

# High alert: Preventing insulin errors

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The Institute for Safe Medication Practices Canada (ISMP Canada) is an independent, not-for-profit organization founded in early 2000 with the goal of promoting medication safety. It operates a voluntary medication error-reporting program that receives error reports, in confidence, from nurses, pharmacists, physicians and the public. Most reports are analyzed and error prevention strategies are developed and disseminated through a monthly bulletin to health care professionals and health care organizations for their learning. With permission, this article includes material originally published in an *ISMP Canada Medication Safety Bulletin* in April 2003.

High-alert medications are drugs that bear a heightened risk of causing significant harm due to their narrow therapeutic range. Although mistakes may or may not be more common with these drugs, the consequences of an error with these medications are often severe. Insulin, considered one of the top 10 high-alert medications, is frequently used in critical care settings and is also one of the drugs most likely to be involved in an error (Prager, 2001). Errors in dosing and administration of insulin can result in severe patient adverse effects. Administration of an excessive dose can rapidly lead to hypoglycemia, which may progress to seizure, coma and death. Under-dosing can allow worsening of hyperglycemia that may progress to ketoacidosis. Furthermore, in a recent study, patients admitted to a surgical intensive care unit who were not maintained in the normoglycemic serum range (4.4 to 6.1 mmol/L) had higher morbidity and mortality, particularly if they had underlying sepsis (Van Den Berghe, Wouters, Weekers et al., 2001). Maintaining normoglycemia had a significant correlation with a reduction of adverse events such as bloodstream infections, acute renal failure requiring dialysis, polyneuropathy, as well as a reduction in prolonged mechanical ventilation and intensive care unit stay (Van Den Berghe, Wouters, Weekers et al., 2001). A retrospective study of diabetic ketoacidosis cases found that 12% were caused by insulin error alone (Basu, Close, Jenkins et al., 1993). Due to the frequency of insulin use and its narrow therapeutic index, the risk for medication

errors can be high. This article will describe potential errors that can occur in the prescribing, transcription, preparation and medication administration phases of insulin.

Insulin orders have been misinterpreted due to the use of abbreviations where “units” has been written as “U”, “u”, or “IU”. Such orders have caused 10-fold dosing errors when the “U” was interpreted as “zero” or the “I” in “IU” was interpreted as “one”. Examples are: an order for insulin written as 7U was interpreted as 70 units, resulting in permanent patient harm (ISMP Canada, 2003); and an order for subcutaneous insulin 4 IU was given as 41 units (ISMP, 1997). Symbols can also cause problems. Both the ampersand (&) and plus sign (+), when handwritten, have been misinterpreted as the numbers 2 and 4, respectively (ISMP, 1997, 1999). The order “Insulin N 70/30 10U qAM &8U qPM” was dispensed as 10 units in the morning and 28 units in the evening (ISMP, 1999).

With the increasing number of insulin preparations on the market, there is the possibility of mistaking the type of insulin. ISMP Canada and ISMP (U.S.) have received reports of mistakes made between Humulin and Humalog, Humulin N (NPH) and Humulin U (Ultralente), and Humulin L (Lente) and Insulin Lantus (Health Canada DPD, 2004). Risk for such errors exists in interpretation, transcription and computer order entry.

The preparation of insulin injections using a tuberculin syringe instead of an insulin syringe is another significant cause of error (Cohen, 2003). All insulin products marketed in Canada and intended for human use provide 100 units insulin per millilitre (mL) (Health Canada DPD, 2004). The tuberculin syringe barrel is marked in 0.1 mL increments, without leading zeros. The insulin syringe is marked in insulin unit gradations. Health professionals withdrawing insulin into tuberculin syringes are easily confused by the fractional millilitre gradations and such confusion can result in 10-fold overdose errors. A case reported to ISMP Canada involved a nurse drawing up 0.68 mL of regular insulin using a tuberculin syringe subsequent to an order for 6.8 units of insulin (ISMP Canada, 2003). The correct volume should have been **0.068mL**. The fractional dose order written by the physician contributed to the error: the dose was calculated according to patient weight and then not rounded to seven units. The hospital subsequently took steps to ensure that only insulin syringes are used for insulin administration and added a discussion of dose rounding to the physician orientation program.

Although hospitals make the use of infusion pumps mandatory for intravenous insulin infusions, risk of problems persists. Patients are often prescribed more than one drug infusion at a time and there have been reported cases of line mix-ups with resultant insulin overdose. Programming of pumps has also caused difficulties when frequent dosage adjustments, calculations and new pump rate settings are required. More and more facilities are returning to the practice of documented independent double checks for select high-alert drugs, such as intravenous insulin.

ISMP Canada received a case report of read-out display and interpretation problems with a glucose meter (ISMP Canada, 2003). When a blood sugar reading was taken on a patient exhibiting signs of hypoglycemia, a pop-up window obscured part of the read-out. This pop-up window was a safety feature to alert the user of abnormal results. A reading of 1.8 mmol/L was misread as 18 mmol/L. In this case, the design of the pop-up window display, as well as the lack of experience on the part of the practitioner, contributed to the error. Furthermore, a later reading of "LO" was misread as "10". The errors (additional doses of insulin administered) resulted in permanent patient harm. The manufacturer was notified of the device display problems which have since been corrected.

The "most effective remedies to medication errors often lie outside the direct control of individual practitioners" (ISMP, 2001). System-based safeguards for insulin can include standardized order writing (no abbreviations), standardized formulary selections, pre-printed order forms for complex treatment protocols, clear policies and administration guidelines and differentiation of similar drug items by storage location, colour and auxiliary labelling.

"But there are many things individual practitioners can do in their own practice – things that are at least partly under their control – to reduce the risk of an error" (ISMP, 1999). Practitioner-based practices can include asking for an independent double-check for high-alert drugs, such as insulin, as well as sharing medication incident or near-miss experiences to educate each other about potential error. Furthermore, including patients and family in the medication administration process can also assist in the prevention of errors and adverse events (Canadian Medical Association, 2002; Koczmara, in press).

ISMP Canada encourages all practitioners, including critical care nurses, to report medication errors and near misses for the purposes of sharing the learning from such events. Information can be provided on-line via the ISMP Canada website, [www.ismp-canada.org](http://www.ismp-canada.org), by e-mail, [info@ismp-canada.org](mailto:info@ismp-canada.org), or by phone, (416) 480-5899. ISMP Canada guarantees confidentiality and security of information received and respects the wishes of the reporter as to the level of detail to be included in articles and other publications. 

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