ARTICLE

Medication Error Reporting Systems: A Survey of Canadian Intensive Care Units

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ABSTRACT

Background: Patients in the intensive care unit (ICU) have complex problems and experience many medical errors. Currently, little is known about the measurement of medication errors and adverse drug events in Canadian ICUs.

Objective: To investigate methods of measuring medication errors and adverse drug events in ICUs in Canada.

Methods: A questionnaire was constructed and uploaded to an online survey tool, SurveyMonkey. Through the mailing list software of the Critical Care Pharmacy Specialty Network of the Canadian Society of Hospital Pharmacists, the survey was sent by e-mail to 146 pharmacists working in 79 ICUs across Canada; 2 reminder e-mails followed. The survey was open from July 18 to September 18, 2007.

Results: A total of 34 individual responses were received from 31 (39%) of the 79 ICUs. Responses were from academic hospitals (11/31 [35%]), community teaching hospitals (9/31 [29%]), and community nonteaching hospitals (11/31 [35%]). Twenty-six (84%) of the 31 responding ICUs had a process for tracking medication errors and adverse drug events: non-anonymous voluntary reporting (19 or 73%), direct observation (14 or 54%), anonymous voluntary reporting (12 or 46%), chart review (6 or 23%), computerized system (3 or 12%), trigger tools (2 or 8%), pharmacist intervention (2 or 8%), and weekly ICU "safety huddles" (1 or 4%). Fourteen (54%) of the 26 ICUs that had a method of measuring medication errors and adverse drug events had implemented changes to address identified problems.

Conclusions: Most respondents were measuring the frequency of medication errors and adverse drug events, but a wide variety of methods were in use. Only about half of the ICUs had implemented changes as a result of these measurements. There is an opportunity to improve standardization of the measurement of medication errors and adverse drug events in Canadian ICUs.

Key words: medication safety, intensive care unit, reporting system

RÉSUMÉ

Contexte : Les patients à l'unité de soins intensifs (USI) ont des problèmes complexes et sont victimes de nombreuses erreurs médicales. On connaît actuellement peu de choses sur la mesure des erreurs de médication et des événements indésirables liés aux médicaments dans les USI au Canada.

Objectif : Étudier les méthodes de mesure des erreurs de médication et des événements indésirables liés aux médicaments dans les USI au Canada.

Méthodes : Un questionnaire a été élaboré et téléchargé dans l'outil de sondage en ligne, SurveyMonkey. Le sondage a été envoyé à 146 pharmaciens d'hôpitaux de 79 USI du Canada à partir du gestionnaire de liste de diffusion du Réseau de spécialistes en pharmacie des soins intensifs de la Société canadienne des pharmaciens d'hôpitaux, et ceci suivi de deux courriels de rappel. Le sondage était ouvert du 18 juillet au 18 septembre 2007.

Résultats : Trente-quatre pharmaciens de 31 (39 %) des 79 USI ont répondu au sondage. Les réponses provenaient d'hôpitaux d'enseignement universitaire (11/31 ou 35 %), d'hôpitaux d'enseignement communautaires (9/31 ou 29 %) et d'hôpitaux communautaires sans vocation d'enseignement (11/31 ou 35 %). Vingt-six (84 %) des 31 USI disposaient d'un processus pour faire le suivi de erreurs de médication et des événements indésirables liés aux médicaments : les déclarations volontaires non anonymes (19 ou 73 %), les observations directes (14 ou 54 %), les déclarations volontaires anonymes (12 ou 46 %), l'examen des dossiers médicaux (6 ou 23 %), un système informatisé (3 ou 12 %), des outils d'alerte (2 ou 8 %), les interventions des pharmaciens (2 ou 8 %) et les « caucus de sécurité » hebdomadaires de l'USI (1 ou 4 %). Quatorze (54 %) des 26 USI qui disposaient d'une méthode pour mesurer les erreurs de médication et les événements indésirables liés aux médicaments avaient mis en œuvre des changements pour rectifier les problèmes décelés.

Conclusions : La plupart des répondants mesuraient la fréquence des erreurs de médication et des événements indésirables liés aux médicaments, mais utilisaient diverses méthodes. Seulement près de la moitié des USI avaient mis en œuvre des changements par suite de ces mesures. Il y a une occasion d'améliorer la standardisation des mesures des erreurs de médication et des événements indésirables liés aux médicaments dans les USI du Canada.

Mots clés : sécurité des médicaments, unité de soins intensifs, système de déclaration

[Traduction par l'éditeur]

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INTRODUCTION

A medication error is a failure of a planned action to be completed as intended[1] or the use of an incorrect plan to achieve an aim at any stage of the medication process, including ordering, transcribing, dispensing, administering, or monitoring. Serious medication errors either cause harm or have the potential to do so.[2] Adverse events are incidents that occur during the process of providing health care and result in patient injury or death.[1] The Canadian Adverse Events Study showed that adverse events due to medication errors and other causes occur in 7.5% of hospital admissions involving Canadian adults and are associated with a 20% risk of death and longer duration of hospital stay.[3]

Intensive care units (ICUs) house the most critically ill patients, who have the most complex medical problems, little physiologic reserve, and the highest mortality rates. These patients are subjected to numerous risky medications and invasive medical procedures. It is not surprising that the rates and consequences of medical errors are much greater among ICU patients than among other patients.[2,4,5] Some Canadian hospitals report adverse events as part of their risk management strategies and accreditation requirements, and some report to the Canadian Medication Incident Reporting and Prevention System (sponsored in part by the Canadian Institute for Health Information) and the Canadian Adverse Event Reporting and Learning System (sponsored by the Canadian Patient Safety Institute). However, there is no standard method of measuring medication errors and adverse drug events, and very little information is available about reporting systems for medication errors in Canadian ICUs. The objective of this study was to characterize local reporting of medication errors and adverse drug events in Canadian ICUs.

METHODS

The study was approved by the Research Ethics Board of Providence Health Care.

Collection of Data

A questionnaire was developed to learn how medication errors and adverse drug events are measured in Canadian ICUs. Face and content validity of the survey were assessed by reviewing each item on the proposed questionnaire with a critical care pharmacist, 2 critical care physicians, and 2 medical students who were conducting other research on adverse medication events. No quantitative tests of content validity were conducted. The final version of the survey consisted of a total of 16 questions, with each respondent answering from 8 to 16 of the questions, depending on responses to previous questions. The survey was uploaded to SurveyMonkey, an online survey tool.

The survey was designed so that users were directed to certain questions on the basis of their responses to previous questions (see online Appendix 1, at www.cjhp-online.ca/index.php/cjhp/issue/view/72/showToc). Response options were to choose one answer, choose all answers that apply, or fill in the field (for open-ended questions).

A cover letter describing the purpose and origin of the survey (and including a link to the online survey) was distributed by e-mail to all 146 members of the Critical Care Pharmacy Specialty Network (PSN) of the Canadian Society of Hospital Pharmacists. These potential respondents worked in a total of 79 ICUs. It is pertinent to note that not all Canadian ICU pharmacists are members of this PSN, and not all members of the PSN are ICU pharmacists. Furthermore, a total of 208 Canadian hospitals (excluding hospitals in Quebec and Nunavut) report that they have an ICU (information provided by Canadian Institute for Health Information). Reminder e-mail messages were sent at 1 and 2 weeks after the initial invitation. The survey remained open for 2 months, from July 18 to September 18, 2007.

Analysis

Responses were compiled by the SurveyMonkey software. The request to identify the centre (question 1) was used to ensure that the responses represented a variety of centres and allowed duplicate responses from the same centre to be eliminated. Results were summarized descriptively.

RESULTS

Responses were received from 34 pharmacists working in 31 ICUs. The survey response rate was 39% (31/79) in terms of the number of ICUs or 23% (34/146) in terms of the number of respondents. Response rates by question, according to number of individuals responding, were 100% (34/34) for questions 1, 4, 5, and 6; 91% (31/34) for question 2; 97% (33/34) for question 3; 100% (2/2) for questions 7 and 13; 94% (32/34) for question 8; 100% (28/28) for questions 9, 10, 11, and 14; 100% (4/4) for question 12; and 50% (14/28) for question 15. For ICUs with more than one respondent, only the single most complete survey was analyzed.

Demographic Characteristics

Responses were received from all provinces except Quebec, Prince Edward Island, and Newfoundland and Labrador. The 31 ICUs represented were fairly evenly split among academic hospitals (11 or 35%), community teaching hospitals (9 or 29%), and community nonteaching centres (11 or 35%). The majority of ICUs represented were mixed medical/surgical (23/31 [74%]); other types of ICU represented were neurologic, coronary, pediatric, medical, and a joint unit providing trauma,

neurologic, burn, and cardiothoracic care. Thirteen (42%) of the 31 responding ICUs had 1–10 beds, 12 (39%) had 11–20 beds, and 6 (19%) had 21–30 beds. Twenty-seven (87%) of the responding ICUs had a pharmacist who was familiar with the patients' conditions and who reviewed the patients' drug therapy with the ICU team at least 5 days per week during daytime hours. Most ICUs (29/31 [94%]) did not have computerized physician order entry. Of the 2 (6%) hospitals that did have this capability, only 1 (50%) also had decision support software.

Measurement of Medication Errors and Adverse Drug Events

Twenty-six (90%) of the 29 ICUs that responded to this question had a method for tracking medication errors and adverse events. Of these, 24 (92%) used the same method throughout the hospital; the remainder used a method that was specific to the ICU. Non-anonymous and anonymous voluntary reporting and direct observation were the most common methods used to measure medication errors and adverse drug events in these ICUs (Figure 1). Other methods were chart review, trigger tools, tracking of pharmacist interventions, and ICU "safety huddles". Twenty (77%) of the 26 ICUs that had a method for measuring errors and adverse drug events reported using more than one method. The most common combinations of methods were non-anonymous and anonymous voluntary reporting, voluntary reporting and direct observation, and voluntary reporting, direct observation, and chart review.

Voluntary Reporting

Paper reports were the most popular method (16/26 [62%]) for voluntary reporting of medication errors (Figure 2). Other methods were intranet, phone calls, and Internet (Figure 2). Netsafe, Meditech EMR, and Risk MonitorPro were reported as the web-based systems in use. An internal e-mail system built into the computer system was reported by one ICU.

Trigger Tools

All ICUs that used trigger tools for chart review included voluntary reporting of medication errors as a trigger signal. Other trigger signals were abnormal drug levels, antidote use, use of allergy medications, low serum glucose level, other abnormal laboratory values, abrupt medication stop, and abnormal electrolyte concentrations.

Actions Taken as a Result of Measuring Medication Errors and/or Adverse Drug Events

Of the 26 ICUs that had a process for measuring medication errors, only 14 (54%) had implemented changes on the basis of this information, according to the ICU pharmacist respondents. Reported changes are listed in Box 1.

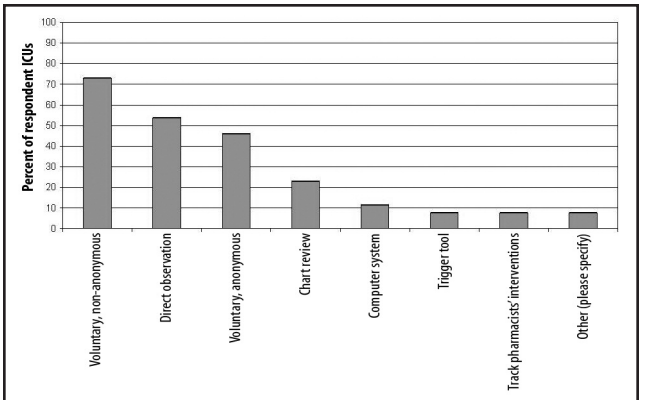

Figure 1. Methods used for measuring medication errors and adverse drug events, as reported by survey respondents in Canadian intensive care units (*n* = 26 ICUs).

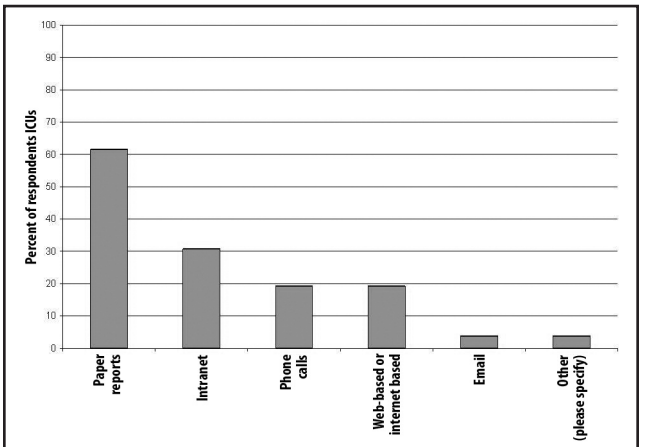

Figure 2. Methods for voluntary reporting of medication errors and adverse drug events, as reported by survey respondents in Canadian intensive care units (*n* = 26 ICUs).

DISCUSSION

This survey was the first to systematically examine the reporting of medication errors and adverse drug events in Canadian ICUs. Responses came from a wide variety of Canadian ICUs, and only 3 provinces were not represented. Responses were obtained almost equally from academic, community teaching, and community nonteaching hospitals. In a similar recently reported survey of ICUs in the United States, most respondents were from nonteaching community institutions.[6] Because of this difference in the responding population, the findings from the US survey[6] may not be applicable to Canadian ICUs and may explain differences such as the rate of use of voluntary reporting systems (94.7% in the US study compared to 73% in this Canadian survey).

The majority of Canadian ICUs that responded to this survey reported having a pharmacist who was familiar with the patients' conditions and who reviewed the patients' drug therapy with the ICU team at least 5 days per week. Having a

Box 1. Changes Made as a Result of Tracking Medication Errors and Adverse Drug Events

- Changes in procedures—dispensary
- Numerous: e.g., in point of use system, only one dosage form/drawer, re-work of drug naming system in POU system esp. for IR vs SR drugs
- We removed vials of potassium chloride to a separate area and removed potassium phosphate completely from the unit ward stock.
- Actions are dependent upon the error identified. As best as possible the point(s) of break down are identified. Actions might include staff education/reinforcement of process, support document.
- ISMP recommendation implementation – pharmacists in patient safety roles within institution that provide safety related information to staff, prohibited abbreviation implementation – adjustment of pharmacy dispensing, order triaging, and IV preparation procedures where applicable.
- Developed procedure for procedural propofol administration. Developed reference for standard concentrations and guidelines for administration for designated IV medication infusions.
- Monthly review of incidents at program's quality improvement committee meeting. Where trends in incidents are observed, this information is communicated to staff via a newsletter along with associated advice on avoiding or improving performance. Trends specific to an individual are dealt with one-on-one to avoid confusing staff that are performing a particular function without incident.
- Changes in drug availability in the unit vs. pharmacy preparation changes to the process of medication administration.
- Concentrated KCl and other electrolytes availability, neuromuscular blocker availability, standardized orders/protocol.
- 1. Drug cards for vasopressors/inotropes. 2. Clear guidelines for dosing of vasopressors when being used as bolus doses for intermittent hypotension (as opposed to infusions for sepsis). 3. Electrolyte protocols, insulin protocols, sedation protocols.
- Education.
- We changed our CRRT protocols. We also introduced an electrolyte algorithm.
- Implemented or improved policies educational interventions drug removal from stock system/process changes.

CRRT = continuous renal replacement therapy,
ISMP = Institute for Safe Medication Practices, IR = immediate release,
POU = point of use, SR = sustained release.

critical care pharmacist who fulfils these roles has been associated with better outcomes for patients.[7,8] Although a pharmacist was present in the majority of responding ICUs, only a few of the units used pharmacist interventions as a method of tracking medication errors. This suggests that critical care pharmacists are not being used to their full potential, which may include the detection, interception, reporting, and resolution of medication errors and adverse drug events.

The wide range of methods of measuring medication errors and adverse drug events reported by the respondents to this survey indicates that there is no standard for such measurement in Canadian ICUs. As well, reliance on voluntary reporting may indicate that rates of medication errors and adverse events in Canadian ICUs are underestimated. Jha and others[9] reported that chart review or computer-based monitoring led to the identification of more medication errors than did voluntary reporting. This may relate to lack of time to complete voluntary reports or fear of punitive action after voluntary reporting.

One of the more surprising results from this study was that 10% (3/29) of responding ICUs did not have any method for tracking medication errors and/or adverse events. Farley and others[10] reported similarly that 13% of the hospitals they surveyed did not have a patient safety program. These results suggest that some ICUs do not address medication errors and adverse drug events at all. This situation is particularly alarming given that the rates and severity of adverse drug events are more severe among ICU patients than among patients in other areas of the hospital.[4] Although the majority of ICUs used a method to measure medication errors and adverse drug events, only 54% had made changes in response to reports of such events. Areas where changes could be made include technical and organizational strategies. Technical strategies include choices and restriction of antibiotics, nomograms for the use of heparin and insulin, and sedation protocols. Organizational strategies include using checklists of safety tasks during ICU rounds, preventing fatigue among providers by implementing sensible call schedules, utilizing the expertise of ICU pharmacists as described above, and having a systematic approach to quality improvement based on reports of medication errors and adverse events. Changes in both technical and organizational strategies are often required to prevent medication errors, and a combined approach may be superior to making changes in only one of these areas.[11] Unfortunately, it may be difficult to implement changes in both areas, but the incentive of accreditation may be helpful. In addition to the difficulty of implementing changes in ICUs, reports of errors do not always provide guidance for prevention. Weinert and others[12] reported that even when guidance for change was provided, in the form of findings from a randomized controlled trial, the implementation of change was often slow. These difficulties in implementation may explain the finding in our study that only about half of responding ICUs had made changes in reaction to reports of medication errors and adverse drug events. There is clearly great room for improvement in the measurement of medication safety in Canadian ICUs.

One limitation of this study was that the survey response rate at the level of the ICU (39%) was lower than that in other national surveys involving critical care, which had response rates of 76%[13] and 60%.[14] These Canadian surveys were sent to critical care physicians using postal mail and involved a second mailing of the survey and telephone calls to prompt participation.[13,14] Hébert and others[13] also sent a reminder postcard before the second mailing of the survey. However, other surveys using e-mail and online methods have had response rates similar to ours. For example, Barger and others[15] had a response rate of 18.5% from medical interns. Jones and Pitt[16] compared methods used for health surveys and reported that postal surveys produced a 72% response rate, whereas e-mail surveys yielded a 34% response rate. Phone calls may be more effective than e-mail messages in prompting participation in mail surveys. The response rate in the current study might have been greater if the survey had also been available in French, as the

unilingual presentation of the survey might have been a factor discouraging responses from Quebec. The implications of a low response rate include threats to generalizability of the findings.

A second limitation of the study involved the method of survey delivery. The survey was delivered only to ICUs that had a member of the Critical Care PSN of the Canadian Society of Hospital Pharmacists. This meant that Canadian ICUs that did not have a critical care pharmacist and those that had a pharmacist who was not a member of the PSN would not have been reached by the survey and thus would not have been represented. Furthermore, some members of the PSN might not have responded because they did not work in an ICU. A third limitation of the study was the collection of data using a self-report survey format, rather than direct observation. Although collection of data by direct observation would have been superior, it was not feasible for this study.

The strengths of this study include the development of the survey and its assessment for face and content validity by a multidisciplinary team, representation of a variety of ICUs from across Canada in the survey results, and identification of opportunities for improvement in the processes of reporting and acting on medication errors and adverse drug events. Many of these opportunities could be actualized by existing ICU pharmacists.

In summary, most ICUs in Canada that responded to this survey had a method for measuring medication errors, with voluntary reporting by hard-copy (paper) documentation being the most popular method. Although most ICUs had a dedicated ICU pharmacist, only half of the ICUs that measured medication errors and adverse drug events had made changes based on the information from these reports. These findings indicate that there is room for improvement in the standardization of measurement of medication errors and adverse drug events in Canadian ICUs.

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