

ISMP Canada Safety Bulletin

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Weight-Based Medication Dose Errors

- *Weigh each patient to obtain an accurate weight, in metric units, ideally at the first encounter; do not rely on an estimated, historical, or patient-reported value, especially for children.*
- *Work with informatics and human factors specialists to configure computer order entry screens to accept patient weight in metric units only (i.e., grams or kilograms) and to require recent values.*
- *Install body or body mass index visualizer imaging technology into computerized systems to provide a visual depiction of a patient's body shape based on the person's height (in metres) and weight.*
- *Conduct an independent double check of the dose and dose calculations for all medication orders that involve dosing based on the patient's weight.*
- *Aim to integrate systems to enable automatic, accurate, and transparent transmission of a patient's weight (in metric units) directly from weigh scales to patient records, prescriber and pharmacy information systems, and other medical devices.*

Failure to accurately measure and record a patient's weight can contribute to serious, even fatal, dose errors, especially with high-alert medications such as anticoagulants and chemotherapeutic agents and in certain populations (e.g., children, elderly people).¹ ISMP Canada recently received 3 reports of

medication dosing incidents attributed to use of an incorrect patient weight. These incidents occurred in both hospital and community settings and resulted in or had the potential to cause patient harm. This bulletin highlights the sources of these errors, their implications, and a systems approach to reduce their occurrence.

Medication Incidents

In the first incident, a hospitalized patient was ordered treatment doses (based on units/kg) of the anticoagulant dalteparin to be administered subcutaneously daily for a thromboembolic disorder. The patient was discharged on the same dose, but returned to the hospital several weeks later reporting dizziness and falls. An intracranial hemorrhage was diagnosed and surgery was required. It was then discovered that, during the previous admission, the patient's weight had been measured in pounds but had been documented in the pharmacy system in kilograms. As a result, the patient had received approximately double the dalteparin dose that was intended, which contributed to the subsequent bleed.

The second incident involved a hospital inpatient for whom an erroneous dose of enoxaparin had been prescribed, because of calculations based on an incorrect body weight. After a week of treatment, the physician noticed that the patient's body mass index (BMI) as recorded in the chart appeared to be incorrect. It was discovered that the hospital bed scale that had been used to weigh the patient reported the weight in pounds. Although the number was

entered correctly into the computer, the units were not identified at the time of entry. The system default in the weight entry field was kilograms, if units were not specified otherwise. As a result, the patient received twice the intended dose of enoxaparin. Fortunately, there was no negative clinical outcome.

In a community-based incident, a child was seen in a medical clinic for a sore throat. A throat swab was obtained on the initial visit, and a positive culture result was reported 2 days later. Clinic staff contacted the parents to obtain allergy information and the child's weight. The mother reported that the child had no allergies and that her weight was "18". This information was passed on to the physician, who prescribed amoxicillin at a dose based on a weight of 18 pounds. Five days later the child returned to the clinic with a persistent fever and sore throat, requiring additional treatment. Before an alternative antibiotic was prescribed, the physician weighed the patient, and it was determined that she weighed 40 pounds (18 kg). The physician's assumption that the weight initially provided by the mother was in pounds led to underdosing of the initial antibiotic.

Background

Canada converted to the metric system or International System of Units (also known as SI units) many decades ago, including units of measurement for body weight (grams [g], kilograms [kg]). Nonetheless, many people still know their weight only in imperial units (pounds, ounces).

Factors that can contribute to weight-based dose errors:

- *failure to weigh patient*
- *inaccurate documentation of patient's weight because of incorrect entry of unit of measure or failure to enter unit of measure*
- *failure to correctly convert between pounds and kilograms*
- *inaccurate estimation of weight*
- *use of an outdated weight, especially for growing children*

However, medication doses are usually calculated in terms of amount per kilogram (e.g., mg/kg) or some other SI-based unit (e.g., mg/m² body surface area). Therefore, it is essential to have an accurate weight, *in kilograms*, for every patient who needs a medication that is dosed according to body weight.

Often, confusion is created when equipment (e.g., bed scales) or systems (e.g., computerized documentation) that measure or record patient data in imperial units rather than SI units are available in a healthcare facility. Using more than one system of measurement introduces ambiguity and necessitates that healthcare providers and patients perform mathematical calculations for unit conversions, which can lead to significant dose errors.

Clinicians frequently estimate a patient's weight or rely on a patient's self-reported weight for chart documentation and calculations. Both of these practices are prone to error; furthermore, there is evidence that practitioners' estimates are often incorrect¹ and that patients routinely underestimate their weight.^{2,3} Emergency departments are especially prone to weight-based dose errors, because the urgency of a patient's medical status may lead the clinician to forego formal weighing and estimate weight or use a historical weight.

Relying on a historical weight (i.e., weight as previously documented in the patient chart) is also problematic. Using a previous weight can result in perpetuation of erroneous information if that weight was incorrect. It also assumes that the patient's weight has remained stable since the last documentation. To avoid dosing errors, patients must be weighed at every encounter during which medication may be prescribed. Skipping the step of weighing the patient increases the likelihood of weight-based dose errors.^{1,4}

Recommendations

Healthcare Facilities and Practitioner Clinics

- Standardize the unit of measure for weigh scales and order entry systems (paper and computerized) to SI units only.

- For scales designed to measure in either pounds or kilograms, set the default to kilograms and lock out pounds;⁵ alternatively, replace these types of scales with metric scales.
- Establish a procedure to weigh (and measure the height in metres of) all patients upon first contact at the clinic or hospital. To ensure that this step is not overlooked, consider linking it with obtaining vital signs.
- If possible, provide the date each weight was entered in the record, so that healthcare providers can readily identify the most current weight value. Ideally, electronic systems would flag outdated values.
- To facilitate weight measurement, ensure that all patient care areas, especially the emergency department and clinical pediatric areas, have the necessary weigh scales. Specialized equipment, such as chair, wheelchair, and bed scales should be available, as appropriate.
- If it is necessary to estimate a patient's weight (e.g., because the patient is critically ill or equipment is lacking), flag the value as an estimate if the functionality exists, and obtain an accurate weight as soon as possible.
- Replace or conduct regular maintenance on all weighing equipment to ensure that scales are tared and calibrated correctly.⁶
- Provide the weight and dose per unit weight on all weight-based outpatient prescriptions, so that the community pharmacist can update the patient's record and double check dose calculations.⁷
- Ensure relevant standardized order sets (including those that are paper-based) allow for documentation of weight in kilograms.
- Learn from areas of the hospital (e.g., chemotherapy clinics) or practices/clinics that have implemented many of these changes to support the correct capture of weight.

Pharmacists and Pharmacy Staff

- Confirm the patient's weight and the unit of measure (e.g., kg) prior to preparing or dispensing a medication dosed by weight. If necessary, weigh the patient in the pharmacy, using a metric weigh scale.

- Conduct an independent double check of the dose and dose calculations for all medication orders that involve dosing based on the patient's weight. This double check is especially important for high-alert medications⁸ (<https://www.ismp.org/tools/highalertmedicationLists.asp>) and medications prescribed for high-risk populations, such as pediatric patients.

Computer System Administrators

- Configure order entry screens to accept patient weight in metric units only (i.e., grams [g] or kilograms [kg]), whether in the computerized patient record, in devices such as infusion pumps, or on preprinted order forms.⁴ Ensure that the unit of measure is prominently displayed on the screen.
- Create a hard stop or require mandatory entry of a patient's weight in the electronic order entry system for all medications dosed according to patient weight.
- Create an expiration date for weights and heights, requiring the patient to be measured.
- Integrate systems to enable automatic, accurate, and transparent transmission of a patient's weight (in metric units) directly from weigh scales to patient records, prescriber and pharmacy information systems, and other medical devices.⁴
- To eliminate the need for complex calculations, build automated dose calculators into the dictionaries of medications dosed according to patient weight. Prevent automatic transfer of weight data from previous office visits or hospital admissions into the current chart.⁶
- For pediatric patients, provide an automated clinical decision support tool in the order entry system that compares the weight entered against standardized, age-adjusted norms. Work with human factors specialists to determine best methods to flag large discrepancies.⁹
- Install body or BMI visualizer imaging technology into the computerized system (see Figure 1). These programs will display the body shape of an adult patient, based on height and weight entered. A visualized image will support the practitioner in identifying incorrect patient weight or height data entry.

Figure 1. Sample body images, based on visualizer technology, of a man weighing 150 lbs (left) and 150 kg (right).



Conclusion

Weight-based dosing errors resulting from improper capture of a patient's weight are preventable. Just as the accurate collection of vital signs (e.g., blood pressure and oxygen saturation) is critical for the safe and effective care of a patient, timely and accurate measurement of a patient's weight, in SI units

(i.e., grams or kilograms, depending on age), helps to ensure appropriate and safe medication dosing. This bulletin has identified some of the factors that can contribute to weight-based dosing errors and outlines system-based recommendations that practitioners in healthcare facilities and in community settings can use to help prevent such errors.

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References

1. Pennsylvania Patient Safety Authority. Medication errors: significance of accurate patient weights. Pa Patient Saf Advis. 2009 [cited 2016 Sep 6];6(1):10-15. Available from: [http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2009/mar6\(1\)/Pages/10.aspx](http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2009/mar6(1)/Pages/10.aspx)
2. Shields M, Gorber SC, Tremblay MS. Estimates of obesity based on self-report versus direct measures. Health Rep. 2008;19(2). Available from <http://www.statcan.gc.ca/pub/82-003-x/2008002/article/5002558-eng.htm>
3. Oliveira A, Ramos E, Lopes C, Barros H. Self-reporting weight and height: misclassification effect on the risk estimates for acute myocardial infarction. Eur J Public Health. 2009;19(5): 548-553.
4. Pennsylvania Patient Safety Authority. Update on medication errors associated with incorrect patient weights. Pa Patient Saf Advis. 2016 [cited 2016 Sep 6];13(2):50-57. Available from: [http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2016/jun;13\(2\)/Pages/50.aspx](http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2016/jun;13(2)/Pages/50.aspx)
5. 2016-2017 targeted medication safety best practices for hospitals. Horsham (PA): Institute for Safe Medication Practices; [cited 2016 Sep 7]. Available from: <http://www.ismp.org/tools/bestpractices/TMSBP-for-Hospitals.pdf>
6. Medication safety: inaccurate patient weight can cause dosing errors. Plymouth Meeting (PA): ECRI Institute; 2014 [cited 2016 Sep 7]. Available from: <https://www.ecri.org/components/PSOCore/Pages/PSONav0214.aspx>
7. Prescribing errors with levETIRAcetam oral solution. Acute Care ISMP Med Saf Alert. 2016 Apr 21 [cited 2016 Oct 6]. Available from: <https://www.ismp.org/newsletters/acutecare/showarticle.aspx?id=1135>
8. Vulnerabilities of electronic prescribing systems: height and weight mix-up leads to an incident with panitumumab. ISMP Can Saf Bull. 2010[cited 2016 Nov 2]; 10(5). Available from: <https://www.ismp-canada.org/download/safetyBulletins/ISMPCSB2010-05-ElectronicPrescribingSystems.pdf>
9. Potts AL, Barr FE, Gregory DF, Wright L, Patel NR. Computerized physician order entry and medication errors in pediatric critical care unit. Pediatrics. 2004;113(1 Pt 1):59-63.

This segment of the bulletin describes a recent SafeMedicationUse.ca publication from ISMP Canada's Consumer Program.

November 2016 - Newsletter:

Be Sure You Know the Meaning of "Take as Needed"

The terms "take as needed" and "take as required" can be interpreted in different ways by different individuals. Healthcare providers have a responsibility to inform consumers about how their medications should be taken. In particular, it is important to emphasize that the instruction to take a medication "as needed" or "as required" for a specific symptom does not mean that the medication can be taken repeatedly until the symptom has resolved.

SafeMedicationUse.ca received a report from a consumer who was taking lorazepam for sleep. The label instructions stated, "TAKE 1 TABLET BY MOUTH AT BEDTIME AS REQUIRED". When the consumer asked for a refill earlier than expected, the pharmacist discovered that there had been a misunderstanding: the consumer thought that she could take as many tablets as she needed each night, so long as she took 1 tablet at a time. However, the prescriber had intended that the patient take just 1 tablet each night and only if she was having trouble sleeping.

Tips for Practitioners:

- For "as needed" prescriptions, give your patient specific instructions on how to properly take the medication. These instructions should include the following details:
 - the reason for taking the medication
 - how much medication is to be taken each time
 - how often the medication can be taken
 - the maximum amount of medication that can be taken each day
- Provide written and verbal instructions to help the patient understand how to use the "as needed" medication.

Tips to Share with Consumers:

- If the instructions for a medication include the words "as needed", be sure you understand the following details:
 - the reason for taking the medication
 - how much medication you are supposed to take each time
 - how often you can take the medication
 - the maximum amount of medication that you can take in one day
- If the instructions for a medication state that you are to take it on a regular schedule and also "as needed", be sure you understand when you can take the extra "as needed" doses.
- If an "as needed" medication is not helping you to feel better, do not take more than the maximum amount prescribed for one day. Speak to your healthcare provider for advice.

For more information, read the full newsletter: [Be Sure You Know the Meaning of "Take as Needed"](https://safemedicationuse.ca/newsletter/newsletter_TakeAsNeeded.html) (https://safemedicationuse.ca/newsletter/newsletter_TakeAsNeeded.html)



**Consumers Can Help Prevent
Harmful Medication Incidents**

SafeMedicationUse.ca



The Canadian Medication Incident Reporting and Prevention System (CMIRPS) is a collaborative pan-Canadian program of Health Canada, the Canadian Institute for Health Information (CIHI), the Institute for Safe Medication Practices Canada (ISMP Canada) and the Canadian Patient Safety Institute (CPSI). The goal of CMIRPS is to reduce and prevent harmful medication incidents in Canada.



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



The Institute for Safe Medication Practices Canada (ISMP Canada) is an independent national not-for-profit organization committed to the advancement of medication safety in all healthcare settings. ISMP Canada's mandate includes analyzing medication incidents, making recommendations for the prevention of harmful medication incidents, and facilitating quality improvement initiatives.

Report Medication Incidents

(Including near misses)

Online: www.ismp-canada.org/err_index.htm

Phone: 1-866-544-7672

ISMP Canada strives to ensure confidentiality and security of information received, and respects the wishes of the reporter as to the level of detail to be included in publications. Medication Safety bulletins contribute to Global Patient Safety Alerts.

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