كليفلاند كلينك أبوظبي
Cleveland Clinic Abu Dhabi
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4th IVPN SYMPOSIUM
PHARMACY: FROM EVIDENCE TO PRACTICE

Practice Exchange Session
EMR-Infusion Pump Interoperability

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Objectives

At the completion of this activity, you will be able to:

- Interpret root causes and contributing factors in medication errors that occur despite use of a smart infusion pump.
- Given case examples, report which error reduction strategies could be effective to prevent, eliminate, or capture an error.
- Review which error reduction strategies are more likely to prevent an error.

Disclosure

- Presentation: ***Practice Exchange Session; EMR-Infusion Pump Interoperability***

- Given by: Christina Michalek, BS, RPh, FASHP and Rabih Dabliz, PharmD, FISMP

We have no financial relationships to disclose, AND we will not discuss off label use and/or investigational use in our practice exchange session.

Workshop Outline

- Briefly review infusion administration changes over time
- Share your current state with regard to administration of infusions
- Introduce the topic of smart pump interoperability and what it means for medication safety
- Work as a group to identify root causes of infusion-related errors
- Work as a group to identify error-reduction strategies that can prevent or eliminate infusion-related errors

Infusion of Injectable Medications

Evolution

Drips and Drops

Electronic Rate Control

Dose Error Reduction System

Interoperability with Electronic Health Record

Comparison: Without and With a Pump

- Infusions administered **without** assistance of an electronic device
  - Infusions flow based on gravity
  - Mechanical (manual) control of flow rate
- *How is the rate calculated?*
  - Administration set properties (drops per mL)
  - Volume to be delivered over time (mL/hour)

- Infusions administered **with** an electronic infusion device – two modes
- Basic: rate controlled; consistent delivery
- Advanced:
  - Adds dose error reduction system
  - Soft alerts and hard limits
  - Weight-based dose calculations
  - Drives toward standardization
    - Concentrations
    - Dosing units

Discussion Question

Where is your organization in the evolution of infusion pump technology?

Discussion Question

What?
Where?
Metrics?
Library Owner?
Data Analysis?
Vendors?

Interactive Patient Case #1

Doctor M. was a relatively new anesthesiologist at Sunshine Hospital.

As was typical procedure, in preparing his patient Mr. B. for the OR, he inserted an IV cannula and was preparing to start an infusion of normal saline.

Mr. B had a history significant for gout, congestive heart failure, and arthritis.

Dr. M looked for an infusion pump, but could not find one. He asked a colleague for help, and the colleague told him “we don’t use pumps to infuse fluids, we have a small supply of infusion pumps and we reserve them for infusing pressors, but if we are out, we can also run pressors with out a pump.”

Dr. M was less familiar with setting rates by gravity and a review of infusion practices was not included in the orientation he completed prior to starting to practice at Sunshine Hospital.

Dr. M inserted infusion tubing into the 1 L bag, attached the tubing end to the patient’s intravenous access port, and adjusted the gravity flow of fluid using the roller clamp.

Within 20 minutes, the 1 L infusion bag of 0.9% sodium chloride was empty.

Root Causes and Contributing Factors

Can we identify a root cause of this error?

- *Root Cause: the most fundamental reason an event has occurred*

What factors contributed to the patient receiving intravenous fluids too fast?

- *Contributing Factor: an additional reason, not necessarily the most basic reason that an event has occurred*

What Strategies Could Prevent this Error?

Goals

- Prevent errors
- Make errors visible
- Mitigate harm

Safety Hierarchy

- High Level:
  - Automation
  - Implement fail-safes/barriers
- Mid-Level:
  - Standardization
  - Redundancies
- Low-Level:
  - Education
  - Creating a policy/rule

Case Example

- A patient in the post anesthesia care unit became hypotensive and norepinephrine was ordered to start at a rate of 0.2 mcg/kg/min
- The patient was also receiving an infusion of propofol for sedation
- As the nurse was starting the norepinephrine, it was discovered that the pump was set to deliver 30 mL/hour of propofol instead of 30 mcg/kg/min
  - Based on the patient's weight, this error resulted in the patient receiving three times the intended dose of propofol

What factors contributed to this event?

Why didn't the smart pump stop this error?

Infusion Pump Screen

Propofol

Continuous infusion

Rate:	mL/hr
VTBI:	mL
Dose:	mcg/kg/min

Interoperability

- Sometimes referred to as “integration” or “autoprogramming” and “autodocumentation”

- *The extent to which systems and devices can exchange data, and interpret that shared data. (HIMSS)*

- *Technologies that enable the creation of an electronic connection between an infusion pump channel and an electronic medical record (EMR) system. This connection allows the pump channel, the patient, and a medication order to be associated with each other. (ECRI Institute)*

www.ecri.org
www.himss.org/library/interoperability-standards/what-is-interoperability

Interoperability

- “Auto” Programming
  - May also be referred to as smart pump programming or pre-population of infusion parameters
  - Infusion program parameters, such as flow rate, dose, and patient weight, are populated from the EMR to the pump based on a provider order
- “Auto” Documentation
  - May also be referred to as auto-charting and infusion documentation
  - Infusion information, such as intake data, dose/rate changes, and stop time, is sent to the EMR system for clinician confirmation to enable accurate recording of this infusion information to the patient’s record after the infusion is started

Interoperability Workflow

- Associating the Pump, Patient, and Medication Order
  - Order is entered, verified, and medication available for administration
  - Patient, medication, pump channel scan

- Programming
  - Infusion parameters are sent to the pump after the association has been created
  - Parameters are automatically populated and displayed
  - Clinician reviews and confirms and manually initiates medication delivery

    ** *Interoperability workflow eliminates programming steps*

- Documentation
  - Information streams to the pump server
  - Pump server sends information to the patient's EMR
  - Clinician validation required for information to become part of the record

Interactive Patient Case #2

Patient D.B. was ordered a norepinephrine infusion at 4 mcg/minute.

The nurse obtained the medication and began to program the smart infusion pump.

The nurse selected the appropriate library (critical care) and selected norepinephrine from the alphabetical listing.

Three strengths were listed as follows: 16 mg/250 mL; 8 mg/250 mL; 4 mg/250 mL.

The nurse selected 16 mg/250 mL.

The error was detected after repeated titrations had to be made to control the patient's blood pressure.

Root Causes and Contributing Factors

Can we identify a root cause of this error?

- *Root Cause: the most fundamental reason an event has occurred*

What factors contributed to the patient receiving the wrong amount of medication?

- *Contributing Factor: an additional reason, not necessarily the most basic reason that an event has occurred*

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Case Examples

- Patient J.K. presented to the emergency department in atrial fibrillation
- An order to initiate an amiodarone 150 mg IV bolus, followed by a continuous infusion at a rate of 1 mg/minute was entered
- When programming the infusion pump to deliver the bolus dose, the nurse selected aminophylline instead of amiodarone

- Patient M.D. was receiving DOBUTamine 2 mcg/kg/min as an infusion prior to admission via an ambulatory infusion pump
- Upon admission to the hospital, the patient was switched to a hospital-prepared DOBUTamine bag with administration via a hospital-owned smart infusion pump
- When entering the patient's weight into the smart pump, 94 kg was entered; however the patient's actual weight was 49 kg

Case Examples

- A infant undergoing pyeloplasty surgery was ordered fentaNYL interoperatively for pain management
- The infusion was programmed into the smart infusion pump at a dose of 1 mcg/kg/min
- The ordered dose was 1 mcg/kg/hour
- The infant received the entire 200 mcg/20 mL syringe of fentaNYL in 30 minutes instead of over 30 hours
- An independent check had occurred; however, the checking practitioner missed seeing “min” instead of “hr”

- A patient was ordered a heparin infusion at 800 units/hour and 0.9% sodium chloride at 75 mL/hr
- The medications and pumps were prepared; inadvertently the heparin line was set in the pump programmed for saline, and the saline line set in the pump programed for heparin

Planning for Interoperability

- Wireless infrastructure (foundation)
- Human resources (initiation, testing, testing, testing, and beyond go live)
  - Multidisciplinary
- Standardization of communication of medication and fluid orders and nomenclature
  - Align names, concentrations, dosing units, and limits; prescribers will need to follow set standards
  - Ensure all medications/fluids are in pump libraries
  - Evaluate: overfill, dose rounding/truncation (could trigger a mis-match)
  - Consider scope: PCA, epidural, pediatric patients and neonates
- Push compliance with barcode medication administration (BCMA) *(component of interoperability)*
  - Seek out existing barriers to BCMA

Planning for Interoperability

- Evaluate current and future state workflow (go to the Gemba!) and **continue** to observe
  - Environmental assessment of areas
  - Secondary infusions, titrated infusions, bolus dosing (from the bag?), use of “carrier,” “medication lines” (or other unauthorized flush solutions), line flushes, emergency situations, how moving in/out of a patient care area with/without interoperability
  - *Note: at this time, not all infusion pump models are capable of interoperability*

- Set metrics to determine success with interoperability; you will have even *more* data available with interoperability
  - Transparency will increase with interoperability; what is documented may not have been what was done; with interoperability, this will become apparent

- Many have completed interoperability projects; vendors are very helpful

Errors That Can Happen *With* Interoperability

- A patient in the critical care unit had 3% sodium chloride infusing at a rate of 30 mL/hour
- Vancomycin 1 g/250 mL was ordered to be given over 2 hours
- The nurse set up the vancomycin as a secondary infusion to the 3% sodium chloride; however, the bag heights were adjusted
- The 3% sodium chloride infused over 2 hours

- A patient in the critical care ward had insulin and dextrose 10% each infusing through separate lines in smart infusion pumps
- The nurse used the hold (not pause) function to stop the dextrose infusion in order to draw blood to run laboratory studies
- After drawing the blood samples, the nurse reconnected the dextrose line, but forgot to push restart
- When the next blood glucose was checked, it was 50 mg/dL

Interactive Case #3

Patient A.F. was well known to Happy Hospital as he had multiple comorbidities which required regular treatment.

He was admitted on Tuesday complaining of weakness and leg pain.

A heparin infusion was started for a diagnosed deep vein thrombosis.

A.F. had an existing central line that needed replacement; the heparin was stopped for the procedure.

During the procedure, A.F. started to destabilize and required a fluid bolus.

Multiple staff came to the treatment room to assist in the care of A.F. who was quickly decompensating; medical equipment including the resuscitation cart was positioned around the patient.

Infusion pump interoperability was in use; the patient and saline infusion were scanned; however, the pump channel for the heparin was scanned instead of the channel meant for the saline.

The heparin began to infuse at 999 mL/hr, the rate intended for the sodium chloride bolus.

Root Causes and Contributing Factors

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Recap

- Infusion pumps are in improvement over gravity flow for the administration of medication, intravenous fluid, and parenteral nutrition

- Smart infusion pumps with DERS improve safe administration of medication, intravenous fluids, and parenteral nutrition by:
  - Supporting standardization
  - Directing appropriate medication administration based on care area
  - Providing error reduction support through programmed soft limits and hard stops

- Integration of infusion pumps with EMRs further improves administration of medication, intravenous fluids, and parenteral nutrition by:
  - Streamlining programming and eliminating wrong manual smart pump programming entries

Key Take Action Points

- Maximize use smart pump with DERS for medication administration (goal: compliance 95% or greater).
- Plan for interoperability (a high-level error reduction strategy) to eliminate infusion programming errors that continue to happen despite use of smart pumps with DERS.
- Continually monitor data from smart infusion devices in order to improve practice (e.g., alerts, top drugs, overrides, reprograms, alarms).
- Regularly go to the Gemba! And engaged staff in discussions.

Additional Literature/References

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Thank You