

## Dangerous Medication Mistakes

### Session Overview

The Emergency Department is a fast-paced environment in which important treatment decisions are sometimes made with limited time. Medication mistakes, particularly those with high-risk drugs, can increase morbidity and mortality. The goal of this talk is to introduce several high-risk medications and provide practical pearls to help avoid common, potentially serious mistakes.

### Objectives

- 1) List the five high-risk medications/medication classes that make up the PINCH acronym.
  - 2) When treating a hyperkalemic patient with insulin, design a dextrose regimen to avoid hypoglycemia.
  - 3) Utilize a low-dose naloxone dosing scheme for opioid overdoses.
  - 4) Convert doses of epinephrine between the various concentration formulations.
  - 5) Identify the two most critical pieces of information needed on syringes labeled in the ED.
- Medication errors are common. One academic medical center evaluated error rates during medical resuscitations and found that 1 out of 2 doses was administered in error. 14% were considered at least moderate in severity. 46% were prescribing errors, 28% administration technique, 14% mislabeling, 10% preparation, and 2% improper doses. ([Gokham R, et al. Resuscitation 2012;83\(4\):482-7.](#))
  - At the University of Maryland we have an acronym to remember the high-risk medications: PINCH. P - Potassium, I - Insulin, N - Narcotics, C - Chemotherapy, H - Heparin.
  - Treating Hyperkalemia with Insulin
    - Insulin remains one of the cornerstones of early severe hyperkalemia management. Insulin works via a complex process to temporarily shift potassium intracellularly. Though insulin certainly lowers plasma potassium concentrations, we often underestimate the hypoglycemic potential of a 10 unit IV insulin dose in this setting.
    - Incidence of hypoglycemia
      - A 10 unit dose of IV regular insulin has an onset of action of about 5-10 minutes, peaks at 25-30 minutes, and lasts 2-3 hours. Herein lies the problem in that IV dextrose only lasts about an hour (at most). Allon et al reported up to 75% of hemodialysis patients with hyperkalemia developed hypoglycemia at 60 minutes after insulin administration ([Kidney Int 1990;38:869-72](#)). A retrospective review of 219 hyperkalemic patients reported an 8.7% incidence of hypoglycemia after insulin treatment ([Schafers S, et al. J Hosp Med 2012;7:239-42](#)). More than half of the hypoglycemic episodes occurred with the commonly used regimen of 10 units of IV insulin with 25 gm of dextrose. A more recent study of 221 end-stage renal disease patients who received insulin for

treatment of hyperkalemia reported a 13% incidence of hypoglycemia ([Apel J, et al. Clin Kidney J 2014;7:248-50](#))

- **Incidence of hypoglycemia appears to be ~10%, but could be higher.**
- Risk factors for developing hypoglycemia
  - The study by Apel et al identified three factors associated with a higher risk of developing hypoglycemia:
    - No prior diagnosis of diabetes [odds ratio (OR) 2.3, 95% confidence interval (CI) 1.0–5.1, P = 0.05]
    - No use of diabetes medication prior to admission [OR 3.6, 95% CI 1.2–10.7, P = 0.02]
    - A lower pretreatment glucose level
      - In mg/dL: mean 104 ± 12 mg/dL vs 162 ± 11 mg/dL, P = 0.04
      - In mmol/L: mean 5.8 ± 0.7 mmol/L vs 9.0 ± 0.6 mmol/L, P = 0.04
  - Renal dysfunction in and of itself may also be a risk factor for developing hypoglycemia. Some evidence suggests that insulin is metabolized by the kidneys to some extent. Furthermore, patients with acute kidney injury (AKI) have clinically relevant changes in insulin metabolism, as evidenced by increased hypoglycemic events and lower insulin requirements upon developing AKI ([Dickerson RN, et al. Nutrition 2011;27:766-72](#)).
- Strategies for avoiding hypoglycemia
  - Preventing hypoglycemia is important. Some clinicians use up to 20 units of IV regular insulin as the hypokalemic effect is dose dependent ([Blumberg A, et al. Am J Med 1988;85:507-12](#)). Here is a suggested strategy for administering enough dextrose to counter the initial insulin bolus of 10 or 20 units. It is loosely based on the Rush University protocol (Apel 2014).
  - <https://www.aliem.com/2015/hyperkalemia-management-preventing-hypoglycemia-from-insulin/>
- Opioids are a frequent cause of litigation in ED cases, particularly hydromorphone
  - Some EDs are becoming 'opioid free,' and instead utilizing acetaminophen, NSAIDs, and even ketamine for acute pain control.
  - Hydromorphone 1 mg IV = Morphine 7 mg IV
    - It seems odd that 10 mg of morphine seems like a lot to us, yet 2 mg of hydromorphone is prescribed with little concern.
    - An appropriate starting dose of morphine is 0.1 mg/kg, assuming normal kidney function and age < 65 years
    - A good strategy is start low, go slow (or consider opioid alternatives)
  - Naloxone
    - We should also use caution when ordering naloxone.
    - Patients typically receive 2 mg in the prehospital setting, a dose much too high for patients chronically taking opioids. This dose will precipitate withdrawal.

- [The important caveat is that with fentanyl (and fentanyl derivatives) mixed with heroin, a high dose of naloxone (up to 10 mg) may be needed)
- A more conservative strategy is to start with 0.04 mg and administer 0.04-0.08 mg increments to achieve the desired respiratory rate ([Kim HK et al. J Med Toxicol 2016;12:107-10.](#))
  - Here is a great trick-of-the-trade for preparing the naloxone to give these smaller doses: <https://www.aliem.com/2014/trick-trade-naloxone-dilution/>
- Heparin is also fraught with errors:  
[http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2006/Dec3\(4\)/Pages/31.aspx](http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2006/Dec3(4)/Pages/31.aspx)
  - Alteplase (tPA), although actually easy to mix (<https://resusreview.com/2013/tpa-mixing-tutorial/>), the high-pressure situations in which it is given lead to dosing errors.
    - Make sure to have dosing sheets available on paper and in EMRs:  
<http://emcrit.org/podcasts/avoiding-resuscitation-medication-errors/>
  - Epinephrine is one of the most problematic medications in the ED with regard to errors
    - The ratio concentration labeling only increases the confusion. And, there are so many sizes/concentrations that may be available in EDs and code carts.
      - Cardiac arrest concentration: **1:10,000** = 1 gm/10,000 mL = 1,000 mg/10,000 mL = **0.1 mg/mL**
      - Pretty-much-everything-else concentration: **1:1,000** = 1 gm/1,000 mL = 1,000 mg/1,000 mL = **1 mg/mL**
      - **Fortunately, the epinephrine ratio labeling was said to be going away in May 2016 (at least in the U.S.)!**
        - <http://empharmd.blogspot.com/2016/01/no-more-epinephrine-ratios.html?q=epinephrine>
        - [https://www.ismp-canada.org/download/safetyBulletins/2016/ISMPCSB2016-02\\_ChangesInExpressionStrength.pdf](https://www.ismp-canada.org/download/safetyBulletins/2016/ISMPCSB2016-02_ChangesInExpressionStrength.pdf)
    - Here are a few ways to reduce errors:
      - Limit the number of epinephrine sizes/concentrations in your ED
      - Consider stocking epinephrine auto injectors for anaphylaxis/asthma
        - <http://empharmd.blogspot.com/2012/10/epinephrine-im-for-anaphylaxis.html>
        - <http://empharmd.blogspot.com/2013/10/epinephrine-auto-injectors-for-in.html>
  - Hydralazine

- Hydralazine is a potent vasodilator. Onset of action: upwards of 20 minutes, peak effects last for 60 minutes, duration of action is unpredictable and can persist for upwards of 8 hours. ([Powers DR, et al. J Emerg Med 1998;16:191-6.](#))
- Bad adverse effects
  - Stimulation of sympathetic nervous system, leading to exacerbation of oxygen consumption in a myocardium as well as an increase in heart rate.
  - Associated with increasing ICP. ([Rhoney DH, et al. Crit Care Clin 2006; 22:221-43.](#)) ([Skinhoj E, et al. Acta Med Scand Suppl 1983; 678:83-7.](#))
  - Latent period of 5-15 minutes followed by progressive and often precipitous BP drop. (Schroeder HA. J Clin Invest 1951;30:672-3.) ([Shepherd AM, et al. Clin Pharmacol Ther 1980;28:804-11.](#))
  - Severe hypotension and complications associated with birth. ([Obstet Gynecol 2011; 118:1465-8.](#)) ([Magee LA, et al. BMJ 2003; 327:955-60.](#))
  - Profound hypotension in critically ill. ([Kane-Gill SL, et al. Crit Care Med 2014;42:2197-203.](#))
- Bottom line: start low, go slow (or consider alternative agents)
- Further reading: <http://empharmd.blogspot.com/2014/10/the-wonders-and-woes-of-parenteral.html?q=hydralazine>
- Syringe labeling in the ED
  - We frequently draw up medications for administration, but most IV meds are clear liquids. How can we tell the difference between a BP med and a neuromuscular blocker? What if a syringe has a dose written on it, but someone gives half and puts the syringe back down? How will the next person know how much is actually in there?
  - The two critical pieces of information that must be on every syringe are: **drug name** and **concentration** ([Kothari D, et al. Br J Anaesth 2013;110\(6\):1056-8.](#))
  - Further reading: <https://www.aliem.com/2015/art-of-syringe-labeling-in-the-ed/>