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Educating the Healthcare Community About Safe Medication Practices

Microlearning—Bringing bite-sized heparin education to nursing units

The job-related expectations of nurses have become greater than ever. When it comes to medication safety, there is a vast amount of information that nurses must process to be proficient in their job. A medication safety team at PeaceHealth St. Joseph Medical Center, a 251-bed Level II trauma center in the North Sound region of Washington, understood this challenge and recognized that there was an upsurge in administration errors related to intravenous (IV) heparin infusions.

Heparin is a high-alert medication with a heightened risk of causing significant patient harm when used in error, so details of the events were shared and discussed with the full interdisciplinary medication safety committee. During this discussion, they noted that their heparin protocol was multi-faceted with several moving parts (e.g., collaboration with other disciplines such as pharmacy, phlebotomy, and laboratory) with just-in-time dosing adjustments often being required to maintain therapeutic effect. Through error report analysis and nursing staff feedback, the committee also discovered there was an educational gap around heparin administration and monitoring, particularly when it came to smart pump programming. The organization identified there could be a better, more innovative, and engaging way for nurses to enhance learning and knowledge as opposed to traditional approaches.

We know that when organizations simply educate practitioners about how to achieve better outcomes within poorly designed systems, they are bound to be unsuccessful. However, this organization had systems and processes in place to prevent heparin errors (e.g., order sets, standardized nurse-driven protocols, smart infusion pumps with dose error-reduction systems [DERS]), but still found that there was a lack of targeted education about the specific type of heparin errors that had occurred and no guidance was given on how to prevent them from happening again. The team discussed different methods to use, while being sensitive to the usual demands of nursing care and the lack of time nurses had for a lengthy training session. Ultimately, they decided to provide additional heparin education on their nursing units by utilizing microlearning sessions.

Understanding microlearning

Microlearning provides learners with an engaging and less time-consuming bite-sized approach to increase knowledge. The idea is to deliver short bursts of content for learners to digest. It can be provided in different formats (e.g., simulation, videos, audio, games) (www.ismp.org/ext/1279). As an example, St. James Hospital in Dublin, Ireland, provides prescribers with bite-sized weekly, medication safety messages, known as *The Medication Safety Minute* (www.ismp.org/ext/1280), which take just one minute to read. Now used by several hospitals in Ireland, shared with undergraduate and postgraduate students at local colleges in Ireland, and shared on social media, this microlearning format has been well received with widespread positive feedback.

Implementing microlearning

The medication safety committee at PeaceHealth consulted with the acute care clinical education team, and with the help of a graduate nursing student, they created innovative microlearning content referred to as, "Have you heard about heparin?" The format included heparin-related case studies along with hands-on interaction with equipment and supplies (e.g., computer with a medication administration record [MAR] test domain, test smart pump, infusion connected to tubing) for simulation. Simulation is an evidence-based teaching method that can help facilitate the

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what's in a Name?

The "-curium/-curonium" stem name

Medications with the suffix "-curium/-curonium" belong to a class of drugs called non-depolarizing neuromuscular blocking agents. These medications competitively block acetylcholine, a neurotransmitter of the peripheral nervous system, from binding to receptors on motor endplates of muscle fibers. By preventing the transmission of electric signals between neurons and muscle fibers, this inhibits the contraction of muscles. Neuromuscular blockers are used to facilitate airway management (i.e., endotracheal intubations, mechanical ventilation) in adult and pediatric patients during procedures or emergent situations by relaxing the airways to prevent injury and improve ventilation.

There are currently four non-depolarizing neuromuscular blockers approved by the US Food and Drug Administration (FDA) (**Table 1**). All are available as intravenous (IV) solutions that may be given as a bolus or continuous infusion. The decision of which neuromuscular blocker to use may be based on onset of action and duration. For example, agents with a quicker onset of action and shorter duration of effect may be preferred for rapid sequence intubation and other short procedures, while agents with a slower onset of action and longer duration of effect are ideal for longer procedures and mechanical ventilation.

Table 1. List of non-depolarizing neuromuscular blockers in the United States.

Generic name	Brand name
atracurium	NA
cisatracurium	NA
rocuronium	NA
vecuronium	NA

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learning of important safety and quality aspects of patient care by replicating a process or system in a safe environment to gain insight (www.ismp.org/node/75988).

The educators hosted "drop-in" sessions on four acute care units. For accessibility and convenience, the sessions were held in a central location (e.g., nurses' station) as well as roving on the units, which allowed bedside nurses to stop by and interact with educational materials as time allowed. Materials were designed to take about five to ten minutes for the nurses to review and practice. Attendance was captured and highly encouraged by leadership.

Microlearning included a review of organization-specific resources:

- Medication administration policy
- Heparin deep vein thrombosis (DVT)/pulmonary embolism (PE) high-dose weight-based infusion partial thromboplastin time (PTT) monitoring protocol
- Heparin cardiac low-dose weight-based infusion PTT monitoring protocol

Case studies included the following:

- Using the appropriate weight-based heparin protocol with pump programming (obtain weight from test patient's MAR)
- Delivering a rate change per the protocol
- Demonstration of an independent double check with a second nurse
- Describing unexpected outcomes for patients on heparin and follow up actions

During the simulation, individual nurses were coached on reviewing the MAR, laboratory results, patient weight, and how to program heparin infusions into the smart pump using DERS. Here are examples of case studies based on the organization's internal heparin protocol that were used for microlearning.

You just came on shift and received report from the off-going nurse. Your patient was admitted two days ago with a non-operative fracture of his left femur. His pain has been uncontrolled and he declined to be assisted out of bed or use a sequential compression device. He has complained of left calf tenderness and swelling. His skin is warm. The off-going nurse obtained an order for an ultrasound that confirmed a left leg DVT. The physician was notified and ordered the heparin DVT/PE high-dose weight-based infusion PTT monitoring protocol. Baseline labs were drawn and a baseline weight was obtained. The pharmacist input orders for an initial bolus and continuous infusion based on the most current weight. You administer the heparin bolus and start the infusion at 1945.

1) Based on the protocol, what weight will you input into the pump? The nurse should check the patient's weight and pharmacist's order in the electronic health record (EHR). *89 kg is the most recent weight for this patient. Confirm that this is the weight the pharmacist used for the orders. Call the pharmacist if you need clarification.*
2) What heparin bolus dose do you anticipate administering? *80 units/kg, IV, once with a max of 10,000 units. The pharmacist may take into account additional factors (such as baseline PTT) and adjust the order accordingly.* The nurse should practice programming this in the pump using DERS.
3) What initial continuous infusion dose do you anticipate? *18 units/kg/hour. The pharmacist may take into account additional factors and adjust the order accordingly.* The nurse should practice programming this in the pump using DERS.
4) What labs do you need to order? What time should they be drawn? *PTT is timed 6 hours after the continuous infusion is started. This will be at 0145.*

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Because neuromuscular blockers do not provide pain control or sedation, analgesic and sedative agents should be administered before and during the use of these agents. Ventilator support must be initiated and continued until there is sufficient muscle function and the patient can breathe on their own. Because these agents pose an imminent risk of death or serious harm, the cap or overseal contains the warning "Warning-Paralyzing agent." (Since Federal labeling regulations allow print on the caps or overseal of vials only when there is imminent danger to patients, never administer a drug with such labeling without full understanding of the warning and its implications.) In addition, patients receiving therapy over a period of time should receive appropriate eye care by using a lubricating ointment or eye drops, and ensuring their eyelids are closed to prevent dryness, ulceration, and infection.

Patients on neuromuscular blocking agents must have continuous cardiac and respiratory monitoring and be assessed neurologically based on organizational protocols. The recovery of muscle tone may take longer in patients who are obese, elderly, have renal or hepatic disease, myasthenia gravis, myopathy, other neuromuscular diseases, severe acid/base imbalance, dehydration, or electrolyte imbalance.

Neuromuscular blockers have the potential to induce hypersensitivity reactions, including cross-sensitivity to other neuromuscular blocking agents. Extravasation may also occur and present as local irritation in which case administration should be discontinued and restarted in another vein.

ISMP has categorized these agents as high-alert medications due to many reports of accidental administration of neuromuscular blockers resulting in severe and fatal consequences. Maintaining a heightened awareness of potential risks associated with neuromuscular blockers is important for safe administration, as well as vigilance and adherence to safety protocols such as barcode scanning on selection and

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5) When do you need an independent double check with a second nurse sign-off on heparin? *This is required for all IV administrations of heparin including boluses, initiation of a continuous drip, and rate changes. The nurse should simulate how this is done with a second nurse.*

A patient with a DVT has just been admitted from the emergency department with a heparin drip infusing at 18 units/kg/hour based on a weight of 60 kg. The heparin drip was initiated at 0830. There is an order for the heparin DVT/PE high-dose weight-based infusion PTT monitoring protocol. It is now 1300 and you are evaluating the patient's admission orders. You note that there are no labs ordered until tomorrow.

1) Who should order the next PTT? *You should order the PTT per protocol to ensure it is drawn at the correct time.*

2) When should the next PTT be drawn? *The next PTT should be drawn at 1430, which is 6 hours after the initiation of the drip.*

3) Based on the PTT results from 1430, how should you titrate the heparin drip? *The current infusion rate is subtherapeutic and per the protocol, the patient will require an IV bolus of heparin. For this patient, the bolus will be 3,000 units based on the patient's weight. Increase the heparin drip rate from 18 to 22 units/kg/hour, performing an independent double check and handoff with another nurse. Order the next PTT for 6 hours from the time of titration, which is 2100.*

After each microlearning session, the educators held a debrief to provide the nurse with feedback, review what went well, and discuss what could be improved upon.

Outcomes from microlearning

The educators provided around 50 total hours of simulations over a two-week period for more than 70 nurses. The organization analyzed heparin errors reported through the hospital incident reporting system before and after the microlearning was completed. We want to point out that organizations must be mindful of the limitations of using reporting systems alone to quantify errors. It is important to recognize that "error rates" are grossly inaccurate, because they are only based on voluntary reporting in an environment in which staff may not recognize that an error has occurred, or for a variety of reasons may choose not to report (www.ismp.org/node/67099). Additional metrics could have included pharmacy interventions as process measures or monitoring the use of rescue agents (e.g., vitamin K, platelets). In this organization, nurses were encouraged to report events and coached on how errors would be used for learning to improve systems and processes.

In the two months prior to education, the organization reported 11 errors with heparin infusions, 4 of which were on the acute care units. These were the units that would receive the microlearning. Error types included wrong dose, wrong medication, wrong monitoring, and wrong administration time. In the two months post-microlearning education, staff reported three heparin-related errors. These errors occurred on units where nurses had not received the microlearning sessions; no events were reported on the units where the microlearning occurred. In the third and fourth months post-education, staff reported ten errors with heparin infusions, including two occurrences on the units where nurses had received microlearning education. This uptick in errors farther out from when microlearning occurred is not surprising. New knowledge and skills fade over time, particularly if they have not been repeatedly applied, so individuals may simply forget what they have learned by the time it is needed.

We have previously discussed the limitations of education, including in our July 2020 newsletter, *Education is "predictably disappointing" and should never be relied upon alone to improve safety* (www.ismp.org/node/18998). Although education is prerequisite for a comprehensive error-reduction program, education alone is a weak improvement strategy and is not enough to change behaviors and prevent errors. Instead, numerous high-leverage risk-reduction strategies that improve system

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administration. Further recommendations to mitigate risks such as inadequate labeling or unsafe storage are included in the ISMP ***Targeted Medication Safety Best Practices for Hospitals*** (www.ismp.org/node/160).

what's in a *Name?* is a regular feature highlighting common drug name stems to promote their recognition. With permission, ISMP has borrowed the idea from an outstanding effort that is already underway in the French publication, *Prescrire International*, a journal that provides comprehensive and reliable information about medications that are available in Europe.

SAFETY wire

No, not three lidocaine patches at a time! A prescriber ordered a lidocaine 5% patch for an elderly patient with instructions to "apply 1 patch daily, for 12 hours on and then remove for 12 hours." However, the patient applied three patches daily instead. Rather than following the instructions on the prescription label, the patient followed the "usual dosage" information on the outer package, which states "Apply up to 3 patches. See package insert for complete prescribing information." While the manufacturer was not reported, there are several lidocaine patch products

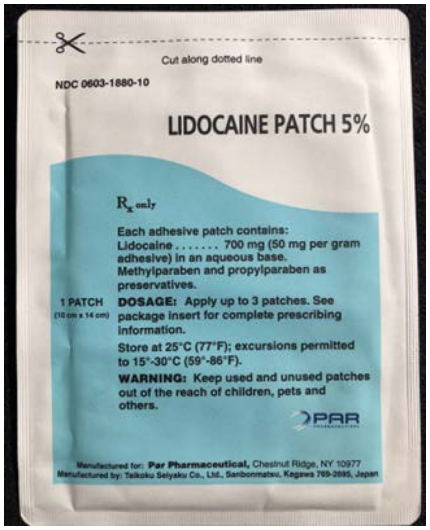


Figure 1. Example of a lidocaine patch with "DOSAGE" instructions that state "Apply up to 3 patches. See package insert for complete prescribing information."

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reliability must be layered, on top of education, to create a more robust safety system. At PeaceHealth additional changes were made in systems and processes including the addition of a pharmacist daily review of heparin orders, with enhanced communication between pharmacy and nursing.

Conclusion

Innovative and user-valued education may have played a role in the decrease in heparin-related errors within this organization. The data also supports the known problem that education may wane after a period of time. We encourage other organizations to develop similar microlearning programs such as case studies with simulation to advance clinical-related competencies when nurses perform essential medication-related tasks. Utilizing this type of microlearning on an ongoing basis can be helpful when introducing new procedures or reeducating staff on infrequently performed tasks.

Educators may consider repeating the simulation with different variables until the learner has become proficient (www.ismp.org/node/75988). Keep in mind that infrequently used knowledge or rarely performed activities require continuous education, rather than a once-and-done educational program. While education is a low-leverage strategy, it is still important, but it must be used to support the implementation of higher-leverage strategies. Bringing microlearning to the bedside can be a useful technique to boost knowledge retention, and when used with simulation, it may help practitioners apply knowledge and reinforce targeted skills.

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Safe drug administration during fasting

Fasting is practiced by several cultures around the world. For example, during Lent, many Christians commit to fasting on Ash Wednesday and Good Friday. During Ramadan, which begins on the evening of March 10 and ends on April 9 this year, Muslims who fast refrain from eating and drinking from dawn until sunset. However, practices may include exemptions from fasting if it is detrimental to one's health (e.g., diabetes, pregnancy, the frail and elderly, children). However, many patients may still choose to fast, which may affect how they take their medications. Thus, healthcare professionals should be prepared to help these patients manage their medication regimens safely while fasting.

Patients must be educated regarding the best time to take any oral medications, particularly if drug absorption can be affected by food intake. Generally, medications that are dosed once or twice daily can be taken before or with the morning meal and/or with or after the evening meal. A physician will need to assess the risk versus benefit of medications that require three or more daily doses and determine the safest administration plan, including possibly switching medications.

Patients with diabetes who choose to fast may need dose modifications. Blood glucose testing should occur throughout the day, and patients should be instructed to break the fast for a blood glucose level less than 70 mg/dL or greater than 300 mg/dL, or for symptoms of hypoglycemia or hyperglycemia. Additional suggestions for managing medications for patients with other health issues can be found at: www.ismp.org/ext/252. Examples of handouts for patients with diabetes fasting during Ramadan can be found at: www.ismp.org/ext/253 (English) and www.ismp.org/ext/254 (Arabic).

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that have similar statements on the label (**Figure 1**, page 3). The organization did not report if there was any patient harm. However, excessive dosing or prolonged exposure to lidocaine patches may lead to lidocaine toxicity, with dose-related adverse effects such as central nervous system excitation and/or depression, as well as bradycardia, hypotension, and cardiovascular collapse.

The lidocaine 5% strength is available only by prescription; therefore, patients should refer to the specific instructions on the prescription label rather than the product's outer package. We have notified the US Food and Drug Administration (FDA) about this concern and recommended removing the dosage instructions from the outer package label. If your organization or pharmacy purchases this product, review the instructions for use and use the teach-back method to ensure the patient understands how to take the medication properly.

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