Keeping Our Smart Pumps “Smart”

Submitted by: Susan Skledar, R.Ph., M.P.H., FASHP, Associate Professor, Pharmacy and Therapeutics, University of Pittsburgh School of Pharmacy, University of Pittsburgh Medical Center, 200 Lothrop Street, Pittsburgh, PA 15213, (412) 647-6424, skledarsj@upmc.edu

Cynthia Niccolai, Pharm.D., Clinical Pharmacist, Drug Use and Disease Management Program, University of Pittsburgh Medical Center

Primary Intended Outcome
1. Develop a multidisciplinary smart pump continuous quality improvement (CQI) program.
2. Sustain or increase library Guardrail® (GDR) compliance rates.
3. Reduce clinically insignificant GDR alerts and end-user alert fatigue.
4. Reduce IV medication administration errors.

Relevant PPMI Recommendation(s)
B24. Every pharmacy department should:
   
   B24k: Identify problem-prone and high-risk therapies using pre-established criteria.

C2. The following technology solutions in hospitals and health systems are important enablers in the development of optimal pharmacy practice models:
   
   C2m. Integration of intelligent infusion devices into a closed loop medication-use process (i.e., CPOE-eMAR-BCMA).

Situation Analysis
In 2007, we implemented smart-pump technology to assist in standardizing IV medication admixtures, dosing regimens, and administration guidelines. This technology, supported by a customizable drug library, is designed to generate GDR alerts when a nurse programs an infusion outside preset drug administration safety limits. CQI software is part of this technology, allowing for ongoing analysis of GDR compliance, alerts generated during programming, and nurse responses. CQI data is key to understanding the system-wide use of the smart-pumps and their impact on safety.

Post-implementation, we were committed to developing a program encompassing the retrieval and interpretation of CQI data, system-wide dissemination of information, and translation of findings into meaningful GDR library revisions. Our goal was to assist with the continued growth and success of the smart-pump program demonstrated by sustained or increased GDR compliance.
rates and reduction of clinically insignificant GDR alerts and, most importantly, IV medication administration errors.

Service Description
In January 2010, we initiated a smart-pump CQI program across 15 inpatient sites and multiple outpatient cancer clinics. Data retrieval, analytics, and report preparation were the responsibility of a team of two pharmacists and a data analyst pharmacy technician. Quality indicator metrics included aggregate GDR compliance, top 25 drugs ranked by alert frequency, drugs with an alert override rate of greater than or equal to 90%, alert rates by infusion type and selected programming parameters, and nurse responses to alerts.

Findings are posted quarterly to an interdisciplinary website along with recommended library revisions, which provides an opportunity for system-wide discussion and consensus. This information is a standing agenda item for our Safe Medication Practices Subcommittee, Pharmacy & Therapeutics Committee, and Total Quality and Patient Safety Council.

Key Elements for Success
1. Wireless technology
2. System-wide interdisciplinary participation and collaboration
3. Ongoing nursing education on pump programming processes that result in optimal infusion safety
4. A focus on the “big picture” of data patterns

Resource Utilization
Personnel: One clinical pharmacist FTE to create reports and interpret results, one pharmacy technician to extract data from system-wide CQI database, one infusion advanced practice nurse to assist nurse educators system-wide, and biomedical engineering resources.

IT and other infrastructure: Pump CPUs, pump infusion modules, dedicated server, facility-specific wireless capability, and software for building the drug library and for CQI data analysis.

Supply Expense: N/A. Each hospital has its own budget for this. Budgeting includes pump hardware, software, disposables (tubing, etc), and maintenance contract.

Return on Investment: Drug library updates released into the pump in January 2010, November 2010, and May 2011, successfully reduced the rate of clinically insignificant alerts by 20 percent, 27 percent, and 10 percent, respectively. Of the original top 25 drugs generating alerts, only four remained as of June 2010. Compared to 2007, pump-related errors decreased 27 percent in 2008 and 43% in 2009. Alerts due to infusion programming outside of GDR library limits prompted nurses to reprogram or cancel infusions an average of 400 times per month, potentially averting IV medication events. As a specific example, the addition of a hard GDR limit for fontanel infusion rate pre-empted 193 potentially harmful infusion errors from January through June 2010.

Recognized Intangible Benefits
1. Nurses and pharmacists throughout the system collaborate for the shared purpose of reducing IV medication infusion adverse drug events.
2. Pharmacist-led educational services
   Improved nurses’ understanding of correct infusion programming and the inherent dangers of programming work-arounds.

3. Nurses trust pharmacists as a primary resource for pump programming issues encountered at the bedside.

4. Smart-pump clinical pharmacists are routinely consulted in the root-cause analysis of infusion errors.

**Outcome Measures**

1. To date, we have released four GDR library updates, including 607 revisions derived from CQI data, event reports, and site-specific requests.

2. GDR compliance increased from 78 percent (first quarter, 2011) to 80 percent (third quarter, 2011), resulting in an additional 41,000 infusions programmed using the GDR’s library system-wide in the third quarter.

3. Comparing the first quarter of 2011 to the third quarter of 2011, GDR alerts, nurse alert override rate, and nurse reprogram rate decreased by 22 percent, 27 percent, and 12 percent, respectively.

**Lessons Learned**

1. Pump data is objective evidence of practice for administering IV medications and illustrates how nurses infuse medications including the use of the GDR library. It also illustrates their bedside decisions in responding to generated alerts (override alert versus reprogram infusion).

2. A high number of overrides for a library entry may indicate that the GDR library settings are either too conservative or do not match actual practice.

3. Understanding how nurses program the pump greatly assists the pharmacist when setting the GDR limits as he or she builds the drug library.

4. The individual responsible for building the library and analyzing CQI data should have access to an actual smart pump to recreate nursing programming processes.

**Other Considerations**

Wireless technology is essential to successful smart pump implementation. It enables quick updates to the drug library and management of changes in drug availability, new literature recommendations, and safety warnings in real time.

Each hospital in the health system has a different culture. It was necessary to understand and work within the structure of each culture to achieve positive results.

**Suggestions for Other Hospitals/Health Systems**

Make the investment in site experts who know how to drill down into the CQI data, identify patterns, and develop potential resolutions.

Select your outcome measures as you start. Focus on GDR compliance and continue to delve into IV infusion adverse event and medication errors that occur to see how the pump could potentially prevent those events.
Set up ways to communicate data to each facility as well as to different groups within a facility such as nursing, medical, and pharmacy staff, and safety leaders.

Understand pump technology and keep it updated. Learn to understand nursing workflow as to how the pumps are used in daily practice, and design pump settings to catch the most common programming errors.

Helpful References