Patient Safety Tip of the Week

March 13, 2018 Intercepting Errors

Errors are inevitable. Therefore, a good patient safety system recognizes that errors occur and seeks to identify those errors before they reach the patient. We, of course, already have some interventions that intercept errors and protect patients. Some examples are (1) bedside medication verification systems using barcoding, (2) independent double checks, (3) having a pharmacist and a nurse check the order prescribed by a physician before a drug gets dispensed and administered, (4) clinical decision support systems that create alerts during CPOE (eg. when a dose is higher than the expected range for "usual" doses).

But sometimes even those tools that are designed to intercept errors may fail and a medication may be administered to a patient in error. There is still time, however, in some circumstances to mitigate the effects of that error and spare the patient harm. That is especially likely when the medication is given slowly over a period of time, such as by IV infusion.

So researchers at Cincinnati Children's Hospital Medical Center developed a system for real-time identification of medication administration errors and were able to demonstrate the efficacy of that system in preventing patient harm (Ni 2018). They focused on reconciling 10 high-risk continuous intravenous infusions and medications prescribed to NICU inpatients: total parenteral nutrition (TPN), lipids, intravenous fluids (IVF), insulin, morphine, fentanyl, milrinone, vasopressin, dopamine, and epinephrine.

Previous studies have shown that continuous intravenous infusion has a higher risk and severity of error than other medication administrations. The pediatric population, and especially a NICU population, is ideal for such a system since so many drugs are given based upon patient weight and dosage calculations and therefore are prone to error. In addition, intravenous infusions usually span multiple nursing shifts and involve complex dosage adjustments that are not captured by in-place interventions such as BCMA.

The researchers developed a **"data extractor" module** that extracted data about medications from 4 separate sources (entered medication orders, structured order modifications that adjusted the original doses/rates via CPOE, medication administration records that documented actual doses/rates administered to patients, and free-text orders communicated from physicians to nurses that delivered complex dose/rate adjustments). Then they developed a **"detector" module** that identified discrepancies in doses/rates between MAR's and other data sources. If a discrepancy was identified, the module would trigger a medication administration error (MAE) event with a summary and suggestion. (A 30-minute grace period was allotted for verbal orders to allow for delays in processing these orders.) A **"notifier" module** then sent a message about the suspected

MAE event to the clinician via a secure messaging platform and the clinician would decide whether the event was truly an MAE event.

Among the targeted medications/infusions, epinephrine had the highest MAE rate, followed by TPN, IVF, morphine, and lipid. Five medications had no associated MAEs. The frequency of dose adjustments varied between medications/infusions during patient care. In particular, most adjustments for TPN, lipid, and IVF were delivered via free-text communication from physician to nurse. There was also a moderate positive correlation between error rate and number of dose adjustments.

The automated MAE detection system achieved an overall sensitivity of 85.3% and positive predictive value (PPV) of 78.0%. Sensitivity was >75% across all medications/infusions except lipid and morphine, where one lipid and one morphine MAE each was missed. With adjustments, the system achieved 100% PPV for the majority of the medications/infusions and >75% for those with frequent dose adjustments (epinephrine, TPN, and IVF). However, there was a very high negative correlation between PPV and number of free-text dose adjustments.

The automated system detected 84% of MAE events that represented overdose or underdose, and 100% of MAE events that represented significant overdose.

Chart review of MAE events detected by the automated MAE detection system then helped identify system problems underlying the errors. The 78.0% PPV achieved by the system suggests that for every 10 error notifications, 2 were false positive alarms. This relatively low false positive rate is encouraging in averting alert fatigue.

Overall, the automated system detected 86.7% of clinical errors that reached patients and, importantly, captured all rare but substantial dosing errors. Though the most substantial reductions were realized for long-time intravenous medications/infusions such as TPN and lipid, the system has the potential to reduce harm exposure significantly for all medications via real-time messaging technology.

This is an exciting development that has the potential to help us intercept errors that have occurred before significant harm comes to the patient, thus adding yet an additional layer of defense against patient harm.

Note also that, unlike the dangers we've discussed regarding texting orders, this is an example of the positive potential of text messaging in health care. It is similar to the alerts sent to responsible parties that we've discussed in our numerous columns on alarm management systems.

We look forward to refinements of this system and extrapolation to other patient populations and healthcare settings. Nice work!

References:

Ni Y, Lingren T, Hall ES, et al. Designing and evaluating an automated system for real-time medication administration error detection in a neonatal intensive care unit. Journal of the American Medical Informatics Association 2018; Published: 10 January 2018 https://academic.oup.com/jamia/advance-article/doi/10.1093/jamia/ocx156/4797402

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