Patient-Related Risk Factors for the Occurrence of Patient-Reported Medication Errors in One Community Pharmacy: A Local Perspective

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Abstract

Background: Medication errors have been shown to occur 4 times more often in the community compared to the hospital setting. Therefore, identifying the patient-related factors within the community that contribute to an increased occurrence of medication errors is required. **Objective:** To assess patients' knowledge and understanding of their medications in order to determine risk for medication errors. **Methods:** This quantitative descriptive study used a convenience sample of participants filling their prescriptions at one independent pharmacy in Canada. The study used descriptive statistics including frequencies and correlations. Further multiple regressions were conducted to explore the relationship between the patient factors and medication knowledge and use. **Results:** A total of 33.5% of respondents indicated that they know what medication they are currently taking, and that they know why they taking their current medications. Decreased knowledge of medication taken was significantly associated with likelihood of a medication error by 3.6 times ($P = .048$). Increased age ($P = .01$) and the death of a spouse ($P = .01$) correspond to a decreased knowledge of medications. Those with less education appeared to have decreased understanding as to why they are taking their medications ($P = .01$). The odds of experiencing a medication error increased with multiple medications. Also, changes in medication dose increased the probability of experiencing a medication error by 2.2 times. This study however had a small sample size. **Conclusions:** With identification and understanding of patient factors that influence the incidence of medication error, we can increase awareness and determine solutions to decrease risk of medication error in clinical practice.

Keywords

medication error, community, patient knowledge, patient understanding, prescriptions

Introduction

The occurrence of medication errors not only has negative outcomes for patients and providers, but they are also costly for the health care system.^{1,2} The cost of preventable drug-related morbidity and mortality in older adults is estimated to be approximately \$11 billion in Canada.² This is equivalent to \$8.9 billion dollars in the United States of America. In the United States, 700 000 emergency room visits and 120 000 hospitalizations occur every year as a result of a medication error.¹ In Canada, Patel and Zed³ identified that 28% of all emergency department visits were drug related, and of these drug-related events, 70% were preventable.

A recent study identified patient-related contributors to drug-related safety problems that included a lack of patient knowledge and patient nonadherence to medical recommendations.⁴ Moreover, patient-related factors that increase a person's risk for medication errors have been shown to involve age, gender, relationship status, and the number of

medications one is taking⁵ as well as experiencing multiple medication transitions of care.⁶ Furthermore, medication errors have been shown to occur 4 times more often in the community compared to the hospital.⁵ Therefore, the increased occurrence of medication errors can be better understood by identifying which patient-related factors are prevalent within the community setting. For the purpose of this study, a medication error was defined as "any preventable error that occurred as a result of human mistakes or system flaws that occurred in the process of administering a medication, regardless of whether an injury occurred or the potential for injury was present."⁷ The purpose of this study was to assess patients'

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Table 1. Demographic Information and Respondents' Knowledge of Current Medication Taken^a.

Item	Dimension	N	Do You Know What Medication You Are Currently Taking?		df	χ^2	P	Do You Know Why You Are Taking Your Current Medication?		df	χ^2	P
			Yes	No				Yes	No			
Number of pharmacies	1	89	86%	14%	1	0.01	.92	80%	20%	1	0.034	.85
	>1	108	87%	13%				79%	21%			
Gender ^b	Male	85	89%	10%	1	0.746	.39	82%	18%	1	0.746	.39
	Female	101	85%	15%				77%	23%			
Age, years	18-40	62	97%	3%	1	7.85	.01	86%	14%	1	2.18	.14
	>41	135	82%	18%				76%	24%			
Education	High school	38	79%	21%	2	4.16	.13	66%	34%	2	11.93	.01
	Postsecondary	121	87%	13%				78%	23%			
	Graduate	38	95%	5%				97%	3%			
Relationship status	Single	52	94%	6%	3	11.19	.01	84%	16%	3	6.09	.11
	Committed	98	86%	14%				80%	20%			
	Divorced	31	90%	10%				80%	20%			
	Widowed	16	63%	38%				56%	44%			
Language	English/Farsi	154	87%	13%	1	0.668	.54	75%	25%	1	3.31	.07
	Other	38	85%	15%				84%	16%			

^aSignificant data are given in boldface.

^bEleven patients did not report gender.

knowledge and understanding of their medications and explore the association between these factors and the opportunity for medication error in the community setting.

Methods

The researchers obtained approval from the Health Sciences Research Ethics Board to conduct this study. The study was conducted over a 1-month period. This descriptive study used a convenience sample of participants that were filling their prescriptions at an independent pharmacy in Canada. A pilot study at the same site, using the same tool and sampling method, was completed over 2 weeks prior to launching the full study allowing 1 week for data collection and 1 week for data analysis. Data were collected in the pharmacy owned and run by pharmacists of Iranian ancestry who are fluent in Farsi and English. The sample was conveniently chosen representing 10% of the sample in the main study; thus, 20 participants were recorded. The sample size for the full study was targeted at 200 participants. Participants who were included in the study were adults over the age of 18 who were picking up a prescription from the pharmacy under study over the study period. Data were collected over 2 weeks, until the target of 200 participants was achieved.

Measures

Medication errors were self-reported. The survey tool was paper-based with 28 validated multiple-choice questions.

The survey included the patient's demographic data, a medication questionnaire including questions regarding their knowledge and understanding of the medications they are taking, if they experienced a medication error, and if they reported it. The last section included questions about the number of pharmacies used as well as what risks predispose them to a medication error such as their use of herbal supplements or if they take their medications according to instructions given.

Data were analyzed to ensure that kurtosis and skewness were acceptable to conduct parametric analyses. Listwise removal was completed if cells were empty. Incomplete and duplicated responses were also removed. Factorial logistic regression was used to determine the relative probability of outcomes (eg, medication error) as determined by contributing variables (eg, number of medications). The study used descriptive statistics including frequencies and correlations. Further multiple regressions were conducted to explore the relationship between the patient factors (number of pharmacies, gender, age, education, relationship status, language) and medication knowledge (knowing what medication they are taking and why they are taking them) and the number of medications.

Results

The total sample from this study included 217 participants; however, after data cleaning there were 197 surveys that were valid for inclusion. See Table 1 for demographics of

Table 2. Medication Error Incidence Related to Knowledge and Understanding of Medication Taken and Dose Change^a.

	Have You Ever Experienced a Medication Error	Yes		No/Not Sure	
		n	%	n	%
Do you know what medication you are currently taking?	Yes	58	29.9	7	3.6
	No/Not sure	112	57.7	17	8.8
Do you know why you are taking your current medication	Yes	49	25.3	16	8.2
	No/Not sure	107	55.2	22	11.3
Has your medication dose changed in the last 6 months	Yes	42	21.6	23	11.9
	No/Not sure	47	24.2	82	42.3

^aSeven participants did not respond.

the sample. On examination of medication errors, 33% of the participants identified that they have experienced an error. Twenty-four identified that the error was in the hospital, and 41 identified that they experienced an error in the community. Therefore, 1.7 more errors were reported to have occurred in the community.

Table 2 indicates that only 33.5% of the respondents knew what medications they were taking and knew why they were taking these medications. The majority of the respondents indicated they do not know or are not sure of the medications they are taking (66.5%) and why they are taking them (66.5%). Generally, the results demonstrate that the patients in the community may not be properly informed about the medications they are taking. “No” and “Not sure” were grouped to create a dichotomous variable to give sufficient statistical power. Moreover, both responses relate to the inability to substantiate a medical error, and therefore were thought to be sufficiently proximal for the purposes of the questions in this article. Cross-tabulations were calculated with “Do you know what medication you are currently taking” and “Do you know why you are taking your current medication” as dependent variables. Contrasting variables included the number of pharmacies used, gender, age, education, relationship status, and language. Many of the demographic factors were also combined in an attempt to obtain the greatest possible statistical power. Groups of ages over 41 years such as 41 to 55 years, 56 to 64 years, and 65 or over were combined into the group >41 years of age. As indicated in Table 1, levels of age and relationship status were statistically detectably different between responses of “Yes” and “No” on outcome variables. Specifically, results indicated that increased age of over 41 years ($P = .01$) and the death of a spouse ($P = .01$) correspond to a decreased knowledge of medications reaching statistical significance.

As stated, data were collected in the pharmacy run by pharmacists of Iranian ancestry who are fluent in Farsi and English; therefore, medication instructions were given fluently in both languages. Results indicated that age, losing a spouse, and speaking languages other than English or Farsi

were not statistically significant with regard to knowledge of medications taken (Table 1). Levels of education including college, associate’s degree, and bachelor’s degree were combined into a postsecondary education group, and the master’s degree and PhD were combined into a graduate education category. A statistically significant effect was found for education ($P = .01$), where those with less education appeared to have decreased understanding of why they are taking their medications.

When examining the results, patients that take multiple medications have an increased risk of medication error. As the number of medications taken increased, the number of medication errors increased. This effect was found to be statistically significant using a χ^2 test, $\chi^2(3) = 9.06$, $P < .03$. Chi-square tests can be skewed by a lack of responses; in this case, “number of medication per day” and “have you ever experienced a medication error” have less than 5 responses for 10 medications and a “yes” response to medication error. Therefore, categories of over 10 medications per day was omitted from this analysis.

To assess the relative probability of experiencing a medication error due to an increased number of medications, a binary logistic regression was conducted. Respondents who reported taking only one medication were coded as the comparison group, whereas others who reported levels of daily medication intake were coded as contrast variables. Results of the Hosmer and Lemshow χ^2 indicated a good model fit, $\chi^2(2) = 0.000$, $P = 1.0$. Estimations of effect size were modest, with Cox and Snell $R^2 = 0.051$ and Nagelkerke $R^2 = 0.071$.

Results indicated that the odds of experiencing a medication error increased with multiple medications. Specifically, compared with those who only took one medication, taking multiple medications increased the probability of experiencing a medication error by 3.1 times (2-3 medications), 4.1 times (4-5 medications), and 3.5 times (6-10 medications; Table 3).

To determine the relative predictive power of personal medication knowledge and change on experience of a medication error, a hierarchical binary logistic regression was

Table 3. Binary Logistic Regression Between Number of Medications Taken and Experience of Medication Error^a.

	B	SE	Wald Statistic	P	Exp(B)
2-3 Medications per day	1.13	0.477	5.62	.02	3.10
4-5 Medications per day	1.41	0.504	7.80	.01	4.08
6-10 Medications per day	1.26	0.608	4.28	.04	3.51

Abbreviations: B, beta; SE, standard error; Exp(B), exponentiation of the B coefficient (odds ratio).

^aSignificant data are given in boldface.

Table 4. Binary Logistic Regression Between Medication Practices and Experience of Medication Error^a.

	B	SE	Wald Statistic	P	Exp(B)
Block 1					
2-3 Medications per day	0.777	0.509	2.327	.13	2.174
4-5 Medications per day	0.942	0.553	2.903	.09	2.565
6-10 Medications per day	0.612	0.682	0.807	.37	1.845
Change in dose of medication	0.789	0.367	4.619	.03	2.20
Block 2					
2-3 Medications per day	0.722	0.516	1.95	.16	0.462
4-5 Medications per day	0.976	0.568	2.95	.09	0.951
6-10 Medications per day	0.772	0.709	1.19	.28	1.23
Change in dose of medication	0.879	0.374	5.53	.02	2.41
Knowledge of type of medications taken	1.290	0.654	3.90	.048	3.63
Understanding of why medications are taken	-0.551	0.507	1.18	.277	0.576

Abbreviations: B, beta; SE, standard error; Exp(B), exponentiation of the B coefficient (odds ratio).

^aSignificant data are given in boldface.

conducted. Specifically, the questions “do you know what medication you are currently taking” and “do you know why you are taking your current medications” was regressed on “have you ever experienced a medication error?” To control for variance, accounted for by the “number of medications per day” and “if your medication dose changed,” these items were placed into the first block. Importantly, low numbers and resulting problems of dispersion required response item “not sure” to be recoded into “no,” thus making the dependent variable binary.

The first block showed modest effect sizes (Cox and Snell $R^2 = 0.074$ and Nagelkerke $R^2 = 0.104$), and the acceptable model fit with the Hosmer and Lemshow's χ^2 was not statistically significant, $\chi^2(5) = 1.49$, $P = .91$. Results indicated changes in medication dose increase the probability of experiencing medication error by 2.2 times. Interestingly, the number of medications per day was no longer statistically significant at $P \leq .05$, as compared to the results in Table 3. This indicates that medication knowledge shares variance with the number of medications per day. Although not statistically significant at traditional levels, taking multiple medications increased the probability of experiencing a medication error by 2.2 times (2-3 medications, $P = .13$) and 2.6 times (4-5 medications, $P = .09$).

In the second block, “do you know what medication you are currently taking” and “do you know why you are taking

your current medications” were added into the analysis. Understanding of why medications are taken was not statistically significantly related to medication errors, and was in fact negatively related. Lack of knowledge of medications taken increased the likelihood of medication error by 3.6 times (Table 4). Although the test statistics were within limits, Cox and Snell $R^2 = 0.094$ and Nagelkerke $R^2 = 0.13$, and the model fit acceptable with a Hosmer and Lemshow's, the χ^2 was not statistically significant, $\chi^2(5) = 4.35$, $P = .63$. Only a small percentage of respondents reported being unaware/unsure of what medications they were taking (21%), and why (13%) they were taking them. The disproportion of responses may have decreased the sensitivity and reliability of this test.

Discussion

In a pharmacy filling 250 prescriptions each day, 4 errors occur per day⁸; therefore, it is made evident that errors in the community are prevalent. The results of this study showed that 1.7 more errors were reported to have occurred in the community than in the hospital. This finding is similar to a study conducted by Sears and colleagues,⁵ which demonstrated that there was a higher rate in the occurrence of reported medication errors in the community, 570 (79%), compared with the hospital setting, 147 (21%). Participants

in the predominantly Farsi-speaking community we studied indicated that they did not know where to report the errors or did not bother. Therefore, there appears to be important learning opportunities lost within this community for patients, health care workers, and community members in order to report medication errors.

There is only one system in Canada that patients in the community can report their medication errors. The Canadian Medication Incident Reporting and Prevention System is a Canada-wide program where many agencies have collaborated in order to prevent and reduce medication error occurrences in Canada.⁹ The problem is that this system is voluntary, making it hard to take into account all medication errors. There is little awareness of this program, leading to a risk of underreporting resulting in inconsistent or incomplete data collected from hospitals and the community.

A concern identified when individuals use several community pharmacies is the lack of communication between these pharmacies, which may increase medication errors. Since the patient will be obtaining medications from multiple pharmacies, all drug interactions may not be identified and all information may not be communicated properly, introducing a risk to the patient. Individuals may be prone to using several pharmacies given various factors such as ease of location, proximity to the clinic where they received the prescription, and fee charged for filling the prescription. The Institute for Safe Medication Practices identifies that having pertinent information at the time of medication delivery is essential to decreasing the risk of preventable medication events.¹⁰

The findings from our study within the predominantly Iranian community indicate that participants aged over 41 years correspond to a decreased knowledge of medications ($P = .01$). Age has been shown to be a patient-related risk factor for the occurrence of medication errors. For example, the data from the Commonwealth Fund from 8 nations identified that the odds for the occurrence of a medication error were lower for individuals 18 to 24 compared to those 35 to 49, 50 to 64 years, or 65 years or older.⁵

Polypharmacy has been cited as a risk factor contributing to increased morbidity and mortality.⁵ Further studies have identified that over 40% of ambulatory adults who are 65 years or older use at least 5 medications per week.¹¹ In older adults taking 5 medications or more, 33% will experience a medication error each year leading to a preventable adverse drug event.¹² Of these patients, 66% will experience a severe enough reaction to require medical attention.¹³ A significant finding in this study was the number of medications that a person is taking (Table 3) and how it influences the risk for error. The risk of a medication error increased as the number of medications taken increased. There was an increased probability of experiencing a medication error by 3.1 times for 2 to 3 medications, 4.1 times for 4 to 5 medications, and 3.5 times for 6 to 10 medications. This finding was also

supported from data from the Commonwealth Study that identified that the odds for the occurrence of a self-reported medication error were greater for respondents who were taking between 6 and 10 medications than for those taking between 1 and 5 medications.⁵

Knowledge was identified as a contributor to the decreased risk of a potential medication error. Decreased knowledge of medication taken was significantly associated with likelihood of a medication error by 3.6 times ($P = .048$). This finding is supported by Jylhä and colleagues,¹⁴ who concluded that some of the most frequent human factors-related medication errors related to medication included incomplete medication histories, relying on memory, incomplete patient data, and miscommunication regarding medications. It can be concluded through our results and results found throughout the literature that the more knowledge a patient has on the medication they are taking, the risk of a potential medication error decreases.

Furthermore, results indicated changes in medication dose increase the probability of experiencing medication error by 2.2 times. Our study identified any dose changes as an important risk factor for predicting a medication error. In one study, writing the wrong dose was one of the most common prescription medication errors.¹⁵ It is therefore important to be able to catch that error before administration of the medication.

Our data identified that those with less education appeared to have decreased knowledge of why they are taking their medications ($P = .01$). Health literacy plays an important role in medication errors, although this is not shown in our study.¹⁶ The Institute of Medicine defined health literacy in a 2004 report as “the degree to which individuals have the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions.”¹⁶ Health literacy is required for successful communication of health information, making decisions about health care issues, and understanding research in health care.¹⁶ Health literacy is not interchangeable with a person’s level of education however.

Pharmacists have been identified as crucial players in the prevention of medication errors. They play an important educator role for both prescribers and patients. They perform medication reviews, counsel, and assist in communication through transitions in care. Up to a quarter of discharged patients have no understanding of approximately 66% of the changes to their medications or new medications added to their regimens.¹⁷ If people do not understand health care providers’ instructions and are not able to learn more about their health they can be harmed.¹⁸ Patients who have a limited understanding of English also have an increased risk of misunderstanding information leading to an increase in medication errors.¹⁹

There are limitations to this study. A convenience sample was used as this was the most efficient and timely method of obtaining the sample. A larger sample size may have

provided more information regarding the probability of medication errors (Table 4). However, this possibility cannot be further determined with the current data set as the power of the study was deficient. Only one pharmacy was used; therefore, we are unable to generalize the findings to the entire population. The data were also self-reported, which could introduce bias. Moreover, it is possible that there could have been some confusion as some patients would not be able to differentiate where the error occurred (in the hospital or in the community) if the medication error occurred at discharge. In addition, language barriers are common. However, the specific language barrier depends on the location of the pharmacy and the language capabilities of the pharmacist. Last, logically, more medications per day would be expected to increase the likelihood of a medication error; however, in this study the 6 to 10 medication group has a low number. This is probably due to the number of patients in this sample.

Conclusion

The results of this study identify that certain patient-related risk factors contribute to risk of self-reported medication errors in the community setting. These factors are multiple medications, medication dose, and knowledge of the medications that a person is taking and why they are taking them. Patients identified that they did not know where to report the errors or did not bother. Therefore, there appears to be important learning opportunities within the community concerning appropriate places and instruction pertaining to where and how to report a medication error. This is critical since reporting errors may help better identify medication errors and therefore find ways to decrease errors in the future.

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