NCPS
Nebraska Coalition for Patient Safety

# Patient Safety Alert

September 2021

## Mitigating Risks Associated with Administering Potassium and/or Managing Serum Levels

### Situation

There have been multiple adverse events reported to NCPS that have resulted in patients experiencing hyper- and hypokalemia requiring life-saving measures.

- In several instances, lab values were not monitored in a timely manner for patients receiving IV potassium infusions, resulting in critical levels of hyperkalemia.
  - In another instance, potassium was infused faster than is recommended resulting in the patient going into cardiac arrest and requiring resuscitation.
- Several patients with diabetic ketoacidosis (DKA) were treated with IV insulin to manage hyperglycemia, resulting in critical levels of hypokalemia.
- Several patients with hyperkalemia were treated with IV insulin, resulting in critical levels of hypoglycemia.

**Although each event type will be touched upon, this Safety Alert will focus primarily on mitigating risks associated with managing hyperkalemia with IV insulin.**

### Background

- Injectable potassium chloride (or phosphate) concentrate remains one of the top high-alert medications identified by the Institute for Safe Medication Practices.[1,2,3]
- There are dangerous risks to patient safety when IV potassium is infused too rapidly.[2]
- Treatment of hyperglycemia with IV insulin has been shown to result in hypokalemia.[4,5]
- Clinical manifestations of hyperkalemia include life threatening cardiac dysrhythmias and respiratory depression.[6,7,8]
- Management of hyperkalemia involves shifting potassium from the extracellular to the intracellular space.[9,10]
- Insulin therapy is the most reliable and consistent method of shifting potassium into cells when treating hyperkalemia.[7,10,11]
- When administered IV, the potassium shifting effects of insulin occur within 15 minutes of administration.[6]
- IV insulin and dextrose are frequently used to manage patients with hyperkalemia;[6-13] however, there is no consensus on what is the best and safest way to administer insulin in the treatment of hyperkalemia.[7,8,10,14]

NCPS Nebraska Coalition for Patient Safety

# Patient Safety Alert

September 2021

## Mitigating Risks Associated with Administering Potassium and/or Managing Serum Levels

### Assessment

- Hypoglycemia is a frequent complication after the use of insulin and glucose for managing hyperkalemia.[6-10,12,14]
- According to the American Diabetes Association (ADA), a hypoglycemic episode could be characterized as "an event during which typical symptoms of hypoglycemia are accompanied by a measured plasma glucose concentration ≤ 70 mg/dl."[15]
- Research has revealed there are inconsistencies with monitoring blood glucose levels during and after insulin administration when treating hyperkalemia,[8,9] and that hypoglycemic events can occur for up to 7.5 hours after insulin administration.[16]
- Studies have shown that obtaining a baseline blood glucose measure prior to initiating insulin and dextrose for hyperkalemia can help to identify patients who may be at higher risk of developing hypoglycemia; for instance, those with a lower pretreatment blood glucose level[8,14] and/or those with lower body weight.[8,10]

### Recommendation

- Health care providers need to remain diligent about the risks associated with the administration of potassium.[2]
- Failure mode and effects analysis (FMEA) has been shown to be an effective mechanism for identifying and mitigating risks associated with ordering and administering potassium chloride.[2,17]
- Does your organization have a standardized protocol for management of hyperkalemia that includes weight-based insulin dosing, and concurrent administration of dextrose?[6,8]
- Does your organization have a policy or procedure for monitoring blood glucose before, during and for up to at least 6 hours after insulin administration?[6,13,14]
- Does your organization utilize decision support tools embedded within an electronic prescription and medication administration system to auto-populate with patient demographic data to identify individuals at high risk of hypoglycemia following hyperkalemia treatment?[8]
- Does your organization have a policy or procedure for obtaining a serum potassium before initiating IV insulin therapy in patients with DKA, as recommended by the ADA,[4] for monitoring serum potassium levels during insulin therapy for management of hyperglycemia?[5]

**This Safety Alert is made possible through the committed efforts of NCPS members in reporting patient safety events.**
**Please continue to report patient safety events to NCPS. *We improve safety when we learn together!***

NCPS
Nebraska Coalition for Patient Safety

## References


1. Institute for Safe Medication Practices. (2018). ISMP List of high-alert medications in acute care settings. Available at: https://www.ismp.org/sites/default/files/attachments/2018-10/highAlert2018new-Oct2018-v1.pdf
2. Grissinger, M. (2011). Potassium chloride injection still poses threats to patients. Pharmacy & Therapeutics; 36(5): 241-242. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3138362/
3. Cohen, M. (2001). High-alert medications and patient safety. International Journal for quality in Health Care; 13(4): 339-340.
4. Arora, S., Cheng, D., Wyler, B., Menchine, M. (2012). Prevalence of hypokalemia in ED patients with diabetic ketoacidosis. American Journal of Emergency Medicine; 30: 481–484. Available at: https://www.sciencedirect.com/science/article/pii/S0735675711000118
5. Koscal, L., Weeda, E., Matuskowitz, A., Weant, K. (2021). Intravenous insulin for the management of non-emergent hyperglycemia in the emergency department. American Journal of Emergency Medicine; 45: 335-339.
6. Moussavi, K., Fitter, S., Gabrielson, S.W., Koyfman, A., Long, B. (2019). Management of hyperkalemia with insulin and glucose: Pearls for the emergency clinician. The Journal of Emergency Medicine; 57(1): 36-42. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0736467919302501
7. Harel, Z., Kamel, K. (2016). Optimal dose and method of administration of intravenous insulin in the management of emergency hyperkalemia: A systematic review. PLoS ONE 11(5): e0154963. doi:10.1371/journal.pone.0154963. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0154963
8. Boughton, C., Dixon, D., Goble, E., Burridge, A., Cox, A., et al. (2019). Preventing hypoglycemia following treatment of hyperkalemia in hospitalized patients. Journal of Hospital Medicine; 14: 284-287. Available at: https://cdn.mdedge.com/files/s3fs-public/issues/articles/jhm014050284.pdf
9. McNicholas, B., Pham, M., Carli, K., Chen, C.H., Colobong-Smith, N., et al. (2018). Treatment of hyperkalemia with a low-dose insulin protocol is effective and results in reduced hypoglycemia. Kidney International Reports: 3(2): 328-336. Available at: https://www.sciencedirect.com/science/article/pii/S2468024917304278
10. Schafers, S, Naunheim, R., Vijayan, A., Tobin, G. (2012). Incidence of hypoglycemia following insulin-based acute stabilization of hyperkalemia treatment. Journal of Hospital Medicine; 7(3): 239-242. Available at: https://www.journalofhospitalmedicine.com/jhospmed/article/127536/hypoglycemia-post-hyperkalemia-treatment
11. Li, T., Vijayan, A. (2014). Insulin for the treatment of hyperkalemia: a double-edged sword? Clinical Kidney Journal; 7(3): 239–241. Available at: https://academic.oup.com/ckj/article/7/3/239/427335
12. Tingting, L., Vijayan, A. (2014). Insulin for the treatment of hyperkalemia: A double-edged sword? Clinical Kidney Journal; &: 239-241. Available at: https://academic.oup.com/ckj/article/7/3/239/427335
13. Institute for Safe Medication Practices. (2018). Medication errors during insulin administration for patients with hyperkalemia. Medication Safety Alert; 23(3):1-4. Available at: https://www.ismp.org/resources/medication-errors-during-insulin-administration-patients-hyperkalemia
14. Coca, A., Valencia, A.L., Bustamante, J., Mendiluce, A., Floege, J. (2017) Hypoglycemia following intravenous insulin plus glucose for hyperkalemia in patients with impaired renal function. PLoS ONE 12(2): e0172961. doi:10.1371/journal.pone.0172961. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0172961


**This Safety Alert is made possible through the committed efforts of NCPS members in reporting patient safety events.**

**For NCPS members only. Please do not distribute this resource outside of your organization.**

## References (continued)


15. American Diabetes Association Workgroup on Hypoglycemia. (2005). Defining and reporting hypoglycemia in diabetes. Diabetes Care; 28(5): 1245-1249. Available at: https://care.diabetesjournals.org/content/diacare/28/5/1245.full.pdf
16. Pierce, D., Russell, G., Pirkle, J. (2015). Incidence of hypoglycemia in patients with low eGFR treated with insulin and dextrose for hyperkalemia. Annals of Pharmacotherapy; 49(12): 1322-1326.
17. Esmail, R.,m Cummings, C., Dersch, D., Duchscherer, G., Glowa, J., et al. (2005). Using healthcare failure mode and effect analysis tool to review the proce3ss of ordering and administrating potassium chloride and potassium phosphate. Healthcare Quarterly; 8: 73-80. Available at: https://www.researchgate.net/profile/Greg-Duchscherer/publication/7435698_Using_Healthcare_Failure_Mode_and_Effect_Analysis_Tool_to_Review_the_Process_of_Ordering_and_Administrating_Potassium_Chloride_and_Potassium_Phosphate/links/0a140b94c8d88b4e11ef0b7a/Using-Healthcare-Failure-Mode-and-Effect-Analysis-Tool-to-Review-the-Process-of-Ordering-and-Administrating-Potassium-Chloride-and-Potassium-Phosphate.pdf


## Additional Resources

**From the Institute for Healthcare Improvement**

- Failure modes and effects analysis tool: http://www.ihi.org/resources/Pages/Tools/FailureModesandEffectsAnalysisTool.aspx

**From GoLeanSixSigma.com**

- Failure modes and effects analysis. Free templates and other resources. Available at: https://goleansixsigma.com/failure-modes-effects-analysis-fmea/


**This Safety Alert is made possible through the committed efforts of NCPS members in reporting patient safety events.**

**For NCPS members only. Please do not distribute this resource outside of your organization.**