ISMP Canada

Secondary lines require "primary" attention

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Abstract

An incident report received from an intensive care unit involving the administration of a secondary infusion is reprinted, with permission, and includes material from an ISMP Canada Safety Bulletin (ISMP Canada, 2005). The incident highlights a general shortcoming of many infusion pumps: lack of the capability to recognize primary versus secondary infusions. Reliance on practitioner vigilance to ensure appropriate administration adds to their already demanding practice. Secondary lines require "primary" attention from manufacturers to enhance infusion pump design and, in the interim, by all practitioners using infusion pumps with such limitations.

Secondary infusions require "primary" attention from individual practitioners, particularly in intensive care settings, where high-risk patients routinely receive multiple high-alert medications by a secondary line (e.g., electrolyte replacements, such as potassium chloride, magnesium sulphate, potassium phosphate). Secondary lines also require "primary" attention from the pump manufacturers designing these devices. Many makes and models of infusion pumps allow the pump to draw fluid from the primary line, even when a secondary line infusion has been programmed. Design enhancements should incorporate alarm conditions explicit to the specific infusion (primary or secondary). Although the case described in this article involves additional underlying factors that contributed to the outcome of the incident, improved design of devices is needed to reduce reliance on the vigilance of individual health care providers to identify when secondary infusions are not being administered as intended, particularly when the pump has been set up and programmed appropriately.

As of February 2005 when this incident was initially published in the ISMP Canada Safety Bulletin, ISMP Canada had collected reports of eight errors involving the accidental administration of primary intravenous (IV) solutions when initiation of a secondary intermittent IV infusion was intended (ISMP Canada, 2005, February). Reports of such errors involving secondary lines continue to be received. The example provided here occurred in an intensive care unit and was shared by the hospital to provide a warning to others and to highlight deficiencies in existing IV pump designs.

A patient in a critical care unit was receiving multiple continuous infusions through a multi-lumen central line. Potassium replacement with 20 mmol of potassium chloride in 100 mL was ordered for IV infusion over one hour to treat hypokalemia. No IV access lines were available because an intermittent medication was being infused through the single available, plain primary line. Peripheral access was not an option. It was decided that the best course of action would be to temporarily stop the infusion of insulin (Humulin R 100 units in 100mL). The nurse piggybacked the potassium minibag to the secondary infusion port in the insulin infusion line, set the secondary infusion rate to 100 mL/hour with a "volume to be infused" limit of 100 mL, but forgot to open the roller clamp. The pump therefore drew solution from the primary insulin line. Another nurse discovered the error when she responded to the pump alarm indicating "air in line", after the contents of the minibag containing insulin finished infusing. The exact amount of insulin the patient received as a bolus dose is unknown. The patient required 50% dextrose IV to treat the resulting hypoglycemia, as well as requiring treatment for worsening hypokalemia – insulin lowers potassium levels by causing both glucose and potassium to move from serum into cells. The patient recovered without further sequelae.

With the assistance of the nurse who made the error, the hospital identified the following contributing factors to the incident:

- Lack of a readily available plain IV access line.
- Use of the existing insulin line to infuse the secondary medication, rather than initiation of a primary plain solution line (e.g., normal saline with new tubing). Even if the roller clamp for the secondary line had been opened, a bolus of residual insulin 1 unit/mL in the tubing below the secondary line port would have been delivered.
- Perceived patient acuity and urgency of the clinical situation.

Although the nurse used the programming feature for a secondary line, the pump, like most general infusion pumps, did not distinguish between the primary and secondary lines and, therefore, could not activate an alarm to alert the nurse of the error. Because the clamp for the secondary line was not opened, the pump drew fluid from the only accessible infusion, which was the primary line.

Forgetting to open the roller clamp of the secondary line is a common error (ISMP, 2005, February 10). Unfortunately, avoidance of secondary line errors requires that each nurse maintain a level of vigilance, not only to ensure that the roller clamp on the secondary line is open, but also to verify that the secondary line is properly attached and activated; that the secondary line is at the proper height in relation to the primary line, to allow fluid to be drawn from the secondary line (accomplished by using manufacturer-supplied hooks); that the primary line has a back-check valve to prevent the secondary medication from mixing back into the primary solution; and to ensure that the maximum secondary infusion rate (if not preset by the manufacturer) is not exceeded, to prevent unintentional amounts of fluid being drawn from the primary line. Given this complexity, it is not surprising such errors occur.

ISMP Canada has published several bulletins describing errors involving infusion pumps (ISMP Canada, 2003, July; ISMP Canada, 2003, October; ISMP Canada, 2004, January; ISMP Canada, 2004, April). These bulletins clearly identify improvements needed in pump design and interim procedural safeguards that should be implemented to prevent incident occurrence and potential harm to patients.

Ideally, an alarm should notify the nurse that the secondary solution is not infusing and the pump should not draw from the primary line at the programmed secondary rate. ISMP Canada has contacted several manufacturers to inform them of the priority need to design and incorporate pump improvements related to secondary infusions.

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The following procedural recommendations are offered for consideration by hospitals:

1. **Do not piggyback a secondary infusion into a primary infusion containing a high-alert drug** (e.g. insulin).
2. Use educational materials, such as this bulletin, to heighten awareness of the importance of always performing a visual check when starting a secondary line to ensure that it is infusing properly (e.g., roller clamp is open, connection is not faulty) before proceeding to other tasks.

ISMP Canada gratefully acknowledges the valuable learning from the information reported by professionals in the Canadian health care community that can then be shared to enhance medication system safety. All ISMP Canada Safety bulletins are available from **http://www.ismp-canada.org/ISMPCSafetyBulletins.htm**.

ISMP Canada has a national voluntary medication incident and 'near miss' reporting program for the purpose of sharing learning experiences from medication errors. Implementation of preventive strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in health care is our collaborative goal. To report a medication error to ISMP Canada: (i) visit the website, **www.ismp-canada.org**, or (ii) e-mail **info@ismp-canada.org**, or (iii) phone 1-866-544-7672 (1-866-54-ISMPC).

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 publications.

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