



A Case-Control Study: The Impact of Unintentional Discrepancies and Pharmacist Discharge Prescription Review on 30-Day Hospital Readmission

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Abstract

Introduction: Medication discrepancies on hospital discharge are common and occur despite the use of technology to generate electronically created discharge (e-discharge) prescriptions, justifying pharmacist involvement. No published studies have focused on medication discrepancies as a risk factor for readmission. The aim was to explore the relationship between medication discrepancies on discharge and readmission rates, and how both are affected by pharmacist intervention. **Objectives:** The primary objective was to establish the relationship between medication discrepancies on the e-discharge prescription and hospital readmissions within 30 days of discharge. Secondary objectives were to determine the 30-day readmission rate with and without pharmacist involvement, and risk factors for 30-day readmission. **Methods:** This was a matched case-control study where cases and controls consisted of patients readmitted and not readmitted to hospital within 30 days of discharge from the general medicine service, respectively. Case patients were defined as patients who had been readmitted to the hospital within 30 days of discharge from the general medicine unit. Control patients were defined as patients who had not been readmitted to the hospital within 30 days of discharge. Chi-square statistics was used to analyze the association between the presence of medication discrepancy at discharge and 30-day readmission. Multivariate logistic regression was used to further analyze the associations to determine which risk factors best relate to 30-day readmission. **Results:** Between January 1, 2017 and December 31, 2017, a total of 401 e-discharge prescriptions were reviewed, and 194 cases were readmitted within 30 days of discharge. Similar proportions of patients were readmitted compared with not readmitted regardless of whether discrepancies were identified on the e-discharge prescriptions, and there was no relationship identified between medication discrepancies and readmission within 30 days (odds ratio [OR] = 1.04; $P = .854$). The readmission rate with and without pharmacist involvement was similar between the case group (50%) and control group (48.0%). The proportion of discharge prescriptions with discrepancies was 48.8% in the group that had pharmacist involvement and 47.0% in the group that had no pharmacist involvement. Additionally, a LACE score of 12 or greater was identified as a statistically significant risk factor for readmission (OR = 2.13; $P < .001$). **Conclusions:** Pharmacist review of the e-discharge prescription did not affect the readmission rate. A LACE score of 12 or greater was associated with a higher risk of readmission. Future studies are needed to identify patient groups at high risk of readmission and to determine pharmacist interventions that could reduce readmission rates.

Keywords

medication safety, readmission, medication review, risk score

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Background

Medication Discrepancies on Hospital Discharge

Seventy percent of patients have one or more medication discrepancies on discharge.¹ Medication discrepancies are defined as differences between the medications listed on the

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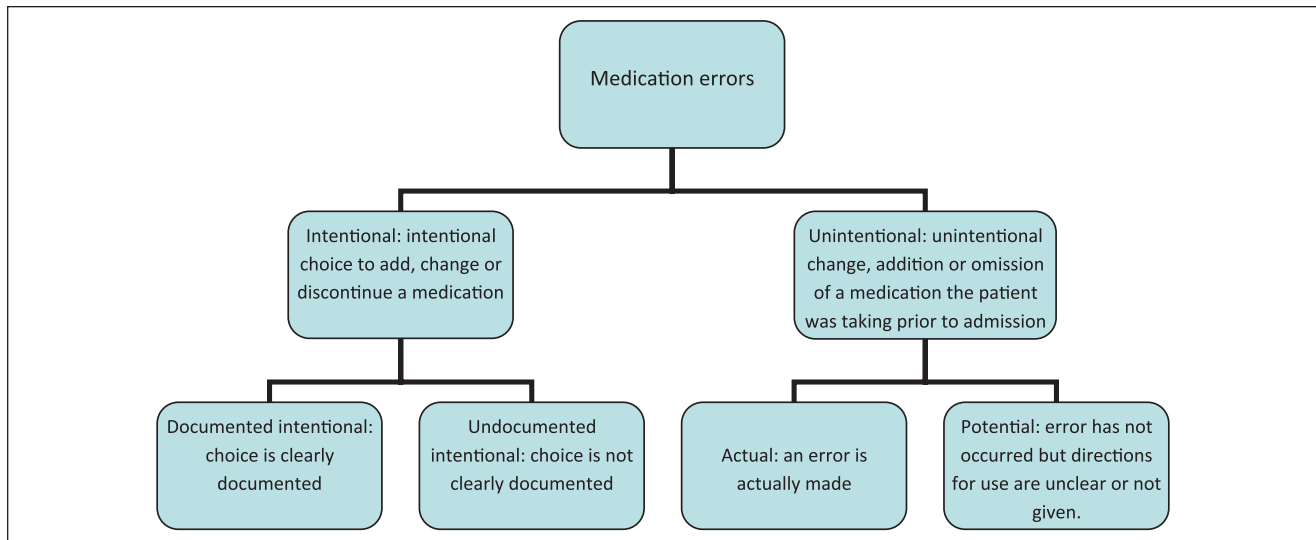


Figure 1. Method of categorizing medication errors.

best possible medication history (BPMH) or best possible medication transfer list and the actual admission or transfer orders written in hospital.² Discharge medication discrepancies are defined as a difference between the best possible medication discharge list and the discharge medication reconciliation (DMR).¹ Studies have shown that pharmacist involvement in creating discharge prescriptions reduces the average number of unintentional discrepancies per patient by 50% compared with discharge prescriptions created without a pharmacist³⁻⁸ and reduces the number of patients with discrepancies by up to 85%.^{5,6} Medication discrepancies exist regardless of whether reconciliation is paper-based or electronic.² Another study focused specifically on pharmacists' impact on electronically created discharge (e-discharge) prescriptions, and it was observed that pharmacists intervened on an average of 3 prescribing errors per patient, even with the use of electronic prescribing.⁴

Number and Type of Medication Discrepancies

Several studies have examined common types of medication discrepancies and prescribing errors,^{1,4,8-11} and several methods of classifying medication discrepancies exist. One of those methods, published by Safer Healthcare Now! (SHN) with the support of the Institute for Safe Medication Practices (ISMP) Canada,¹² classifies types of medication discrepancies as intentional or unintentional (Figure 1).

Intentional discrepancies are defined as discrepancies in which the prescriber made an intentional choice to add, change or discontinue the medication. An undocumented intentional discrepancy refers to a situation where the physician intended a change but failed to document it. Unintentional discrepancies are defined as discrepancies in which the prescriber unintentionally changed, added or

omitted a medication the patient was taking prior to admission. Unintentional discrepancies can be further categorized into actual or potential, where either an error is actually made (such as adding, switching, or omitting a medication) or potential (where directions for medication use were either unclear or not given). Actual discrepancies can be further classified into several categories, including drug omission, incorrect or omitted dose, no indication or drug commission, therapeutic duplication, incomplete or unclear prescription order, drug interaction, incorrect or omitted drug formulation, and incorrect or omitted frequency.¹³

Factors Affecting 30-Day Hospital Readmission

Research has identified many factors that have been associated with 30-day hospital readmissions¹⁴⁻²³; however few studies have considered that discharge medication discrepancies could be a contributing factor.¹⁴⁻²³ Risk factors identified include age greater than 80 years,^{14,21} presence of comorbidities (type and number),^{14,15,20} discharge to a nursing home,^{14,21} and the number of emergency room visits¹⁴ or hospital admissions during the past 30 days.²¹ Drug classes often implicated in medication discrepancies vary by study but often include cardiovascular, gastrointestinal, and neurological, or psychotropic agents.^{1,8,10,11} Appendix A lists high-risk medications as per ISMP.⁴

Studies have been conducted on the impact of pharmacist intervention on the rate of hospital readmissions, and several have shown an overall decrease in 30-day hospital readmission with pharmacist interventions such as medication reconciliation (either on admission or discharge), patient counseling and education on or after discharge, and/or follow up phone calls.²³⁻³⁰

Tools to Target High-Risk Patients

The LACE Index Scoring Tool is used by researchers and clinicians at the Winchester District Memorial Hospital (WDMH) to help clinicians identify patients who are at increased risk for hospital readmission within 30 days. It scores patients on *Length of stay (LOS)*, *Acuity of admission*, *Comorbidities*, and the number of *Emergency department admissions* in the 6 months prior to the current admission.¹⁴

The “10 + 10” criterion was developed by pharmacists at WDMH to identify patients at higher risk for 30-day readmission, and who might benefit from pharmacist involvement in creating the e-discharge prescription. It refers to patients who are being discharged on 10 or more medications or who had a LOS of 10-day or longer.

The Charlson Score is a scoring tool developed and validated to classify the number and severity of comorbidities that may affect the risk of mortality for use in longitudinal studies. Because certain comorbidities have been shown to be risk factors for readmission, it is plausible that the type and number of comorbidities a patient has may affect the risk of hospital readmission.³¹

Rationale and Impact

Discrepancies and prescription errors at discharge are common and can have a negative impact on medication safety. Pharmacist involvement in DMR and patient counseling are 2 interventions that have been evaluated in studies looking to reduce 30-day readmission and studies looking to reduce medication discrepancies and prescribing errors at discharge. However, the impact of medication discrepancies on hospital readmission has yet to be established. It is also currently unknown if pharmacist facilitation of e-discharge prescriptions could decrease both medication discrepancies at discharge and the rate of 30-day hospital readmissions.

The goal of this study is to determine if pharmacist intervention during the generation of discharge prescriptions will have a positive impact on 30-day readmission rates. It also aims to improve upon the current system at WDMH by identifying the most common errors, creating opportunities to educate prescribers on how to avoid them. Finally, this study aims to identify patient groups that are at high risk of 30-day readmission so they can be targeted for pharmacist interventions.

Objectives

The primary objective is to determine the relationship between medication discrepancies on the e-discharge prescription and hospital readmission rate within 30 days of discharge. Secondary objectives are determining the proportion of medication discrepancies on e-discharge prescriptions occurring with and without pharmacist involvement;

	Readmitted	Not Readmitted
Discrepancies at Discharge	Case	Control
No Discrepancies at Discharge	Case	Control

Figure 2. Diagram of 2×2 study format.

quantifying the number and types of discrepancies; determining the mean number of discrepancies per patient with pharmacist involvement compared to without pharmacist involvement; and determining patient risk factors relating to 30-day hospital readmission.

Methods

Study Design

This study was carried out as a matched case-control study in a two-by-two format (Figure 2). Case patients were defined as patients who had been readmitted to the hospital within 30 days of discharge from the general medicine service at WDMH. Control patients were defined as patients who had not been readmitted to WDMH within 30 days of discharge. Some cases and controls had a pharmacist review the e-discharge prescription that was created by, or in conjunction with, a physician. In these situations, the pharmacist compared the e-discharge prescription to the BPMH to ensure completeness. Cases were matched to controls in a one-to-one ratio from the pool of patients discharged from general medicine between January 1, 2017, and December 31, 2017. Matching was based on whether or not the patient was 80 years or older, and whether or not there had been a hospital or emergency department admission in the 6 months prior to admission.

For the purpose of this study, the definition of discharge medication discrepancy is defined as described by Wong et al¹ and included incomplete or unclear prescriptions as defined by SHN/ISMP¹² as types of medication discrepancies. Additionally, all discrepancies were assumed to be unintentional.

Sample Size and Study Population

The population studied included patients discharged from the general medicine department at WDMH between January 1, 2017, and December 31, 2017. The pharmacists documented patients with whom they were involved in the DMR. Patients were included if they had a BPMH completed on hospital admission and a DMR generated at discharge. In order to assess legal prescription requirements, patients were required to have an Ontario address and were otherwise excluded. The study also excluded patients for whom a discharge prescription was not required, patients admitted to hospital for less than 48 hours, and patients who

received a separate prescription which was not included on the e-discharge prescription. Herbal, homeopathic, and complementary medicines were not evaluated for discrepancies on the e-discharge prescription. Finally, elective admission (ie, surgical intervention) within 30 days of hospital discharge, was not counted as a readmission.

The pharmacists targeted patients if they fulfilled the “10 + 10” criterion and/or if the pharmacist or medical team deemed the patient likely to benefit from pharmacist involvement in DMR, based on professional judgment. This included but was not limited to factors such as recent readmission(s) within the previous 6 months; several medication changes and/or addition; perceived or known medication adherence issues; new or stopped high-risk medications (Appendix A); perceived inexperience of medical resident or student with e-discharge; drug coverage issues (not a beneficiary of Ontario Drug Benefit or private insurance); special instructions or education required for the use of a new medication or device; requiring communication with community pharmacy; lack of support at home; and presence of communication barriers.

Data Collection

Two investigators retrospectively collected data. To ensure inter-rater agreement between investigators, a kappa score was calculated on sample 20 of patients. Any discordance between the two investigators was resolved through discussion. See Appendix B for data collection form used for the study.

A list of patients discharged from the general medicine unit at WDMH between January 1, 2017, and December 31, 2017, was obtained from Health Records Department. The list included each patient’s age at admission, gender, and whether there were any emergency department visits to The WDMH within the 6 months prior to the date of admission to general medicine unit.

Data was obtained from the electronic medical record software used by WDMH. Specifically, the investigators used the DMR, BPMH, the record of patient encounters, admission consultation and notes, and the discharge summary for each patient identified. Data were extracted by the principal investigator and a pharmacy student using a standardized form. A select number of charts were reviewed in conjunction with project preceptors to ensure the accuracy of the extracted information. Each patient was assigned a unique number during randomization.

Unintentional discrepancies were classified into 3 main categories. Drug discrepancies included omission or commission; therapeutic duplication (ie, both formulary substitution and original home medication included on prescription), inappropriate route, and formulary substitution not restored to original home medication. Dose discrepancies included incorrect dose (eg, tablet strength that

is not available). The category of incomplete prescriptions included those with missing limited use (LU) code (where applicable), misspelled drug name, omission of formulation, omission of dose, omission of frequency, quantity missing on medications meant to be filled at a community pharmacy, and providing repeats on narcotic drugs.

Statistical Analysis

Based on the administrative database at WDMH, from January 1, 2017 to January 31, 2017, there were 1 843 admissions to the general medicine unit. Thirty percent (approximately 553 admissions) were expected to be readmitted to WDMH within 30 days, according to an internal audit.³² Evidence from published literature estimates that 70% of patients have at least one medication discrepancy on hospital discharge. Based on these data, it was estimated that a sample size of 770 patients (1:1 case:control ratio) would provide a power of 90% to detect an odds ratio of 1.8 with a *P* value of less than .05. For the primary objective, the proportion of patients readmitted and not readmitted who had discrepancies on the e-discharge prescription was reported as percentages of the total number of patients readmitted and not readmitted, respectively. For the secondary objectives, the proportion of medication discrepancies on e-discharge prescriptions occurring with and without pharmacist involvement was reported as percentages of the total number of prescriptions reviewed. The categorization of discrepancies was reported as percentages of the total number of discrepancies. The number of medication discrepancies on e-discharge prescriptions occurring with and without pharmacist involvement was reported as the mean number of discrepancies per patient. The mean number of discrepancies per patient was compared between cases and controls. Potential risk factors for 30-day hospital readmission have been analyzed using a multivariate logistic regression model. The independent variable was 30-day readmission and dependent variables, ranked in order of importance, included 3 or more medication changes; presence of high-risk medications (Appendix A); 10 or more medications on discharge LOS of 10 or more days; pharmacist intervention; LACE (score of ≥ 12); discharge to a nursing home or extended level of care; and discharge in the evening or on weekends.

Chi-square statistics assessed the association between the presence of medication discrepancy at discharge and 30-day readmission. Multivariate logistic regression was used to further analyze the associations to determine which risk factors best relate to 30-day readmission. Risk factors included in the multivariate analysis were selected a priori (hierarchical) and had a *P* value of less than .1 if univariately associated with 30-day readmission. A comparison between categorical and continuous data was done using the chi-square test. The data were analyzed using statistical software (Stata/IC, version 16).

Table 1. Patient Characteristics of Cases (Readmitted) and Controls (Not Readmitted).

	Readmitted (n = 194)	Not readmitted (n = 207)
Age in years, mean (SD)	67.7 (15.0)	69.1 (15.6)
Charlson score, median (range)	2.0 (0-8)	2.0 (0-8)
Risk factors		
Age ≥ 80 years, n (%)	42 (21.6)	53 (25.6)
LACE score, median (range)	12 (6-20)	11 (5-18)
10 + 10 criterion, n (%)	41 (21.1)	24 (11.6)
LOS in days, median (range)	6 (1-36)	5 (2-68)
Admission in previous 6 months, n (%)	129 (66.5)	140 (67.6)
Number of medications		
On BPMH, mean (SD)	11.5 (6)	10.3 (6.2)
On e-discharge, mean (SD)	13.0 (5.8)	11.9 (6.1)
High-risk medications, mean (SD)	2.3 (1.9)	2.2 (2.0)

Abbreviations: LOS, length of stay; BPMH, best possible medication history; e-discharge, electronic discharge.

Results

A total of 401 e-discharge prescriptions met the inclusion criteria for the study. Of these, 194 patients were readmitted (cases), and 207 were not readmitted (controls) within 30 days of discharge from WDMH. Baseline characteristics were similar between cases and controls (Table 1).

The mean ages of patients in each group were 67.7 and 69.1 years for cases and controls, respectively. The median Charlson score for both groups was 2.0. Cases met the “10 + 10” criterion more frequently than controls (21.1% vs 11.6%) and, on average, had 1 additional medication on the BPMH and e-discharge prescription. Pharmacists participated in creating or reviewing the DMR in 84 of the 401 patient encounters (20.9%).

Primary Outcome

Similar numbers of patients were readmitted and not readmitted within 30 days regardless of whether discrepancies were identified on the e-discharge prescriptions. No relationship was established between presence of medication discrepancies on the e-discharge prescription and readmission to the hospital within 30 days of discharge (odds ratio [OR] = 1.04; $P = .854$) (Table 2). The kappa score for the interrater agreement was 0.43 (95% CI 0.06-0.81), which represents moderate agreement.

Medication Discrepancies

Of the 401 e-discharge prescriptions reviewed, 47.4% contained medication discrepancies: 21.5% of those with discrepancies occurred with pharmacist involvement, and

Table 2. Medication Discrepancies by Readmission.

	Any discrepancy	No discrepancies
Not readmitted, n (%)	99 (24.7)	108 (26.9)
Readmitted, n (%)	91 (22.7)	103 (25.7)
Total, n (%)	190 (47.4)	211 (52.6)

Table 3. Medication Discrepancies by Pharmacist Involvement.

	Any discrepancy	No discrepancies
Pharmacist, n (%)	41 (10.2)	43 (10.7)
No pharmacist, n (%)	149 (37.2)	168 (41.9)
Total, n (%)	190 (47.4)	211 (52.6)

Table 4. Types and Number of Discrepancies.

	Number	Percentage of total discrepancies
Omission/commission	200	58.0
Missing limited use code	58	16.8
Missing quantity	21	6.1
Missing frequency	13	3.8
Formulation	11	3.2
Duplication	9	2.6
Repeats on narcotics	8	2.3
Missing dose	8	2.3
Misspelling	8	2.3
Formulary substitution not restored	7	2.0
Incorrect dose	2	0.6
Incorrect route	0	0
Total	345	100

78.5% had no documented pharmacist involvement. The remaining 52.6% of e-discharge prescriptions had no discrepancies. Of these, 20.3% had pharmacist involvement, and 79.7% had no pharmacist involvement (Table 3). The mean number of discrepancies per patient was 0.88 with and 0.85 without pharmacist involvement in creating the e-discharge prescription.

A total of 345 discrepancies were identified out of the 4988 medications on all the e-discharge prescriptions. The most common type identified was drug omission/commission, which accounted for more than half (58%) of the total number. The second most common discrepancy was missing LU code. The types and numbers of discrepancies found are shown in Table 4.

Risk Factors for 30-Day Readmission

Readmission rates within 30 days of discharge with and without pharmacist participation in creating or reviewing the

Table 5. Third-Day Readmission by Pharmacist Intervention.

	Readmitted	Not readmitted
Pharmacist, n (%)	42 (10.5)	42 (10.5)
No pharmacist, n (%)	152 (37.9)	165 (41.1)
Total, n (%)	194 (48.4)	207 (51.6)

Table 6. Risk Factors for 30-Day Readmission.

	Univariate		Multivariate	
	Odds ratio	P	Odds ratio	P
LACE score ≥ 12	2.13	<.001	2.13	<.001
≥ 10 day length of stay	1.93	.008	1.49	NS
≥ 10 medications at discharge	1.46	.113	1.14	NS
10 + 10 criterion	2.04	.01	1.52	NS

Abbreviation: NS, not significant.

e-discharge prescription were 50% and 48.0%, respectively (Table 5). In univariate analysis of risk factors for readmission, LACE score of 12 or greater (OR = 2.13, $P < .001$), 10-day or greater LOS (OR = 1.93, $P = .008$), 10 or more medications at discharge (OR = 1.46, $P = .113$) and the “10 + 10” criterion (OR = 2.04, $P = .01$) were statistically significant. However, in multivariate analysis, the LACE score of 12 or greater (OR = 2.13) was the only statistically significant association with readmission. Neither a 10-day or greater LOS (OR = 1.49), 10 or more medications at discharge (OR = 1.14), nor “10 + 10” criteria (OR = 1.52) had a statistically significant association with 30-day readmission rate in multivariate analysis (Table 6). The number of medication changes, presence of high-risk medications, pharmacist intervention in creating the e-discharge prescription, discharge to a nursing home or extended level of care, and discharge in the evening or on weekends did not show a statistically significant relationship to 30-day readmission rates.

Discussion

Few studies have discussed medications as a risk factor for hospital readmission, and some studies have examined postdischarge follow-ups with pharmacist involvement as well.^{33,34} However, this study focused specifically on the impact that medication discrepancies have on readmission rates within 30 days of discharge. One study suggested that the quality of medication reconciliation may be associated with the risk of readmission.¹⁶ The medication reconciliation procedures implemented at WDMH meet the Required Organizational Practices as per Accreditation Canada.³⁵ However, the variability in BPMH quality is reflective of medication reconciliation challenges faced by pharmacists when identifying and resolving discrepancies.

Results of this study further demonstrate that the number of new medications on discharge has not previously demonstrated a relationship to readmission.¹⁴ Having 10 or more medications at discharge was not shown to increase the risk of readmission, also similar to other studies.^{21,22} Additionally, no relationship was identified between the number of high-risk medications and the risk of readmission, which is not addressed in current literature.

Medication Discrepancies

Among the discharges that had pharmacist involvement, similar proportion of e-discharge prescriptions which had medication discrepancies was similar to prescriptions which had none. One study showed that the rate of medication discrepancies can be reduced by almost 50% with pharmacist involvement compared to no pharmacist involvement. However, these discrepancies were not restricted to discharge, and the study had a much higher occurrence than in this study.⁸ One possible reason for this is that this study evaluated only discrepancies on the e-discharge prescriptions and, therefore, did not capture other pharmacist interventions while the patient was admitted.

Previous studies analyzing discrepancy types in a similar method to this study showed that drug omission is among the top 2 most common discrepancy types, accounting for 20-33% of all discrepancies.^{1,4,8} In a Canadian study, missing LU codes accounted for 29.5% of discrepancies.¹ However, the only study that used e-discharge demonstrated that together drug omission, drug selection and dose errors accounted for more than 75% of all errors.⁴ In this study, 58% of discrepancies were associated with drug omission or commission, and 16.8% of discrepancies were due to missing LU code. The rate of discrepancies in this study is lower than other similar studies identified in the literature.^{1,4,8} This difference could be associated with the use of the electronic medication reconciliation program at WDMH, which is equipped with functions that force reconciliation of home medications included in the BPMH. This function makes unintentionally omitting home medications included on the BPMH very difficult.

The mean number of discrepancies per patient with and without pharmacist involvement was similar. The average number of discrepancies per patient was 0.47, whereas other studies identified a higher number of discrepancies per patient (ranging from 0.7 to 9.6).^{1,4,8} One study showed the mean number of medication discrepancies per patient was reduced by almost half with pharmacist presence on the admitting service.⁸ In the general medicine department at WDMH, each interdisciplinary team includes a clinical pharmacist. Therefore, it is expected that rates of medication discrepancies would be lower at baseline, given the preexisting clinical pharmacist involvement.

Risk Factors

Previously studies identified risk factors for hospital readmission within 30 days of discharge include but are not limited to age 80 years old or greater,^{14,21} increased number and type of comorbidities,^{11,21,22} number of emergency department visits^{14,22} or admissions^{17,21,22} within the previous 1 month to 1 year, the urgency of admission,¹⁴ and discharge to long-term care or with an extended level of care.^{15,18} The relationship between the LOS and 30-day readmission is also conflicting. Some studies have shown that longer LOS is predictive of readmission^{14,17,22,23} and represents the severity of illness.¹⁷ However, associations between LOS less than 72 hours and earlier readmissions have also been formed.¹⁸ The LACE score uses several of the previously noted risk factors to calculate early death or readmission risk to the hospital within 30 days of discharge from the index admission. A score of 12 points is associated with a 17% probability that the patient will either die or be readmitted within 30 days of discharge.¹⁴ This scoring system has been validated,¹⁴ and the current study confirms that a LACE score of 12 or greater is associated with unplanned readmission within 30 days of discharge. However, the 4 components of the LACE score, namely Length of stay, Acuity of admission, Comorbidities, and previous Emergency department visits, are each independently linked with an increased risk of death or readmission.¹⁴ The multivariate analysis in this study also examined these as independent risk factors and did not find any significant associations. LOS of 10 or more days was not shown to be independently associated with an increased risk of 30-day readmission. This lack of association may be due in part to the fact that patients admitted to general medicine for less than 48 hours were automatically excluded from the study whereas other studies either did not exclude patients with a shorter LOS^{14,18,22} or only excluded patients who were admitted for less than 24 hours.¹⁷ Additionally, some of the studies had much larger sample sizes^{14,17} than this study, allowing smaller differences to be observed. Finally, the “10+10” rule developed to target patients at high risk of readmission was not shown to be predictive of 30-day readmission.

Limitations

Limitations to this study include that it was unable to identify patients readmitted to other hospitals within 30 days of discharge from WDMH, and those who passed away within 30 days of discharge. The study also had a restricted time frame for retrospective data collection contributing to a lower sample size and decreased the statistical power of the study. By extending the data collection time period, more patients could have been included contributing to a larger sample size. In addition, the study also did not determine

the number of readmissions related to medication-specific causes since these data were not collected.

Interventions varied among individual pharmacists on discharge such that some may have included patient counseling. In this case, the study was not able to differentiate whether readmissions were affected by an improved patient understanding of medication changes. Also, any impacts made by pharmacists throughout the admission prior to discharge was also not assessed by this study, which may have reduced the number of interventions required at discharge.

This study only evaluated the use of LU codes for beneficiaries of the Ontario Drug Benefit Program who were 65 years or older and not for those who were younger than 65 years since they were more difficult to identify from the population (eg, patients on social assistance). The accuracy of the Charlson score was limited by the accuracy of the sources of information used to collect the medical history and, if undocumented or vague, diagnoses may have been missed and therefore introduced inaccuracy into tabulated Charlson scores.

Medication discrepancies were used as a surrogate marker, but the clinical relevance of discrepancies was not assessed. A large percentage of the captured medication discrepancies were unlikely to be clinically relevant to result in a hospital readmission. Additionally, some discrepancies were not included since they were difficult to evaluate without the utilization of clinical judgment in determining the appropriateness of the prescribing choice (eg, prescribing of a medication the patient has a documented allergy to). These potential discrepancies that were not collected may have been clinically relevant. This study also did not evaluate discrepancies on any prescriptions given to the patient that were not included on the e-discharge (eg, those handwritten by consulting services).

Medication discrepancies addressed by the community pharmacist postdischarge were not captured, for example, missing LU codes, therapeutic duplications, and other drug therapy problems identified with MedsChecks (a publicly funded medication review in Ontario). These interventions may help patients to prevent readmission.

This study was also not able to account for the cumulative experience gained by medical residents or students from completing each e-discharge prescription with a pharmacist. It is anticipated that learning from pharmacist interventions and can reduce the number of discrepancies in future e-discharge prescriptions.

Only the discrepancies on the e-discharge prescription, when compared with the BPMH were captured in this study. Any discrepancies present on the BPMH may be an additional source of discrepancy that could be carried through the hospital stay and the next readmission.

Finally, the software used for medication reconciliation and the creation of the e-discharge prescription is equipped with mandatory fields. This makes it difficult for medications included on the BPMH to be missed on the DMR, and

therefore on the e-discharge prescription. This may limit comparability to other studies and centers where e-discharge prescriptions are not used, or where software is designed differently.

Directions for Future Research

This study reviewed e-discharge prescriptions and medication discrepancies were not shown to reduce the risk of readmission. Therefore, more research is needed to determine risk factors associated with readmissions (including examining the most common medical conditions associated with readmissions) in order to identify populations at high risk. These patients can then be targeted for pharmacist intervention. Also, pharmacist efforts in identifying and resolving medication discrepancies would likely be more effective if focused on patients who were readmitted for medication-related causes. Developing a method of distinguishing these patients on admission is essential. Finally, the value of pharmacist interventions in the medication reconciliation process needs to be identified not solely on discharge but also on patient admission or readmission, and throughout the hospital stay.

Conclusions

Medication discrepancies on e-discharge prescriptions were not found to affect the 30-day readmission rate in general

medicine. Pharmacist involvement with DMR may not be of benefit with regard to readmissions. Therefore, emphasis should be placed on the clinical and educational interventions pharmacists make throughout the admission, as well as at discharge. Given the scarcity of resources, prioritization is key for pharmacists. Future research should be targeted at identifying specific populations that would benefit most from pharmacist intervention both throughout hospital admission and at discharge.

Appendix A

High-Risk Medications List⁴

1. Insulin
2. Anticoagulants
3. Opioids
4. Muscle relaxants
5. Chemotherapeutic agents
6. Intravenous potassium chloride/phosphate
7. Intravenous antibacterials
8. Antiepileptics
9. Cardiac glycosides
10. Respiratory stimulants
11. Antidepressants and mood stabilizers
12. Centrally acting antihypertensives
13. Antiarrhythmics
14. Adrenergic neuron blockers
15. α -Blockers

Appendix B

Data Collection Form.

Meets inclusion		Meets exclusion; reason:		Non-Ontario No medications Rx'd Paper Rx		Transferred Deceased Admitted <48 h		
RPh intervention	Yes	No	10 and 10	Yes	No	Readmit \leq 30 d	Yes	No
Unique number			Age	\geq 80	<80	Readmit \leq 6 mo	Yes	No
IDENTIFIERS								
Date of birth (MM/Year)								
BASELINE CHARACTERISTICS (Charlson score)								
	Yes	No		Yes	No		Yes	No
MI (1)			Mild liver dis.			Leukemia		
CHF			Diabetes			Lymphoma		
Peripheral Vasc			Dementia			Mod/Sev Liver (3)		
Cerebrovascular			Hemiplegia (2)			Metastases (6)		
Connective			Mod/Sev Renal			AIDS		
Ulcer			DM with organ			TOTAL SCORE		
Pulmonary			Tumor					

(continued)

Appendix B. (continued)

PATIENT INFORMATION													
Date of admission (D/M/Y)				Date of discharge (D/M/Y)									
Time of admission		w-day	w-eve	wknd	Time of discharge			w-day	w-eve	wknd			
MEDICATION DISCREPANCIES (Count and Description)													
DRUG					INCOMPLETE PRESCRIPTION								
Omission/commission					LU code								
Duplication					Misspelled								
Route					Formulation								
Formulary switch NR					Dose								
DOSE					Frequency								
Incorrect					Quantity								
NUMBER of MEDICATIONS					Narcotic repeats								
On BPMH					Notes								
eDS													
HIGH-RISK MEDICATIONS (Refer to BNF list)													
		Number	Agent(s)				Number	Agent(s)					
Insulin					Cardiac glycosides								
Anticoagulants					Resp. Stimulants								
Opioids					Antidep & MS								
M. Relaxants					Central AH								
Chemo					Antiarrhythmics								
IV KCl/KPhos					Adren. Blockers								
IV Abx					α-Blockers								
Antiepileptics					TOTAL								
RISK FACTORS													
				Yes			Yes	No					
Ten or more medications					Pharmacist intervention								
Length of stay of 10 or more days					Nursing home/extended level								
Hospital visits within the last 30 days					LACE (greater than ≥12)								
Number of medication changes					L	+	A	+	C	+	E	+	=
After hours of discharge													

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