

Modern Healthcare

THE ONLY HEALTHCARE BUSINESS NEWS WEEKLY

JULY 5, 2010

Case Study: OhioHealth

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The problem: Most patients in an emergency room or hospital receive intravenous fluids or medications. It's a common clinical activity, but not without perils. About 61% of potential adverse drug events are IV-related (vs. medications by mouth or another route). Unlike pills taken by mouth, a tenfold or one hundredfold error can go unnoticed through human error. Errors can endanger patients and damage staff morale.

The technology: Between 2007 and 2009, OhioHealth implemented information technology to decrease IV medication errors. The software protects against harm during infusion delivery through a robust drug and fluid library and technology to control the infusion rate. OhioHealth clinicians now have advanced technology to assist in giving "the right drug at the right dose".

The product features best practices with infusion therapy as follows:

- Best practice limits for drugs to alert the nurse to override a "soft" limit or reprogram ("hard" limit).
- Standardized medication concentrations.
- Clinician notification when a dose exceeds a certain limit with flexibility for individual patients.

- Programmed fluid infusion rate limits.

- Customized messages (e.g., "medication requires a filter, monitor patient closely for signs of reaction, follow chemotherapy precautions").

The technology solution is especially helpful with IV antibiotics, chemotherapy, fluid bolus and patient-controlled analgesia. OhioHealth has implemented an additional module at one hospital to measure breathing parameters for care of patients with respiratory problems.

The software provides advanced analytics to measure the effect of best practices. Reports show the total number of alerts by time of day, filtered by various criteria including pump type, alert type, date, time of day, etc. Data is used to drive training initiatives, improve processes and change parameters of the data set for continual improvement.

The project: Standard project management methodology was used. The vendor supplied technical and clinical resources to guide the OhioHealth multidisciplinary team. Key milestones included agreement on a customized IV medication data set, installation of hardware and software, testing, end-user education, role clarification and phased activation at five

hospitals. The project enhances across hospitals through centralized and speedy implementation of best practices. Cost of the pumps is expensed as an operating lease in the amount of \$144,000 per month for all five hospitals. Hundreds of hours of employee time were part of the investment as well as funding for a full-time pharmacist for two years for benefit realization.

The results

Results relate to measurement of four key performance indicators.

Adverse drug events: Results for adverse drug events prevented between Aug. 1, 2009, and Jan. 31, 2010, were reported to the board of trustees. The report describes how real-life human errors were "re-programmed" using the software technology to prevent overdoses of medications. The mathematics to calculate return on investment was based on three components:

- Reprogramming events.
- Events where the entered amount was at least 2½ times the "soft" limit.
- High-risk drug events likely to cause harm based on inherent risk (e.g., chemotherapy, narcotics, sedatives, insulin and heparin).

During the measurement period, 261 severe potential adverse drug

events were prevented by use of the smart pump technology. Using an average cost of adverse drug events from the Institute of Medicine in July 2006 of \$8750 per event, a total of \$2,283,750 was saved.

Patient controlled analgesia: Patient controlled analgesia, or PCA, errors represent a fourfold higher risk than other reported medication errors due to the nature of the drugs. Internal investigation showed that programming errors with PCA pumps were most often related to the wrong concentration. Changes implemented include:

- Adoption of systemwide PCA physician orders.
- One standard concentration for PCA syringes (fitted into the smart pumps).
- New guidelines for respiratory assessments and frequency of monitoring.
- A two-tiered approach for use of the drug Narcan.

Computer-based learning modules were developed and the electronic nursing documentation system was updated to align with the new requirements. Since implementing the new standards, Ohio-

Health has experienced zero PCA programming errors reported based on the nationally accepted severity ranking.

End tidal carbon dioxide monitoring: An additional smart pump module noninvasively measures several respiratory parameters to produce a waveform. The technology monitors breathing, detects “no breath,” measures carbon dioxide (exhaled), detects early hypoventilation, and is not affected by concurrent administration of supplemental oxygen. It is implemented at one hospital. An anecdote tells the story.

“An elderly female patient was admitted postoperatively with a PCA pump and end tidal module in place. ‘No breath’ and low respiratory rate alarms persisted, so the nurse called the surgeon to discontinue the PCA pump and switch to another method for pain control. Initial readings demonstrated that the patient had high retained CO₂, a very slow respiratory rate and ‘no breath’ alarms at 30 seconds. Using smart pumps, an alarm would sound that aroused the patient enough to take a breath when she would fall asleep

and stop breathing. The family was reassured that the nurses, as well as the smart pump technology, were ‘watching over their mother.’”

Infusion pump programming: OhioHealth reports on nonintercepted medication events according to a nationally accepted severity scale. Events are classified from severity “C” through “I” for all errors that actually reached a patient and were not intercepted. The reported data for four OhioHealth hospitals between January 2007 (the baseline) and January 2010 demonstrates that OhioHealth is steadily decreasing its average number of infusion pump programming errors per month from 12 (the starting point) to seven (the latest reported number).

OhioHealth does not plan to apply for economic stimulus funds for this project; however, other information technology projects are included in our plans for “meaningful use” grant monies.

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