ISMP Canada is an independent Canadian non-profit agency established for the collection and analysis of medication error reports and the development of recommendations for the enhancement of patient safety.

The Healthcare Insurance Reciprocal of Canada (HIROC) is a member-owned expert provider of professional and general liability coverage and risk management support.

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Infusion Pumps – Opportunities for Improvement

Infusion pump technology has facilitated precision in the delivery of medications. Inherent in any new health care technology, however, are opportunities for error and error-induced patient injuries. It has been noted that 54% of potential adverse drug effects[1] and 56% of medication errors[2], respectively, are associated with IV medications. Critical to ensuring continuous improvements in pump design and pump usability is the reporting of problems that may be associated with infusion pumps and the performing a root cause analyses of errors.

Problems related to the use of infusion pumps have been a growing concern in the United States (US) and the United Kingdom (UK). Prompted by the many error reports published by ISMP and other safety agencies, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in the US, has selected the improvement of infusion pump safety as one of their national patient safety goals for a second consecutive year.[3] The UK's National Patient Safety Agency recently announced their plan to tackle many of their infusion pump incidents.[4] There were 161 infusion pump-related incidents reported to the Agency from 18 trusts during a 9-month trial audit of errors and near misses. The Agency acknowledged that Britain was one of very few nations addressing infusion pump issues.

Earlier this year, ISMP Canada highlighted reported errors involving epidural infusions administered via pumps in an *ISMP Canada Safety Bulletin*.[5] Since publishing this bulletin, ISMP Canada has received other error reports involving infusion pump use. In order to heighten awareness of the risks associated with the use of infusion pumps, a few of these problems are listed below. In addition, the previous two issues of *ISMP Medication Safety Alert!* also addressed the problems of the use of patient controlled analgesia (PCA) pumps and highlighted many recommendations to prevent or minimize patient injury from their use.[6,7]

Error reports received by ISMP Canada:

- Infusion pumps easily turned off (accidentally) by users or when physically bumped (against objects)
- Lack of visible or audible warning when tubing, syringe or cassette is not properly loaded, resulting in over or under-dosing of medication
- Confusing tubings/pumps where multiple lines are used – inadvertently setting a drug/solution at the primary IV rate instead of at the intended secondary infusion rate
- Decimal point errors - keying in the infusion rate at 10 times the intended rate (e.g., 44.5 mL/h instead of 4.5 mL/h and 88 mL/h instead of 8 mL/h)
- Dosage calculation errors
- Keying in the volume of the drug to be infused as the infusion rate (e.g., a volume of 500 mL heparin mistakenly entered as rate of 500 mL/h)
- Lack of free-flow protection mechanism

Incidents of free-flow involve the infusate flowing freely under the force of gravity, without being controlled by the infusion pump.[8] An infusion pump without a set-based anti-free-flow mechanism relies on the user to clamp the tubing in order to prevent "free flow" of the solution into the patient when removing the tubing from the pump. Typically, an IV administration set may be removed from the pump to allow routine changes in the administration set, a patient's gown to be changed, patient transfers, and during response to certain pump alarms. The use of a set-based free-flow protection mechanism will automatically stop the flow of fluid by clamping the tubing as it is removed from the pump.

The issue of free-flow protection is noteworthy for Canadian hospitals. Preliminary analysis of a recent national survey indicate that a significant number of Canadian hospitals still use infusion pumps without an anti-free-flow mechanism.[9] Canadian hospitals are urged to review their pumps in use to ensure that up-to-date technology with free-flow protection is in place. Patient deaths and injuries in the US have been directly associated with the use of infusion pumps that were lacking free-flow protection. This has led JCAHO to outline the following national goal and standard for hospital accreditation: **"Ensure free-flow protection on all general-use and PCA (patient controlled analgesia) intravenous infusion pumps used in the organization."**[3]

Error reports related to infusion pumps, such as those mentioned above, have led ISMP Canada to initiate dialogue with pump manufacturers. One of ISMP Canada's goals is to ensure that design improvements of pumps are based on human factors engineering principles (human-pump-environment interaction) and usability testing. In addition, ISMP Canada will share learning and information about underlying contributing factors (from the user side) that are process and practice oriented.

ISMP Canada recently undertook a national survey on infusion pumps: see *Infusion Pump Project* at www.ismp-canada.org. A total of 340 hospitals from across Canada responded and provided information on infusion pump use, along with qualitative data identifying a variety of concerns. ISMP Canada sincerely thanks all the hospitals that participated in the survey. The project's Advisory Group (which includes Health Canada, Canadian Healthcare Association, University of Toronto, Healthcare Insurance Reciprocal of Canada (HIROC), ISMP Canada, and human factors engineering representatives) will be involved in analysis of the data. It is anticipated that the results of this survey will yield a number of recommendations to address some of the major problems related to infusion pump use. In the interim, the detailed checklist published in the previous *ISMP Medication Safety Alert!* will provide the reader with general guidelines.[7]

Error reports can be shared with ISMP Canada on-line at www.ismp-canada.org, by email to info@ismp-canada.org, or by phone at 416-480-4099. The confidentiality of all reports is guaranteed.

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