ARTICLE

Unintended Medication Discrepancies Associated with Reliance on Prescription Databases for Medication Reconciliation on Admission to a General Medical Ward

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ABSTRACT

Background: In a recent study, 50% of the patients who were admitted to a hospital's general medicine ward had at least one error in medication orders at the time of admission related to inaccuracies in the medication history. The use of computerized prescription databases has been suggested as a way to improve medication reconciliation at the time of admission.

Objective: To quantify and describe unintended discrepancies between a best possible medication history and medications ordered on admission to the general medicine ward in a hospital with routine access to a provincial outpatient prescription database (British Columbia's PharmaNet).

Methods: This prospective study involved 20 patients who were regularly using at least 4 prescription medications before admission to hospital. The best possible medication history for each patient (based on a review of the medical chart and the PharmaNet record and an interview with the patient) was compared with the physician's admission orders to identify any discrepancies. The frequency and perceived severity of discrepancies, graded independently by 3 physicians, were compared with observations from a similar study conducted at a hospital where a prescription database was not available.

Results: The 20 patients were recruited between September 2005 and January 2006. For 8 patients (40%), information in the PharmaNet database was consistent with the prescription medication list obtained during the best possible medication history at the time of admission. For the other 12 patients, a total of 30 unintended discrepancies were identified, 13 (43%) of which were classified as having potential for moderate or severe harm. The proportion of patients with unintended discrepancies was similar to that for the comparison cohort (60% versus 54%). Although the percentage of discrepancies involving omissions was lower than in the comparison population (37% versus 46%), these results were offset by a higher proportion of commission discrepancies (27% versus 0%).

Conclusion: Unintended discrepancies were frequent, despite use of the PharmaNet database at the time of admission. Inconsistencies between the PharmaNet record and patients' actual medication use, coupled with

RÉSUMÉ

Contexte : Dans une récente étude, 50 % des patients admis à une unité de médecine générale avaient au moment de leur admission au moins une erreur d'ordonnance de médicament liée à une histoire médicamenteuse inexacte. Il a été suggéré de recourir à des bases de données informatisées sur les ordonnances comme moyen d'améliorer le bilan comparatif des médicaments à l'admission.

Objectif : Quantifier et décrire les différences accidentelles entre le meilleur schéma thérapeutique possible et les ordonnances de médicaments rédigées à l'admission à l'unité de médecine générale en ayant un accès courant à la base de données provinciale sur les ordonnances externes (PharmaNet, en Colombie-Britannique).

Méthodes : Il s'agit d'une étude prospective de 20 patients qui prenaient couramment au moins quatre médicaments d'ordonnance avant leur admission à l'hôpital. Le meilleur schéma thérapeutique possible pour chaque patient (établi grâce à l'étude du dossier médical et du registre PharmaNet et à un entretien avec le patient) a été comparé aux ordonnances rédigées à l'admission par le médecin pour détecter toute différence. La fréquence et l'importance perçue des disparités classées indépendamment par trois médecins ont été comparées aux observations tirées d'une étude similaire menée dans un hôpital où il n'y avait pas d'accès à une telle base de données.

Résultats : Les 20 patients ont été recrutés entre septembre 2005 et janvier 2006. Chez huit patients (40 %), l'information dans la base de données PharmaNet concordait avec la liste de médicaments d'ordonnance obtenue du meilleur schéma thérapeutique possible relevé au moment de l'admission. Pour les 12 autres patients, on a noté un total de 30 différences accidentelles, dont 13 (43 %) ont été classées comme ayant un potentiel délétère modéré à grave. La proportion de patients chez qui on a observé des différences accidentelles était similaire à celle de la cohorte de référence (60 % contre 54 %). Bien que le pourcentage de différences impliquant des omissions était plus faible que celui de la cohorte de référence (37 % contre 46 %), ces résultats ont été contrebalancés par une proportion plus élevée de différences de commission (27 % contre 0 %).

Conclusion : Les différences accidentelles étaient fréquentes malgré le recours à la base de données PharmaNet au moment de l'admission. Des

failure to verify PharmaNet data with patients, were likely contributing factors.

Key words: medication history, medication reconciliation, prescription database, medication errors

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disparités entre le registre PharmaNet et les médicaments réels du patient, jumelées à l'absence de vérification des données tirées de PharmaNet avec les patients, constituaient vraisemblablement des facteurs contribuant à de telles différences accidentelles.

Mots clés : histoire médicamenteuse, bilan comparatif des médicaments, base de données sur les médicaments d'ordonnance, erreurs de médication

[Traduction par l'éditeur]

INTRODUCTION

Medication errors are thought to account for up to 20% of all adverse reactions experienced in the hospital setting.[1] One common source of medication error occurs on admission, when the health care provider collects information about the patient's medications before admission and then decides to continue or discontinue these medications during the hospital stay. Adverse events can arise if there is an unintended discrepancy between the patient's actual medication history and the medications ordered in the hospital. In 2005, Cornish and others[2] reported that for 53.6% of study patients at a 1000-bed tertiary care hospital in Ontario, there were unintended discrepancies between orders written on admission to a general medicine ward and an interview-based medication history. Thirty-nine percent of these discrepancies were identified as having the potential to cause moderate or severe patient discomfort or clinical deterioration.

One potentially attractive option to minimize these errors is the use of pharmacy databases that record medication prescriptions filled at outpatient pharmacies. In British Columbia, pharmacies and hospitals have access to PharmaNet, an electronic, patient-specific record of prescriptions filled at all outpatient pharmacies throughout the province within the previous 14 months.

Although medication information from this type of drug database is increasingly being used as an aid in obtaining patients' medication history, little is known about the accuracy of this process. This pilot study was undertaken with the primary objective of quantifying and describing unintended medication discrepancies between medications ordered by physicians at the time of admission and a best possible medication history (a best-practice, interview-based medication history) for patients admitted to a general medicine ward in a tertiary care hospital with routine access to PharmaNet data. In addition, possible explanatory factors associated with these discrepancies were explored.

METHODS

Patients admitted from the emergency department to a general internal medicine ward by 1 of 2 preselected medical teams were identified the morning after admission by means of a computerized admission roster. Patients were considered for inclusion if their medication history indicated use of at least 4 regular prescription medications before admission. Patients were excluded if they had been transferred from a long-term care or nursing facility or from another acute care facility (since PharmaNet consistently records only outpatient prescriptions), if they were discharged within 24 h after admission, or if they were unable to consent to participate in the study. Because PharmaNet records prescription filling histories only for pharmacies located in British Columbia, patients from outside the province were also excluded. The study investigator (K.K.) approached all other patients, seeking their enrolment in the study, until a total of 20 patients had been recruited. Those who agreed were asked to provide informed consent. Patients who were not available to the study investigator because of obligations pertaining to their care and/or time constraints were not approached.

Medical staff ordered medications for their patients as per routine care, independent of this study. PharmaNet data were readily accessible to medical staff at the time of admission. The PharmaNet profile for each patient provides an electronic record of medications dispensed by provincial pharmacies within the previous 14 months. Information in the profile includes medication name, dose, and quantity dispensed, as well as the dates upon which the transactions occurred. Prescription medications are routinely recorded, but the profile excludes antiretroviral medications (for reasons of confidentiality), medications filled in long-term care facilities, and a small proportion of medications not subsidized under provincial drug benefit plans. Nonprescription medications may occasionally appear on the profile at the discretion of the dispensing pharmacist.

The study investigator prepared a best possible medication history (BPMH) no sooner than 48 h after admission; the 2-day delay allowed for clarification of orders as appropriate and normal provision of pharmaceutical care by ward pharmacists. The study investigator first reviewed both the medical chart and the PharmaNet record and then conducted a patient interview, including examination of prescription vials if available. This process was assumed to provide the most accurate medication history, as it represented a combination of all sources of medication information typically available to the hospital practitioner at the time of patient admission.

This comprehensive history was then compared with the physician's admission orders to identify any discrepancies. Discrepancies were classified as "intended" or "unintended", the latter referring to any discrepancy that was inadvertent or could not be justified by the medical team involved. Where the classification was unclear from the admitting or progress notes, the medical team or ward pharmacist was asked to clarify.

Three attending physicians (N.K., I.M., and G.H.) independently classified each unintended discrepancy for its potential to cause harm. As described by Cornish and others,[2] class 1 discrepancies were those unlikely to cause patient discomfort or clinical deterioration. Class 2 discrepancies were those with the potential to cause moderate discomfort or clinical deterioration, and class 3 discrepancies were those with the potential to cause severe discomfort or clinical deterioration. Inter-rater reliability was assessed (as described below) on the basis of these initial, independent classifications. The final score assigned to each discrepancy was based on agreement between at least 2 of the physician auditors. For situations where the auditors did not agree, they were asked to rescore the specific discrepancies, in consultation with each other, to attain agreement. The physician auditors were not involved in caring for any of the study participants and were blinded to the patients' identity.

Calculation of descriptive statistics and other analyses were performed with Excel 2000 (Microsoft, Redmond, Washington) and SPSS for Windows (version 12; SPSS Inc. Chicago, Illinois). The mean discrepancy rates per patient among selected subgroups from the overall sample were compared with *t* tests for independent samples. Inter-rater reliability among the auditors who rated the potential severity of each unintended discrepancy was calculated using the Fleiss kappa (κ) score for multiple observers,[3] where scores of less than 0.40 indicate poor agreement, scores of 0.4 to 0.75 indicate fair to good agreement, and scores above 0.75 indicate excellent agreement.

The study protocol was approved by the University of British Columbia—Providence Health Care Research Ethics Board.

Table 1. Characteristics of the Study Participants (*n* = 20)

Characteristic	No. (%) of Participants*
Sex	
Male	12 (60)
Female	8 (40)
Age (years), mean ± SD	69 ± 14.2
Admitted on Saturday or Sunday	9 (45)
Admitted after 8 PM	9 (45)
PharmaNet record reviewed by medical staff on admission	19 (95)
No. of medications before admission,† mean ± SD	11.1 ± 3.4
Use of dosing or memory aid	12 (60)
Vials available for inspection during interview	11 (55)

SD = standard deviation.
*Unless indicated otherwise.
†Includes both prescription and nonprescription medications, according to best possible medication history, based on interview with patient.

RESULTS

To reach the intended sample size of 20 patients, a total of 33 patients were approached between September 2005 and January 2006 and asked to participate in the study. Of these, 2 who initially agreed to participate were discharged before their scheduled interview with the investigator; 2 additional patients were recruited to replace them, and the final sample size was 20 patients (Table 1), as planned. The study participants were mostly male and elderly, with 80% using 8 or more medications before admission. Eleven patients (55%) had prescription vials available for inspection during the interview.

For almost all participants (19 of 20), the medical staff consulted PharmaNet before writing the admission orders. For the remaining patient, medical staff consulted PharmaNet within 48 h after admission. The information in the PharmaNet profile was consistent with actual prescription medication use before admission (as indicated by the BPMH) for 8 patients (40%). The chart admission history was consistent with actual prescription medication use for 4 patients (20%). When nonprescription medications were included, the chart admission history was accurate for only 2 patients (10%). In all cases where the PharmaNet profile was inconsistent with actual medication use before admission, the chart admission history was also inconsistent. Nonprescription medication histories were not routinely recorded in the chart. Among 17 patients reporting the use of such medications before admission, only 11 (65%) had any history pertaining to nonprescription products in their chart notes.

A total of 30 unintended admission order discrepancies were identified in the study population, 13 (43%) related to nonprescription medications and 17 (57%) related to prescription medications. These discrepancies occurred in 12 (60%)

patients, the number of discrepancies per patient ranging from 0 to 7. Ten patients (50%) had at least 1 discrepancy involving a prescription medication, whereas 7 (35%) had at least 1 discrepancy involving a nonprescription medication. The median number of discrepancies was 1 (interquartile range 0 to 2) per patient. The most common type of discrepancy was the omission of regularly scheduled medications (n = 11 or 37% of all discrepancies), followed by discrepancies of commission, in which orders were written for medications that patients were no longer taking (n = 8 or 27%) (Table 2).

Inter-rater reliability in the judging of severity was fair to good[3,4] (κ = 0.56, 95% confidence interval 0.42–0.70). A substantial proportion of the medication discrepancies (43%) were rated as having potential for moderate or severe patient discomfort or deterioration (Table 3). Three (23%) of the 13 nonprescription drug discrepancies and 2 (12%) of the 17 prescription drug discrepancies were rated as having the potential for severe patient discomfort or deterioration (Table 4).

In the exploratory analysis, an inaccurate PharmaNet profile was associated with a significantly higher overall rate of discrepancy (Table 5). Although no other associations were significant, there was a nonsignificant trend toward fewer discrepancies among patients for whom the chart admission history was considered accurate and for those who used blister-packaging for compliance before admission (Table 5).

Table 2. Types of Discrepancies Identified

Type of Discrepancy	Nonprescription Drug	Prescription Drug	Sum (% of Total)
Omission	9	2	11 (37)
Commission*	4	4	8 (27)
Wrong drug†	0	5	5 (17)
Wrong dose	0	3	3 (10)
Wrong frequency	0	3	3 (10)
Total	13	17	30 (100)

*Defined as discrepancies involving orders for medications that the patient was thought to be taking before admission, but that were not in fact being taken.
†Defined as discrepancies involving inadvertent substitution of a new drug in hospital for one that was being taken before admission.

Table 3. Severity of Discrepancies Identified

Type of Discrepancy	Nonprescription Drug	Prescription Drug	Sum (% of Total)
Class 1*	10	7	17 (57)
Class 2†	0	8	8 (27)
Class 3‡	3	2	5 (17)
Total	13	17	30 (100)

*Discrepancy was unlikely to result in discomfort or clinical deterioration.
†Discrepancy had potential to result in moderate discomfort or clinical deterioration.
‡Discrepancy had potential to result in severe discomfort or clinical deterioration.

Table 4. Details of Discrepancies* Assigned a Class 3 Severity Score†

Drug Order at Time of Admission	Reason for Discrepancy
Calcium carbonate 2500 mg PO bid, based on PharmaNet record	Although this drug was previously being used by the patient (for end-stage renal disease), it had been discontinued before admission because of patient's high serum calcium levels
Propafenone 150 mg PO tid, based on PharmaNet record	Patient's dose had been decreased to 150 mg PO bid by the cardiologist 6 weeks earlier
Clonazepam 0.5 mg PO tid, based on PharmaNet record	Dose had been reduced to 0.5 mg PO bid before hospital admission, because of excess sedation
Enteric-coated acetylsalicylic acid 81 mg PO daily was *not* ordered (but should have been)	Patient had been using this drug before admission, for reduction of cardiac risk factors (occurred with 2 separate patients)

*As determined by patient interview, PharmaNet review, and inspection of vials, if available.
†Discrepancies with the potential to result in severe discomfort or clinical deterioration.

Table 5. Association Between Selected Variables and Unintended Discrepancies

Characteristic	*n*	Mean No. of Unintended Discrepancies Per Patient		Difference (95% CI)	*p* value
		For Patients with Characteristic	For Patients Without Characteristic		
PharmaNet correct	8	2.25	0.38	1.88 (0.41 to 3.34)	0.021
Medication history correct	2	1.67	0	1.67 (–1.42 to 4.76)	0.27
Use of blister packs before admission	5	1.73	0.80	0.93 (–1.23 to 3.10)	0.38
Vials available	11	1.56	1.45	0.10 (–1.83 to 2.03)	0.91
History taken by medical student (v. medical resident)	8	1.75	1.13	0.63 (–1.05 to 2.30)	0.44
≥ 8 medications before admission	16	1.00	1.63	–0.63 (–3.00 to 1.75)	0.59
Weekend admission	9	0.82	2.33	–1.52 (–3.53 to 0.50)	0.13
Nighttime admission (after 8 PM)	9	1.00	2.11	–1.11 (–3.24 to 1.02)	0.27

CI = confidence interval.

DISCUSSION

Medication errors are a major source of in-hospital adverse events,[5,6] and strategies to reduce these potentially avoidable errors are needed. Although the use of a province-wide prescription database is widely assumed to reduce hospital medication-ordering errors, this strategy had not previously been evaluated. In this pilot study, despite use of the PharmaNet database at the time admission orders were prepared, the proportion of patients with unintended medication discrepancies remained high, and a substantial proportion of the discrepancies were classified as having potential for moderate or severe patient discomfort or clinical deterioration. In a similar study in Ontario,[2] where a provincial prescription database was not available, the proportion of patients with unintended discrepancies was similar (54% versus 60% in the current study), as was the level of potential harm associated with the discrepancies identified. Although the rate of omission errors in the current study was slightly lower than in the Ontario study (37% versus 46%), this benefit was offset by a higher rate of errors of commission (27% versus 0%).

The findings in this study highlight the limitations of relying on a province-wide prescription database to improve the accuracy of admission medication histories. Similarly, a recent study examining agreement between information in the PharmaNet profile and an interview-based BPMH reported PharmaNet inaccuracies for 71% of the study population.[7] The discrepancies in that study were related to the type and number of medications taken by the patient and the doses of individual medications consumed. Medications are only recorded in the PharmaNet profile at the time they are dispensed, and discrepancies may arise when doses are changed or medications are discontinued between refills. As well, late refills can give the impression that a patient no longer uses a particular medication. In the aforementioned study, late refills were the most common source of PharmaNet discrepancies.[7] Misconceptions regarding the scope of the PharmaNet profile may also be a concern, as some practitioners may be unaware that some medications are not recorded in the profile (e.g., no antiretrovirals and few nonprescription medications). In the current study, admission medication histories recorded in the chart were commonly inaccurate, even though PharmaNet was used in almost all cases. In addition, the PharmaNet profiles did not reflect actual medication use for a substantial proportion of patients, and these errors were carried through in the medication ordering. This suggests that PharmaNet may have been used as a substitute for medication history-taking, rather than as an additional resource for medication reconciliation. Educating all practitioners about these limitations will be an important step in encouraging more appropriate use of PharmaNet and similar databases and discouraging their use as sole sources of a medication history.

Practitioners should also be educated about the importance of routinely collecting information for nonprescription products. Although a perception may exist that nonprescription medications are a relatively low priority in the context of a hospital admission, 7 (35%) of the patients in this study had an admission order discrepancy associated with a nonprescription medication, and 23% of these discrepancies were judged to have potential for a severe adverse outcome. Many of these discrepancies occurred because the patient was simply not asked about nonprescription medication use. Even if nonprescription medications are intentionally discontinued upon admission to hospital, information about their use is important. For example, it may give insight into possible drug interactions and adverse effects experienced on admission or even after discharge.

This study had several limitations, including the small sample size. Although the study was underpowered to allow statistical comparisons with the Ontario study, it nevertheless revealed a high proportion of medication errors despite use of a province-wide prescription database. Furthermore, the 3-point scoring system used to evaluate the severity of each discrepancy has not been validated, and it is unknown whether the unintended discrepancies actually resulted in adverse events for the patients. However, this scoring system has been used in other studies, and in the current study there was moderate agreement among the physician auditors who quantified the severity of unintended discrepancies. This study included no patients with language or communication barriers or cognitive impairments; as such, the results may not be generalizable to these patient populations, in whom the risk of medication errors may be higher. Furthermore, the patients who were willing to participate in this study may have been more likely to communicate openly with their health care providers, which would improve the chances that the medication history would be accurate. Finally, this study focused on patients in a general medicine ward who were taking at least 4 regular prescription medications before admission and who had unplanned hospital admissions through the emergency department. As such, the discrepancy rates observed might not be representative of those in other medical services or at other facilities using different admission processes.

Conclusions

The findings of this investigation suggest that despite frequent use of PharmaNet to aid in history-taking, the admission order discrepancy rates in the study population were high and no better than those observed in a similar population where a prescription database was not available. The perceived severity of the discrepancies was also no different than in the comparison population. Although PharmaNet can be a useful tool in the collection of a thorough medication history, its use as a perceived "best source" of information may increase the risk of unintended order discrepancies on hospital admission, possibly leading to preventable medication errors. Using PharmaNet information to guide the collection of an interview-based BPMH and ensuring the collection of information pertaining to nonprescription medication use are likely the best approaches to ensuring an accurate medication history and minimizing medication errors. Health care providers should be aware of the limitations of pharmacy databases such as PharmaNet. The development of a hospital protocol or tool allowing PharmaNet information to be integrated into a form or order sheet that could be reviewed and confirmed with the patient at the bedside might help practitioners to collect the most accurate history possible in an efficient manner and could be an area of future study.

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