

Insulin Errors

Insulin is considered one of the top five “high alert” medications because errors in dosing and administration can result in severe patient adverse effects; it is one of the drugs most likely to be involved in an error.¹ Administration of an excessive dose can rapidly lead to hypoglycaemia which may progress to seizure and coma. An under-dose can allow worsening of hyperglycaemia that may progress to ketoacidosis. The fact that insulin is frequently used and has a narrow therapeutic index increases the risk for medication errors. A retrospective study of diabetic ketoacidosis cases found that 12% were caused by insulin error alone.² This bulletin will describe the potential for error that can occur in the prescribing, transcription, preparation and medication administration phases, as identified through reported errors.

Insulin orders have been misinterpreted because of the use of abbreviations such as those where “units” has been written as “U”, “u”, or “IU”. Such orders have caused ten-fold dosing errors when the “U” was interpreted as “0” or the “IU” was interpreted as “1”. Examples are: an order for insulin written as 7U was given as 70 units, resulting in permanent patient harm;³ and an order for subcutaneous insulin 4 IU given as 41 units.⁴ Symbols can also cause problems. Both the ampersand (&) and plus sign (+), when handwritten, have been misinterpreted as the numbers 2 and 4, respectively.^{4,5} The order “Insulin N 70/30 10U qAM &8U qPM” was dispensed as 10 units in the morning and 28 units in the evening.⁵

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 mix-ups between Humulin and Humalog, Humulin N and Humulin U, and Insulin Lente and Insulin Lantus (not yet marketed in Canada). 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.⁶ All insulin products marketed in Canada intended for human use provide 100 units insulin per mL.⁷ 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. The correct volume should be **0.068mL**. The fractional dose order

written by the physician (exact dose was calculated based on patient weight, and then not rounded to 7 units) contributed to the error. The hospital subsequently took steps to ensure that only insulin syringes are used for insulin administration and added discussion of dose rounding in the physician orientation program.

An administration error can occur when there is a failure to properly prepare insulin suspensions (e.g., NPH insulin) for dose withdrawal and administration. Because suspensions settle in the vial, it is important to gently roll the vial between the palms to re-suspend the insulin. If a vial of insulin is not re-suspended, it is possible that the “suspension” withdrawn will contain as little as 20 units per mL instead of 100 units per mL,⁸ and the patient would be significantly under-dosed. Insulin pens must likewise be re-suspended by tipping and rolling the pen prior to use. Patients and staff alike mistakenly rely on visual inspection to assess adequate suspension.⁹

Although hospitals make the use of infusion pumps mandatory for intravenous insulin infusions, the risks for problems persist. 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 recently received a case report of readout display and interpretation problems with a glucose meter. When a blood sugar reading was taken on a patient exhibiting signs of hypoglycaemia, a pop-up window obscured part of the readout. 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 display of the pop-up window, 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 has been notified of the device display problems which have also been corrected.

The “most effective remedies to medication errors often lie outside the direct control of individual practitioners”.¹⁰ 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.”⁵ Practitioner-based practices can include: asking for an independent double-check for high alert drugs such as insulin, and sharing of medication incident or near miss experiences to educate others of error potential. Enlist patients to act as a check for drug dosing and administration, if possible – tell them that they are ordered to receive insulin for their diabetes. Patients not expecting this will immediately query the need.¹¹

REFERENCES:

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The expert review of this bulletin by Bill Cornish, Drug Information Services, Sunnybrook and Women's College Health Science Center is greatly appreciated and acknowledged.

NOTICE REGARDING RIBAVIRIN:

On April 27, Health Canada notified physicians that the Special Access Programme would no longer provide routine access to ribavirin (oral and parenteral) for the treatment of SARS. An expert working group, after reviewing the anecdotal clinical experience with ribavirin, the negative results from in vitro testing, and reports of serious adverse drug reactions, reached a consensus and advised Health Canada that there is no data to support the continued use of ribavirin for treatment of SARS (outside of clinical trials) at this time.

For further information and SARS updates from Health Canada, refer to <http://www.hc-sc.gc.ca/english/protection/warnings/sars/>.

ISMP CANADA INFUSION PUMP SURVEY UPDATE:

Thank you to all who have submitted responses to the ISMP Canada Infusion Pump Survey!
Due to the SARS situation, the timeline for responses has been extended to **May 16, 2003**.

ISMP Canada is a national voluntary medication incident and ‘near miss’ reporting program founded for the purpose of sharing the learning experiences from medication errors. Implementation of preventative strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in healthcare is our collaborative goal.

To report a medication error to ISMP Canada: (i) visit our website www.ismp-canada.org or (ii) email 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.