



PARTNERSHIP for
HEALTH IT PATIENT SAFETY
a national collaborative

ECRIInstitute
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Partnership Update

January 2019

Data Snapshot: "Smart Pumps" Can't Prevent Infusion Errors Alone

Background

Large volume pumps (LVPs) are infusion pumps designed to deliver large amounts of medication/fluids to a patient through routes such as intravenous (IV). "Smart" LVPs are equipped with dose error reduction systems (DERS). This feature of health information technology (IT) ensures a high accuracy infusion rate and helps prevent an incorrect medication, dose, or flow rate from being administered to a patient.

To ensure infusion parameters are safe for the patient, the system compares the information programmed into the pump against preset limits contained within an integrated drug library for the given medication or fluid and generates an alert when a programmed value is outside of the predetermined limits. These alerts can present as soft limits, which alert that a value is out of limits but the infusion may proceed if deemed to be clinically appropriate by the user. They also can be programmed as hard limits, which alert of potentially harmful parameters and definitively prevent the infusion (ECRI, 2014).

DERS offer many other features. They can aid in the detection of occlusions or air in the IV line. They record and store infusion event detail information, which can be transferred wirelessly over the hospital network for documentation in a patient chart and provide data for patient safety analyses. The data can also be used to adjust the drug library or DERS. The DERS drug library is typically created and maintained within each individual organization based on its formulary and collaboration of multiple stakeholders. These libraries should be regularly updated with new information and can be done so wirelessly. Patient safety experts recommend opting to use pumps equipped with DERS (ECRI, 2014, 2018).

Although smart pumps are becoming more prevalent, they have not eliminated all infusion-related medication errors. One such example surrounding the use of a smart LVP appears below in a de-identified event submitted to ECRI Institute PSO. Examining patient safety events, in particular those reported to PSOs, allows for both the identification of the contributors to these errors and for shared learnings for patient safety efforts.

Case Study Event

A clinician ordered two IV medications: the first potassium chloride (an electrolyte supplement) 10 mEq/100 mL over one hour and the second IV metronidazole (an antibiotic) 500 mg/100 mL over a half hour.

The nurse programmed the first infusion as potassium phosphate (a supplement for low phosphorus) 10 mmol/100 mL over one hour instead of the ordered medication, potassium chloride. This programming triggered a soft alert for dose (i.e., the dose was outside of predetermined limits for that drug but could proceed if deemed clinically appropriate), and a hard stop alert for rate (i.e., the rate was outside of predetermined limits for that drug and potentially dangerous). The soft alert was bypassed but hard stop alert could not be; the drug library contained information regarding risks of infusing potassium phosphate at the programmed rate, such as abnormal heart rhythm, low blood pressure, and confusion. Recorded data in the infusion pump revealed that the same programming was attempted five times, and each time the same alerts fired, with the hard stop alert for rate preventing the infusion. Ultimately the nurse bypassed

the hard stop by programming the infusion as a basic infusion, which does not pass through the drug library, thus defeating the intended purpose of the safety alerts.

The nurse programmed the second infusion as metoclopramide (an anti-nausea and gastric motility drug) 500 mg/100 mL over half an hour, instead of the ordered metronidazole (an antibiotic). This triggered soft alerts for both dose and duration. Recorded data revealed the nurse attempted this programming three times and got the same alerts each time. All alerts were ultimately ignored and the infusion proceeded after the third attempt.

This event highlights areas of concern related to training, effective use of technology, workarounds, and interoperability. What can we learn from this event?

What We Are Learning

In 2012 an estimated 77% of hospitals in the United States had adopted the use of smart pumps—a percentage that continues to rise and correlates with the increased adoption of electronic health records (EHRs), computerized provider order entry (CPOE), and barcode-assisted medication administration (BCMA) (Pedersen et al., 2013).

Early models of smart pumps required manual programming by the operator and did not communicate directly with the EHR. Some newer smart pump products and some EHR products can interface, allowing for bidirectional data exchange, and demonstrate interoperability. Additional smart pump and EHR vendors continue to work towards this, as well. With the use of an interface for bidirectional data exchange, infusion parameters can be transmitted directly from the EHR to the smart pump, bypassing the need for manual programming. Information within the drug library can be readily updated and exchanged. Once an infusion runs, details regarding the infusion are collected, stored, and can then be approved for documentation in the patient chart.

Although smart pumps undoubtedly contribute to safer patient care and have evolved considerably, improvements still need to be made to minimize workarounds and to increase usability by smart pump operators. The need for more formalized training and greater organizational leadership and management is corroborated by findings that nurses more often turn to peers to resolve smart pump issues than they do nursing managers or educators, leading to sharing workarounds to resolve issues instead of discovering and understanding root causes and solutions (Dunford et al., 2017).

Contributing Factors

In the example, the smart pump alerted the nurse that the doses and rates of administration of the medications programmed into the pump were out of limits, but the pump did not alert the nurse that the incorrect medication names had been entered, which was the underlying issue. Given that newer smart pumps have the ability for two-way data exchange between the device and the EHR, such an interface could have alerted the nurse that the medication names entered manually did not match the medication names ordered, or could have automatically loaded the medication details from the EHR into the smart pump, not requiring manual programming at all.

Look-alike/sound-alike issues still occur. The medication names programmed into the pump for this patient event looked very similar to the medications ordered (potassium phosphate versus potassium chloride, metoclopramide versus metronidazole). It is likely the incorrect medications were selected from an alphabetized drop-down menu or from a truncated or abbreviated list. An interface between the EHR and the smart pump might have prevented this error from occurring.

The safety guidance provided by this smart pump was overridden. The operator used a workaround for each of the alerts generated by the DERS. The nurse overrode the hard stop by programming a new infusion type that did not run through the drug library, potentially missing additional alerts. Moreover, the nurse did not attempt to resolve the causes of the soft alerts. Troubleshooting potential causes for the alerts (particularly by consulting with organization-appointed leaders for such issues) might have uncovered that the wrong medication names were programmed and that the soft and hard alerts for dose, rate, and duration were a downstream result of that programming.

Conclusion

Smart pumps alone cannot prevent medication infusion errors despite current capabilities to alert users to incorrect medications, inappropriate doses, and errant flow rates. All eight dimensions of the sociotechnical model for addressing

challenges in health IT (Sittig and Singh, 2010) need to be considered when developing and implementing this technology in order to avoid medication infusion errors, and these dimensions are addressed in the following paragraphs.

Workarounds in health IT increase the chances of patient safety issues arising. Technology cannot improve safety if cautions are ignored. However, interface and interoperability between smart pumps and EHRs decrease opportunities for errors and mitigate patient safety risks, and do so with functional integration of up-to-date drug libraries.

Thus, smart pump technology must be up to date and designed to minimize workarounds. All displays must be clear, and usability should be optimized considering human factors. Users need to be trained to use the technology effectively, adhere to internal organizational policies (such as being mindful of alerts and not bypassing guardrails), and be aware of the consequences of failing to do so. Organizations must establish and enforce appropriate policies and procedures and continuously monitor for potential dangers such as workarounds. Additionally, good communication must exist between providers and between patients and providers. All of these interdependent considerations must be addressed and adopted by smart pump vendors and individual healthcare organizations to ensure the technology is designed for safety, implemented safely, and ultimately improves patient safety.

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Important Announcements

Reminder: 2019 Dates for Upcoming Meetings

The *Partnership for Health IT Patient Safety* gathers stakeholders quarterly. Three of these meetings occur via web conferencing and the fourth is an annual, in-person meeting. We look forward to having you with us on the dates and times and below. We send information on how to join the web meetings via email before each meeting.

Web-based quarterly meetings:

- January 22, 2019, 3 to 4 p.m. ET
- April 23, 2019, 3 to 4 p.m. ET
- July 23, 2019, time to be determined

Annual, in-person meeting:

- September 12, 2019

Partnership News

Invitation to Participate in a Prototype Project for the National Collaborative

The *Partnership* continues to move towards a national collaborative and is launching a prototype project to be completed in 2019. The purpose of this

Expert Advisory Panel

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project is to determine the best way to gather information for prioritizing safety events and shared learning. The project will use a measure endorsed by the National Quality Forum (NQF), the retract-and-reorder measure developed by Dr. Jason Adelman and his team of researchers.

There is still time to get involved in this prototype project. If you would like to participate, please contact us at hit@ecri.org for more information.

Embedding Health IT Into Your Safety Program

At the IHI National Forum on December 9, 2018, ECRI internal *Partnership* team members Robert Giannini and Patricia Giuffrida presented information on embedding health IT into a risk and patient safety program. They discussed ways to identify health IT as patient safety and risk management issue; strategies to develop, implement, and integrate health IT; and safe practice recommendations and implementations.

Hear more about one organization's implementation of a Health IT Safety Program at the upcoming quarterly meeting on January 22, 2019, from 3 to 4 p.m. ET.

Workgroup Updates

2018 workgroup resources, including the EHRA/ECRI Safe Practice Recommendations for Safer Opioid Prescribing whitepaper, evidence-based literature review, and quick implementation guide and the Drug-Allergy Interactions Safe Practice Recommendations toolkit, also with an evidence-based literature review, will be released in early 2019.

ONC is Requesting Comments on the Strategy on Reducing Regulatory and Administrative Burden Relating to the Use of Health IT and EHRs

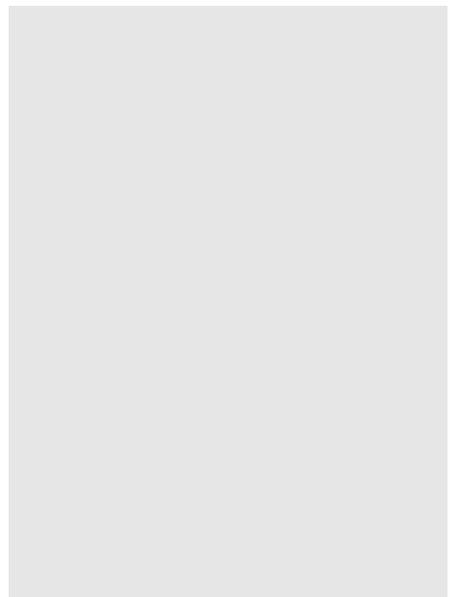
The 21 Century Cures Act, signed into law December 2016, directed the U.S. Department of Health and Human Services (HHS) to produce a goal, strategy, and recommendations for reducing regulatory and administrative burdens relating to the use of health IT and EHRs. A draft of this strategy, released in November 2018, focused on reducing the effort and time required by clinicians to document information in EHRs, reducing the effort and time required for regulatory reporting, and improving the functionality and ease of use of EHRs. Public comments on this strategy have been requested, which can be submitted [here](#) electronically by January 28, 2019.

We Want to Hear from You

Not only is it important to develop safe practices, it is important to implement them. In order to assess and measure their effectiveness we need your help in learning how these practices have enhanced safety within your organization. If your organization/practice has implemented any of the *Partnership's* health IT safe practice recommendations, we would like to hear from you.

What has your experience been? Have you been successful? Did you have difficulty implementing these practices? How did you measure the outcomes? Start the conversation by emailing your responses and questions to

hit@ecri.org.



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Get in Touch with the Partnership

Do you have questions about any of these articles? Get in touch with us today by emailing hit@ecri.org.

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