overall medication administration. The main pharmacy workload exceeded department capacity between 4 a.m. to 6 a.m. and 4 p.m. to 6 p.m. every day. Incoming phone calls peaked at 9 a.m. and 9 p.m., causing spikes in dose preparation. The department’s “non-dose cart duties” consisting of first time doses, narcotics management and consultations spiked from 5 a.m. to 11 a.m. and again from noon to 6 p.m. daily.

Careful analysis of the data showed opportunities to improve medication delivery, decrease waste and save the hospital money. The decision was made to move to a just-in-time distribution process and eliminate the existing 12-hour cart fill process. With the just-in-time system, medications would be delivered every two hours using a mobile rack system with clear hanging bags. To accommodate this change, central pharmacy staffing was augmented with seven additional full-time equivalents (three pharmacists and four pharmacy technicians) and department work schedules were reengineered.

Data analysis did not indicate that a specific department or drug type dominated the returned or discarded doses. However, it did reveal that infusion medications comprised a majority of these returns.

The new just-in-time medication delivery system was designed to improve the process through careful orchestration. The steps are:
1. Three hours prior to scheduled distribution, the medication order in the EHR generates medication labels that include patient identifiers and medication names/doses. This information is also included in a barcode on the label that is scanned by a point of care device.

2. Medications are filled, placed in a clear bag and loaded on racks for delivery to the nursing floors. This improves over the previous system, which lacked sufficient organization. The old process used heavy plastic carts that were difficult to move and maintain, and they often served as a repository for erroneous doses and miscellaneous supplies.

3. Distribution occurs within a 30 minute window every two hours. The EHR creates workflow efficiencies that enable the pharmacy to process orders at this increased frequency.

4. Nurses administer the medications as ordered during the two-hour window as prompted by the EHR work lists and the point of care scanner.

On the three-tier delivery racks, medication “stock” is rotated. Newly-delivered cartfill meds for the next two-hour period are hung on the top tier, the previous 2 hour bags are moved to the middle tier and bulk items and supplies remain on the bottom (third) tier. This process gives nurses access to four hours of medication doses, after which time the unused doses are removed. Bags are color-coded for easy identification and exchange. Bulk medications and supplies have red handles for ease of recognition and are available throughout the hospital stay. First doses continue to be sent when ordered.

How was Health IT Utilized?

Pharmacy Application: Children’s integrated EHR included a pharmacy application, which allowed for seamless implementation of the just-in-time medication process. The EHR’s data capture and analysis capabilities allowed the pharmacy department to create the medication dispensing timeline and monitor its success through real-time reporting.

Medication Labels: Auto-generated medication labels from the pharmacy are a key element of Children’s just-in-time medication delivery process. Each label is barcoded for medication administration and must meet regulatory requirements for patient identification. In addition to medication delivery and administration, the labels also serve as a task list for the pharmacy team to manage work flows.

Standardized Dosing: Standardization of drug concentrations (and available doses) provides an additional layer of patient safety and increases efficiency by enabling pharmacy staff to prepackage standard doses. The EHR enables standardization, which in turn contributes to the success of the abbreviated cart fill time and yields waste reduction benefits.

Automated Dispensing: Health IT is used in the pharmacy department’s automated dispensing process to meet the requirements of a two-hour turnaround time for dispensing efficiently.

Value Derived/Outcomes

By implementing the just-in-time medication process, the organization expected to realize financial benefits through the reduction of wasted medications, as well as nonfinancial results through increased...
access to medications for care delivery, reduced phone disruptions in the Pharmacy Department, fewer medication storage areas on the unit and elimination of medication refrigerators. In addition to the operational improvements, reduced medication preparation and administration time had the potential to positively impact patient care and satisfaction. The project has proven to be successful for Children’s in that the just-in-time process almost immediately resulted in a 90 percent reduction in dispensed dose returns and cost of wasted doses, and a 90 percent reduction in phone calls to the department and trips to the pharmacy by nurses seeking to obtain medications. Figure 3 shows the reduction in waste for the nine-month period following the just-in-time process deployment.

The new process began in April 2010 and Children’s realized an immediate decrease in non-value added tasks that were taking the Pharmacy and Nursing from their primary focus (figure 4). After deployment, Children’s conducted a survey of the nursing department to understand the perceived impacts on the workgroup. Survey results showed that 93 percent of staff reported receiving medications on time and consistently as a result of the change to a two-hour medication distribution. Seventy percent of nurses felt that medications were easier to find, and sixty-four percent felt that patient care had improved with the two-hour cart fill process.

Because of the two-hour distribution process, medications that would have previously required refrigeration under the 12-hour cycle could be stored at room temperature for the shorter interval. As such, maintaining these medications is no longer as labor-intensive for staff. In fact, 92 percent of the nurses surveyed felt that it was easier to have fewer refrigerated medications.
Children’s has experienced an unintended benefit from the two-hour medication distribution process. The EPA Clean Water Act of 2008 focuses on unused or expired pharmaceutical discharges to municipal wastewater treatment plants from hospitals, long-term care facilities and veterinarians. With the previous process (and associated amount of discarded medication), Children’s was considered a large quantity generator of pharmaceutical waste. However, with the new medication distribution process, Children’s federal waste generation status has changed to a small quantity generator. As a result, Children’s became the first hospital in its region to meet EPA requirements, which decreases the cost of disposal.

**Lessons Learned**

**Support your position with data:** The Pharmacy Department learned the power of data and constant, consistent communication. Pharmacy team members reviewed the information, understood the gaps identified, and took action to address the problem.

**Staff to demand:** The new procedure required work schedules to change in the pharmacy so that staffing levels were appropriate for the periods of higher demand. When pharmacy team members saw the facts and understood the potential benefits, they were supportive of changing their schedules to meet the organization’s needs and to provide better patient care delivery. Without good information, schedule changes could have been less palatable for staff and could have impacted the success of the project.

**Show your results:** The immediate savings and success was directly attributable to the staff embracing the requested changes. Once the changes were deployed, benefits were immediate—and the organization shared the information with the team so they could see the results (figure 5).

**Figure 5**

![Medication Waste-Actual Dollars](image)

**Financial Considerations**

The primary financial consideration for the project was to ensure a solid return of benefits. The initial project cost was approximately $1.8M over three years with a medication waste savings estimate of approximately $5.2M, according to data used to present the business case to executive leadership. The data indicated that additional staff would be required to meet a two hour turn-around time for
medication dispensing. In all, seven additional staff members were needed to meet the requirements of the new process, resulting in a cost of nearly $1.5M with increasing savings for subsequent years. Costs of the project and labor were quickly offset by the savings Children’s realized from reduced medication waste: a positive return on investment was achieved in just 3 1/2 months (Table 1).

In this case, the hard benefits were significant and are presented in Table 1 below.

Table 1

<table>
<thead>
<tr>
<th>Expenses</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries / Benefits</td>
<td>$543,753</td>
<td>$560,061</td>
<td>$576,742</td>
<td>$1,680,556</td>
</tr>
<tr>
<td>Consulting Fees</td>
<td>$20,000</td>
<td></td>
<td></td>
<td>$20,000</td>
</tr>
<tr>
<td>Equipment</td>
<td>$28,109</td>
<td>$23,100</td>
<td>$24,255</td>
<td>$75,464</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$591,862</strong></td>
<td><strong>$583,161</strong></td>
<td><strong>$600,997</strong></td>
<td><strong>$1,776,020</strong></td>
</tr>
<tr>
<td>Waste Reduction Savings</td>
<td>$2,083,382</td>
<td>$2,312,554</td>
<td>$2,566,935</td>
<td>$6,962,872</td>
</tr>
<tr>
<td>Net Savings</td>
<td>$1,491,520</td>
<td>$1,729,393</td>
<td>$1,965,938</td>
<td>$5,186,852</td>
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</tbody>
</table>

Soft benefits associated with this effort included but are not limited to:

- 90 percent reduction in dispensed dose returns and cost of wasted doses
- 70 percent of nurses felt medications were easier to find with the two-hour cart fill process
- 64 percent of nurses believed patient care had improved with the new process
- 93 percent of staff reported receipt of medications on time and consistently as a result of the change to two-hour medication distribution
- Fewer calls to the pharmacy promoted efficiency as a result of fewer related tasks
- 90 percent reduction in telephone calls and trips to the pharmacy by nurses needing medications