Case Study

Collaboration Fuels Success of Infusion Management Interoperability Initiative

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Great River Medical Center (GRMC) is a 378-bed regional facility offering acute and intermediate care to residents of southeast Iowa, west-central Illinois, and northeast Missouri. The hospital, which admits more than 6,500 patients and logs more than 190,000 outpatient visits annually, offers comprehensive medical and extensive surgical services.

In 2013, GRMC began a patient safety initiative related to infusion management interoperability. The objective of the initiative, which was identified by senior administration during a transition to a new electronic health record (EHR) vendor, was to improve medication safety and prevent patient harm.

Interoperability provides for pump autoprogramming of the electronic medication order directly into the infusion pump, which reduces the number of manual programming steps and the associated risk of programming error.[1] Interoperability also enables pump autodocumentation, allowing clinical staff to pull accurate infusion rates and volumes in real time into the EHR.[2] It eliminates the need to manually document frequent rate changes for critical patients. This added functionality closes the loop on medication administration safety by helping to ensure "right patient, right medication, right dose, right route, right time, and right documentation." This article describes GRMC's infusion management interoperability initiative, process improvement results, and keys to success.

Interoperability Project Roll Out

The EHR project began in March 2013. An interdisciplinary infusion management safety team was formed; it included staff from pharmacy, biomedical, nursing, education, information systems, and informatics. The team worked collaboratively with its infusion pump system (B. Braun Medical Inc.) and EHR (Cerner) providers to implement improved infusion delivery and workflow processes aimed at achieving infusion pump interoperability and enhancing safety. Concurrent with the roll out of the new EHR, GRMC had several subprojects, including validation that the order sets matched the drug library exactly, implementation of new wireless infusion pumps with reporting software, and education of all clinical staff. Weekly meetings were held by the subgroups. Pulling together these subgroups on a regular basis, in order to compare and confirm processes, was vital to the success of the project.

By April 2014, GRMC went live with infusion pump interoperability across all care units simultaneously. In retrospect, this aggressive facilitywide approach was overly ambitious. Attempting to implement pump autoprogramming and -documentation at a time when staff also were learning a new EHR workflow and undergoing extensive

pharmacy changes was too demanding. The difficulties were compounded by incorrect order sentence issues, connectivity challenges, use errors, and workflow issues. The risk of administering infusions that should have been discontinued is reduced when staff autoprogram pumps because the fluid or medication is identified as being discontinued when initiating the infusion or hanging a new bag. However, unless staff are adequately trained to perform autoprogramming correctly, safety concerns (e.g., under- or overmedicating patients due to incorrect infusion rates) can result.

As a result of these challenges, GRMC halted the facilitywide implementation three days after the go-live date. Then, over the course of the next several months, staff gained familiarity with the new EHR. This period of time also allowed the various disciplines and vendors involved to resolve issues with network connectivity and EHR data integration.

Following this period, pump autoprogramming and -documentation was reintroduced in a phased, unit-to-unit approach, starting with the intensive care unit (ICU) and cardiac care unit (CCU). Compared with other units, the ICU and CCU have the highest volume of high-risk infusions, smaller pools of clinicians to educate, and wider ranges of infusion types. The standard drug delivery protocols that were in place for each unit were maintained for the new process.

Staff received extensive education, with ongoing support and troubleshooting provided by daily rounding. This allowed for early identification and follow-up on any user or workflow issues that arose. For example, inconsistent processes with secondary medications were discovered. Typically, a primary infusion serves as a flush when infusing an intermittent intravenous (IV) piggyback (IVPB). When the IVPB finishes, the pump will automatically switch back to the primary channel with the primary fluid rate. With saline-locked IVs, staff often did not have an order for primary IV fluids for flushing and would run the secondary piggyback as a primary infusion. If they attempted to program the primary as a secondary infusion, autoprogramming errors would result. To resolve these problems, GRMC initiated a protocol to support this workflow and allow nurses to order IV fluids for flushing the IVPB after delivery.

After the initiative was successfully implemented in the ICU and CCU, it was rolled out across other nursing units. By January 2016, the project had been fully implemented and all staff educated. As each unit began using pump autoprogramming functionality, daily rounding was provided by the nursing informatics team with support from unit-based super users. Troubleshooting issues in real time was critical to the ongoing success of the project. Staff needed hands-on help and continual reinforcement to gain the comfort level to ensure that the process became standardized. Reinforcement also occurred through electronic newsletters, team huddles, autoprogramming quick-reference guides, and unit competencies. Rounds were initially performed daily for one month to ensure training consistency, followed by three times a week for an additional month, and then weekly. GRMC continues to conduct weekly rounding and plans to continue this indefinitely. Staff also have been educated that when reporting an issue, they need to provide the patient identification number, the type of medication or fluid, the pump number, and the error message and/or issue that occurred.

Infusion Management Process Improvement

As part of the infusion management improvement project, GRMC upgraded to new wireless smart pumps (Outlook 400ES Safety Infusion Pump System; B. Braun Medical Inc., Bethlehem, PA) with reporting software (DoseTrac Infusion Management Software; B. Braun Medical, Inc.). The software helps the hospital identify drug library workflow issues and modify practice for continual process improvement. Even with initial orders being autoprogrammed into the pump, frequent titrations, bag changes, and workflow issues can affect consistent, safe, and accurate infusion delivery. The software's real-time infusion dashboard and retrospective reports provided information on, for example, drug library and autoprogramming compliance, alert

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trends, and drug dosing practices. The real-time view provided visibility to the current status of all infusions so that drug library use could be monitored by the unit managers and unit clerks, alarms could be managed more efficiently, and therapies infusing outside the dosing limits could be immediately identified and remediated. When it was found that medications and pumps were not associated, the nurse was notified to associate the pump and medication. The infusion management tool also helped to improve pharmacy workflow, as the pharmacy team was able to identify and anticipate infusions nearing completion, improving "just-in-time" refills, and reducing manual rounding to time drips.

During a six-month period, an analysis of GRMC's infusion data was provided by the pump vendor, including a dashboard report on drug library compliance, alerts, and dose corrections compared with national benchmarks.[3] The analysis provided insight into dosing trends, including examples of user programming practices (e.g., bolus dosing by increasing the infusion rate and exiting the drug library to exceed hard maximum limits for therapeutic effect). As a result, a high incidence of drug library limit overrides was identified. This was happening when staff increased the rates over the soft limits set in the pumps. The top infusions contributing to these overrides were identified with specific recommendations to reduce noncredible alerts

Responses -- All Alerts
01/01/2015 - 06/30/2015
Care area = <All>, Location = <All>, Titrations included

Drug	Total Alerts	Corrections	Overrides ▾	Aborts
DOBUTamine	141	1	139	1
Insulin	122	3	116	3
Propofol10mg/ml	99	3	89	7
NORepinephrine	54	1	51	2
Oxytocin	29	2	17	10
TPN / CVN	24	6	17	1
aMIODArone Load	24	4	10	10
Albumin 25%	11	2	6	3
Potassium Cl 20	28	10	5	13
Diltiazem	7	1	4	2
Phenylephrine	3	0	3	0
Sod Bicarb IVF	4	0	3	1
Vasopressin	5	2	2	1
Mag Sulfate OB	3	0	2	1
Fentanyl drip	2	0	2	0
DOPamine	2	0	1	1
Mag Sulfate	2	1	1	0
Midazolam	2	1	1	0
Protonix	4	0	0	4
Insulin Peds	1	0	0	1
Integrilin	4	1	0	3
Potassium Cl	5	0	0	5
Heparin	1	0	0	1
Aminophylline	6	0	0	6
Bivalirudin	3	0	0	3
Totals	**586**	**38**	**469**	**79**

Figure 1. Alert incidence and response to alerts (aborts, overrides, and corrections): Great River Medical Center, January to June 2015. Aborts indicate that following a dosing alert, the clinician changed the drug or delivery mode or put the pump on hold. Overrides indicate that the clinician proceeded with the dose. Corrections indicate that the nurse made an adjustment to the dose. Abbreviations used: CVN, central venous nutrition; TPN, total parenteral nutrition.

and improve drug library compliance. The infusions contributing to 96% of overrides were dobutamine, insulin, propofol, norepinephrine, oxytocin, total parenteral nutrition/central venous nutrition, amiodarone, albumin, and potassium chloride (Figure 1). The staff were not able to override the hard limits, as the pump restricts this action. Therefore, they found a workaround: not using the pump autoprogramming feature. This alternative action was far more dangerous because the safety features of the pump were not being used. For example, this happened frequently during dobutamine stress tests. To resolve the issue, the pharmacy created a separate specific dobutamine order for stress tests that included appropriate dose ranges.

Interventions to reduce overall alert incidence included drug library limit modifications to more closely match actual practice (by comparing to IV pump national averages for use of specific medications), staff education, and real-time auditing. Examples of drug library changes are listed in Table 1. Staff also were provided targeted education on the hazards of high-risk administration practices, such as bolus dosing by increasing the infusion rate with propofol and norepinephrine.

GRMC used the results of the analysis to engage nurse managers and initiate unit-based audits to improve overall drug library and autoprogramming compliance. Unit-based auditing was conducted weekly by Nursing Informatics as part of their scheduled rounding, observing practice to identify any potential barriers. Rounding has continued on a monthly basis. Pharmacy used the real-time dashboard in the reporting software to oversee and conduct safety checks, in order to verify the infusion order and assess compliance with autoprogramming.

Project Results

GRMC achieved considerable success with its infusion management interoperability project. Overall, facilitywide medication scan rates were good (~90%). After educational reinforcement on scanning of IV fluids and secondary infusions, the medication scan rate improved by an additional 3%. Pump association (i.e., associating the pump with the patient and the medication) improved by 65%. Interoperability also resulted in accurate records of medication titration changes and documentation of total volume infused for intake and output records and for charge capture.

Medication safety also improved through the reduction of dose corrections or "good catches" when programming or titrating within the pump drug library. GRMC's incidence of dose corrections was only 1% (38 corrections across 3,586 infusion deliveries). Overall, infusion errors related to not following protocol by using pump autoprogramming decreased from 20 to 10 per year. Because each adverse drug event is estimated to cost $8,750,[4] this 50% reduction in infusion-related medication errors translated to a savings of $87,500. This provided confirmation to GRMC that it had reached its goal of improving patient safety. The project also resulted in improved documentation accuracy for the hospital.

Conclusion

Careful planning and effective collaboration by stakeholders from various disciplines

GRMC used the results of the analysis to engage nurse managers and initiate unit-based audits to improve overall drug library and autoprogramming compliance.

Medication	Drug Library Change
Dobutamine	Added new library entry, "DOBUTamineHVC," with very high maximum limit for stress test use in the heart and vascular center
Insulin	Increased soft maximum limit from 10 to 15 units/h
Norepinephrine	Increased soft maximum limit from 20 to 30 µg/min
Oxytocin	Increased soft maximum limit from 10 to 20 mU/min and increased hard maximum limit from 20 to 500 mU/min to allow for induction and postpartum applications
Albumin 25%	Increased soft maximum limit from 60 to 150 mL/h and increased hard maximum limit from 180 to 200 mL/h

Table 1. Changes in the Great River Medical Center drug library to reduce alert incidence

within GRMC, as well as contributions from GRMC's vendor partners, were vital to the success of this infusion management interoperability initiative, resulting in substantial improvements to medication administration and patient safety. The keys to success of this project (Table 2) included the development of an oversight committee (infusion management safety team), engaging end users and super users throughout the process, establishing metrics to measure success and auditing in real time, treating the project as a long-term safety initiative with ongoing monitoring and maintenance, and working together as a team with mutual goals and accountabilities.

Additional information on GRMC's infusion management initiative is available via a webinar sponsored by the AAMI Foundation's National Coalition for Infusion Therapy

Category	Keys to Success
Project management	Fully integrate hospital, pump, and EHR companies as a team with shared accountability.
	Treat the project as a long-term safety initiative; monitoring and management must be sustained on an ongoing basis.
	Establish targets and audit in real time to address any workflow issues or practice deviations.
	Review all errors and track all costs of the project, including training, rounding, and monitoring.
Interoperability	Conduct a site survey with wireless vendor to assess wireless infrastructure and signal strength and to identify gaps with connectivity.
	Ensure pump firmware is updated to work seamlessly with wireless network.
	Label pumps with MAC address and ensure barcode with serial number is on face of pump for ease of access.
	Consider location of pumps within patient room, brown spots, stacking of pumps, and location of wireless antennae to improve communication.
	Ensure all medication order sentences are tested to avoid autoprogramming errors (e.g., heparin order set up as mg/h versus units/h).
	Have EHR and pump company on site during design and testing phases to address system issues and determine ownership.
Workflow	Address pump workflow or library compliance issues before implementing autoprogramming.
	Anticipate emergency department challenges with intravenous bolus processes and the quick pace of care. Autoprogramming may not be quicker; therefore, provide rationale for improved safety and reduced errors.
	Define intervals for reviewing and signing data into the EHR based on department assessment requirements.
	Turn on the pump while preparing medication to allow for power cycle and network connection and to decrease error messages.
Training and implementation	Engage super users throughout the process (in testing, workflow design, validation, training, and implementation).
	Provide two-hour hands-on training during nurse orientation.
	Provide daily rounding to troubleshoot issues in real time and a hotline for reporting issues.
	Inform staff that process is slower to initiate medication orders until proficiency is achieved; they will need to adjust their workflows, and this change can cause push back.

Table 2. Keys to success of the infusion management interoperability initiative at Great River Medical Center. Abbreviations used: EHR, electronic health record; MAC, media access control.

Safety[5] and a video sponsored by Mission Critical.[6] Great River uses these tools for ongoing staff education and reinforcement for new staff orientation, nurse credentialing, and annual nursing competencies. ■

Resources for Infusion Therapy Safety

The AAMI Foundation's National Coalition for Infusion Therapy Safety offers a variety of educational resources to help you with, for example, new staff orientation, ongoing staff education, and reinforcement for nurse credentialing and annual nursing competencies. The resources can be viewed at **www.aami.org/InfusionSafetySeminars**.

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