

Safety Strategies for Potassium Phosphates Injection

The dangers associated with inadvertent administration of concentrated **potassium** solutions are well known. ISMP Canada and the Canadian Council on Health Services Accreditation (CCHSA) recommend that concentrated electrolytes be removed from patient care areas.[†] Many hospitals have succeeded in removing concentrated potassium *chloride* products from patient care areas. The approach to removal of concentrated potassium *phosphates* solutions, however, is not as straightforward, largely due to the lack of availability of commercially prepared premixed infusion solutions.

Safety Issues with Potassium Phosphates Injection

Potassium phosphates injection is designated as a “high-alert” medication for the following reasons:

- **Vials of potassium phosphates contain more than twice the concentration of potassium (4.4 mmol/mL) compared to potassium chloride concentrate (2 mmol/mL). If inadequately diluted or administered too rapidly, intravenous potassium phosphate can cause serious adverse consequences.**
- Product labels for commercially available potassium phosphates injection can be confusing because of the nature of the product (see Figure 1 for one example). A variety of measurement units (mg, mEq, mmol, mOsm, mL) are used on the labels. The variety of information may cause confusion and may lead to calculation errors during preparation of doses for intravenous infusion.

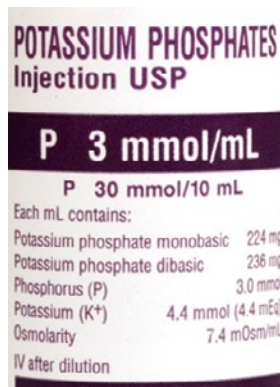


Figure 1: Photograph of a commercially available potassium phosphates injection label illustrating the potential for confusion because of the nature of the product.

- Variations in the way prescribers express doses of potassium phosphate may lead to error-prone conversions between milligrams (mg), milliequivalents (mEq), and millimoles (mmol) for the phosphorus component, as well as inattention to the amount of potassium delivered with each dose.

Note: The terms phosphate and phosphorus are often used interchangeably and this is acceptable for the purposes of

prescribing. Although phosphorus is the elemental form and phosphate exists in various ionic forms, the millimolar content of phosphorous can be considered virtually identical with that of phosphate. Therefore when prescribing a phosphate product, the recommendation (see below) is to specify the dose in millimoles (mmol).

Background Information on the Treatment of Hypophosphatemia

Hypophosphatemia is a frequently encountered metabolic complication in critically ill hospital inpatients. Moderate hypophosphatemia is usually defined as serum phosphate in the range of 0.4-0.8 mmol/L and severe hypophosphatemia as a level below 0.4 mmol/L.^{1,2} Oral phosphate supplementation is preferred for asymptomatic patients with mild to moderate hypophosphatemia when the enteral route is feasible. Intravenous phosphate supplementation is necessary for patients with severe hypophosphatemia, symptomatic patients with moderate hypophosphatemia, or patients for whom the enteral route is not feasible. Either potassium phosphates or sodium phosphates may be used for parenteral phosphate replacement. The electrolyte content of each of these products is noted in Figure 2 below.

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| <p>Potassium Phosphates Injection 10 mL vial Each millilitre supplies: 4.4 mmol of potassium 3 mmol of phosphorus</p> |
| <p>Sodium Phosphates Injection 10 mL vial Each millilitre supplies: 4 mmol of sodium 3 mmol of phosphorus</p> |

Figure 2: Electrolyte content for potassium phosphates and sodium phosphates injections, respectively. Either product may be used for parenteral phosphate replacement.

Recommendations for Preventing Adverse Events:

1. Develop Standard Protocols for Intravenous Phosphate Supplementation

As an essential first step to improving safety, it is recommended that institutions develop standardized dosing and monitoring protocols for intravenous phosphate replacement therapy. The development of such protocols will encourage the use of standardized doses and solutions. There is confusion about the appropriate dosing and administration of phosphate infusions, regardless of whether potassium phosphate or

[†] A comprehensive package to assist in the removal of concentrated potassium chloride is available through ISMP Canada.

sodium phosphate is used. This confusion may arise because the product monograph lacks clear dosing recommendations, because the labelling on the vials is confusing, and because clinical studies have used a variety of dosing regimens.

2. Develop 'Order Sets' (Preprinted or Electronic) for Phosphate Infusions

To ensure compliance with standard protocols, the development of order sets (preprinted or electronic) for phosphate infusions should be considered. These orders should clearly specify the **dose in mmol** of phosphate, the type and volume of infusion solution, and the recommended rate of administration. As well, the mmol of potassium or sodium provided per dose should also be stated on the preprinted orders. The text for labels for infusion bags and entries for computer-generated medication administration records (MARs) should also follow a standard format.

3. Remove Potassium Phosphates Injection from Patient Care Areas

The removal of concentrated potassium phosphates injection from patient care areas is an important patient safety initiative. The approach will depend on the decisions that are made during the development of standard protocols for phosphate infusion.

- Preferential use of sodium phosphate infusions for parenteral phosphate replacement may be an option for minimizing risk, especially when infusion bags cannot be prepared in the pharmacy. Sodium phosphates injection provides the same phosphate content as potassium phosphates injection, and presents less risk to patients if improperly diluted or

rapidly infused. In a recent publication by Esmail et al³ recommendations include the substitution of sodium phosphate for potassium phosphate for certain patients to facilitate removal of concentrated potassium phosphate from patient care areas. Since the product labels for sodium phosphates injection may be as confusing as those for potassium phosphates injection, it is crucial to establish standard dosing protocols and guidelines for the preparation, labelling and administration of infusion bags.

- If it is decided that potassium phosphate infusion is desirable for some or all patients with hypophosphatemia, the removal of the concentrated product from patient care areas will require a system which includes pharmacy-based preparation of standard infusion bags of potassium phosphate.

Collaboration among prescribers, nurses, and pharmacy personnel will be key to each institution's success in implementing safety strategies for removing potassium phosphates injection from patient care areas.

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1. Bugg NC, Jones JA. Hypophosphatemia: pathophysiology, effects and management on the intensive care unit. *Anaesthesia* 1998;53:895-902.
2. Dickerson RN. Guidelines for the intravenous management of hypophosphatemia, hypomagnesemia, hypokalemia, and hypocalcemia. *Hosp. Pharm.* 2001;36:1201-1208.
3. Esmail R Cummings C, Dersch D, Duchsherer G, Gilowa J, Liggett G et al. Using Healthcare Failure Mode and Effects Analysis tool to review the process of ordering and administering potassium chloride and potassium phosphate. *Healthc Q.* 2005;8 Spec No.73-80.

Neuromuscular Blocking Agent Labelling and Packaging Initiative

A collaborative meeting of representatives of pharmaceutical manufacturers of neuromuscular blocking agents was convened by ISMP Canada in Toronto on February 27th, 2006. The foremost outcome was agreement among the attending stakeholders on the "ideal features" for packaging and labeling of neuromuscular blocking agents:

1. Red cap with white lettering: "Paralyzing agent" or "Warning: Paralyzing Agent"
 2. Red ferrule with white lettering: "Paralyzing agent"
 3. Red lettering on the product label: "Paralyzing agent" or "Warning: Paralyzing Agent"
 4. Peel-off label, using the colour scheme and content information recognized by the ASA/CAS recommended standards, for application to a prepared syringe (ASA = American Society of Anesthesiologists (www.asahq.org); CAS = Canadian Anesthesiologists' Society (www.cas.ca))
 5. Space on the product label for bar code application
 6. Development of a universal symbol for neuromuscular blocking agents and proposal for global use: placement of this symbol (e.g., on the label), to be determined
 7. Review of potential benefit of using TALL-man lettering for generic names of neuromuscular blocking agents
- Participating manufacturers (Sandoz Inc, Hospira, Organon, and Abbott) are evaluating the feasibility of incorporating some or all of these features.

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To report a medication error to ISMP Canada: (i) visit our website www.ismp-canada.org, or (ii) e-mail us at info@ismp-canada.org, or (iii) phone us at 416-480-4099. ISMP Canada guarantees confidentiality and security of information received. ISMP Canada respects the wishes of the reporter as to the level of detail to be included in our publications.

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