Self-reported medical, medication and laboratory error in eight countries: risk factors for chronically ill adults

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Abstract

Objective. To identify risk factors associated with self-reported medical, medication and laboratory error in eight countries.

Design. The Commonwealth Fund’s 2008 International Health Policy Survey of chronically ill patients in eight countries.

Setting and Participants. A multi-country telephone survey was conducted between 3 March and 30 May 2008 with patients in Australia, Canada, France, Germany, the Netherlands, New Zealand, the UK and the USA who self-reported being chronically ill.

Main Outcome Measure. A bivariate analysis was performed to determine significant explanatory variables of medical, medication and laboratory error ($P < 0.01$) for inclusion in a binary logistic regression model.

Results. The final regression model included eight risk factors for self-reported error: age 65 and under, education level of some college or less, presence of two or more chronic conditions, high prescription drug use (four+ drugs), four or more doctors seen within 2 years, a care coordination problem, poor doctor–patient communication and use of an emergency department.

Conclusion. Risk factors with the greatest ability to predict experiencing an error encompassed issues with coordination of care and provider knowledge of a patient’s medical history. The identification of these risk factors could help policymakers and organizations to proactively reduce the likelihood of error through greater examination of system- and organization-level practices.

Keywords: medical errors, medication errors, international health survey, risk factors, patient safety

Background

Patient safety has become a growing international health policy initiative as evidenced by the World Health Organization’s World Alliance for Patient Safety. With the knowledge that medical and medication errors are responsible for numerous injuries and deaths every year, international campaigns have set out to reduce medical errors by improving continuity of care, assuring medication accuracy and improving communication [1].

Research from North America has echoed mounting international evidence for patient safety strategies aimed at reducing or mitigating errors. The Canadian Adverse Events Study found a 7.5% incidence rate for adverse events during hospitalization, extrapolating to roughly 185 000 hospital adverse events annually [2]. Furthermore, 70 000 of these adverse events found to be potentially preventable. The Harvard Medical Practice Study conducted in 1984 and the Institute of Medicine’s To Err Is Human published in 1999 concluded that at least 44 000, and as many as 98 000 people, die in hospitals each year as a result of preventable medical errors in the USA [3, 4]. The economic burden of medical errors has also been explored, with results indicating that additional medical expenses and hospitalizations, as well as disability and litigations, cost some countries billions of dollars every year [4, 5].

The magnitude of complications associated with medical and medication errors warrants the identification of risk factors of these events, thereby allowing for policy directives and patient education materials aimed at reducing or mitigating risks. Examining which factors present the highest risk for experiencing and error, and better targeting at-risk
patients, may help to increase patient safety at both the system and individual levels. Furthermore, identifying common risk factors present across several countries may better help to influence health policy reform and direct international and domestic campaigns. As such, the objective of this study was to identify common risk factors associated with self-reported medical, medication and laboratory errors in eight countries.

Methods

The Commonwealth Fund’s 2008 International Health Policy Survey of chronically ill patients, conducted in Australia, Canada, France, Germany, the Netherlands, New Zealand, the UK and the USA, was the primary data source for this research. In each country, surveys were conducted with adults 18 years of age and older who were considered to have chronic and ongoing health needs. Eligible adults self-reported at least one of the following criteria: (i) fair or poor health condition, (ii) a serious or chronic illness, injury or disability that has required a lot of medical care in the past 2 years, (iii) hospitalization (for something other than uncomplicated delivery of a baby) in the past 2 years or (iv) major surgery in the past 2 years. Surveys were conducted by telephone in all eight countries by Harris Interactive, Inc. The average length for the survey was 17 min for eligible respondents, ranging from an average of 14–22 min across countries. Data were weighted according to the most recent census information in each country to reflect demographic distributions. Complete survey methods, along with average rates of errors and other results, have been reported previously [6]. We received permission from the Commonwealth Fund to use the raw survey data for the purpose of this paper.

Bivariate analysis was used to determine eligible variables for inclusion in a logistic regression model. The dependent variable of interest was whether the respondent had experienced a medication error, medical mistake or diagnostic test error within the past 2 years (collectively referred to as ‘error’). Explanatory variables were chosen based on known and hypothesized risk factors for an increased likelihood of experiencing an error. Variables included in the bivariate analysis represented key demographic indicators, patient health indicators, use of emergency health care and patient–provider relationship indicators, including age, sex, education level, presence of chronic conditions, prescription drug use, number of doctors seen, poor provider communication, poor care coordination and emergency department (ED) use. A $\chi^2$ test of significance at $\alpha = 0.01$ was used. Comparisons were made between respondents who indicated they had experienced an error within the past 2 years and those who did not. Only explanatory variables that satisfied the $\chi^2$ test of significance ($P < 0.01$) were then included in the logistic regression model.

Binary logistic regression was used due to the presence of a binary dependent variable (either experiencing an error in the past 2 years or not). Significant variables identified through the bivariate analysis were then included within the binary logistic regression model to determine their ability to predict experiencing an error. The logistic coefficient, standard error, $\chi^2$ probability were calculated. In addition, the odds ratio (OR) for each explanatory variable was calculated to determine the relative risk of experiencing an error given each hypothesized risk factor. Goodness-of-fit was determined using the Hosmer and Lemeshow test, and multicollinearity was determined through an analysis of explanatory variable correlations. Data analysis was performed using PASW Statistics version 18.0 [7].

Results

The final data set included a total of 9944 adults aged 18 and older in eight countries. Demographic characteristics are listed in Table 1.

Results of the bivariate analysis are shown in Table 2. Overall, the results are consistent with the hypothesized risk factors, with a greater percentage of respondents with the risk factors self-reporting they experienced an error within the last 2 years. All hypothesized demographic variables and risk factors were significant with the exception of respondent

<table>
<thead>
<tr>
<th>Country</th>
<th>Total respondents, n</th>
<th>Experienced at least one error, %</th>
<th>Age 18–64, %</th>
<th>65+, %</th>
<th>Sex Male, %</th>
<th>Female, %</th>
<th>At least one chronic condition, %</th>
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<tr>
<td>Australia</td>
<td>750</td>
<td>24.0</td>
<td>67.5</td>
<td>32.5</td>
<td>35.2</td>
<td>64.8</td>
<td>79.1</td>
</tr>
<tr>
<td>Canada</td>
<td>2635</td>
<td>25.4</td>
<td>76.3</td>
<td>23.7</td>
<td>36.1</td>
<td>63.9</td>
<td>74.2</td>
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<tr>
<td>France</td>
<td>1202</td>
<td>16.0</td>
<td>68.3</td>
<td>31.7</td>
<td>30.4</td>
<td>69.6</td>
<td>70.8</td>
</tr>
<tr>
<td>Germany</td>
<td>1200</td>
<td>16.3</td>
<td>62.7</td>
<td>37.3</td>
<td>36.7</td>
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<td>72.2</td>
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<tr>
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<tr>
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<td>76.3</td>
<td>23.7</td>
<td>35.8</td>
<td>64.2</td>
<td>69.0</td>
</tr>
<tr>
<td>UK</td>
<td>1200</td>
<td>19.8</td>
<td>61.3</td>
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<td>65.7</td>
<td>77.8</td>
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<td>65.5</td>
<td>83.6</td>
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<tr>
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<td>68.6</td>
<td>31.4</td>
<td>34.9</td>
<td>65.1</td>
<td>75.0</td>
</tr>
</tbody>
</table>
sex ($P = 0.019$). Interestingly, a greater number of respondents aged 18–64 self-reported having experienced an error compared with respondents aged 65+.

Results of the logistic regression are shown in Table 3. All eight variables were found to be significant within the regression model, with varying abilities to predict the occurrence of an error. The inclusion of all eight variables was justified and the model was able to accurately predict 77.4% of the cases, which was deemed satisfactory, and the results indicated that the model fit the data well. Finally, correlations between explanatory variables were relatively low, ranging between 0.012 and 0.384, indicating that multicollinearity was insignificant.

### Discussion

This study found, within an international sample, a number of statistically significant relationships between experiencing an error and a patient’s age, education level, presence of chronic conditions, prescription drug use, number of doctors seen, poor provider communication, poor care coordination and ED use. Overall, the three risk factors with the largest ORs in the final regression model were (i) experiencing a coordination problem, (ii) having seen four or more doctors within the last 2 years and (iii) having used the ED in the last 2 years. All three of these risk factors suggest issues with coordination, continuity of care and provider knowledge of the patient. Experiencing a coordination problem had the largest OR of all the explanatory variables. This is consistent with literature that suggests that gaps in the continuity of care can create opportunities for errors to occur, and that hand-offs between health care professionals are an important element in ensuring greater patient safety [8, 9]. Furthermore, gaps in coordination are an aspect of patient safety that is often very apparent to patients when they occur. Educating patients and increasing their degree of involvement in treatment plans may help to reduce the likelihood of errors occurring by empowering patients to speak up and ask questions about why certain tests are ordered and how they relate to their diagnosis. Patient perceptions of...
error might also be altered following education, with a greater understanding of the need for patients to protect themselves when receiving care. Since poor communication with a doctor and a lack of involvement in care were also significant predictors of error (OR = 1.571), greater patient involvement and education could considerably reduce the likelihood of experiencing an error.

Continuity of care also seemed to play a large role as a risk factor. Respondents who indicated they had seen four or more doctors within the last 2 years were almost twice as likely to self-report experiencing an error (OR = 1.810). Navigating care through several health care providers is often challenging, with the onus sometimes being placed on the patient to ensure that each provider has important medical information. Lack of adequate information regarding a patient, including their medical history and list of prescription medications, can have a large impact on the likelihood of an error occurring [10]. Furthermore, patients are often unaware of how they can play a role in helping to prevent an error from occurring or may feel uncomfortable doing so [11]. By further engaging patients in their treatment, providing counseling on ongoing and chronic health care conditions as well as on prescription medications, patients may be better able to intervene when they feel that a treatment is either unnecessary or dangerous [12]. Interestingly, it was reported by patients in this survey that errors most often occurred outside of the hospital setting [6]. This further points to a need to decrease gaps in care between the hospital and community settings as well as between health care providers.

Finally, a lack of provider knowledge may also contribute to an increased likelihood of error resulting from emergency room use (OR = 1.779). Doctors and other health care workers within the emergency room setting often have limited access to an individual's medical history and prescription drug information. Moreover, the role of patients in helping to prevent errors in this setting may not be as effective. A lack of coordination between health care providers across the acute and community care settings, coupled with the presence of several complex and chronic health care conditions, may ultimately lead to patients experiencing a greater number of errors. Having the ability to view patient records through the use of electronic health records may ultimately improve the ability for health care providers to coordinate care between the hospital and community settings and to identify potentially harmful medical and medication errors before they occur [10, 13].

The OR for respondent age (OR = 0.618) upheld the previous bivariate results, indicating that more respondents aged 18–64 self-reported having experienced an error within the last 2 years. This result is also found in previous research [14]. Although this is initially counterintuitive, in that older patients often experience higher levels of co-morbidities and require greater coordination among health care providers, it could be explained that younger patients have a better understanding of health care errors. In essence, older patients may not readily identify errors or may be more trusting of their health care provider. This sentiment is echoed by research conducted in the USA which revealed that a majority of the public may not even know what is meant by the term 'medical error' [15].

Limitations of this study stem mainly from the self-reported nature of the data. More specifically, personal experiences or opinions of the respondents could have biased the results. Moreover, the lack of a standardized definition of what 'error' means can lead to a wide range of interpretations among survey respondents, with research suggesting that patient perceptions of error can sometimes result from their perceptions of quality of care or confidence in their health care provider rather than an actual technical error [16]. Nonetheless, self-reported data are important to better understand patient perceptions of error and are useful not only in preventing future errors from occurring, but also in helping to educate patients on how they can play a role in preventing errors when receiving care. Limitations may also stem from the use of an eight-country model, in which all data are grouped together. While this lessens the ability to explore risks on a country-by-country basis, it ultimately allows for a larger sample size, greater statistical power and a more comprehensive approach to identifying common risk factors. Further research stratifying country-specific risk factors to examine underlying system and structural aspects that facilitate or mitigate experiencing an error would be valuable. Finally, this study was limited by its reliance on the Commonwealth Fund's 2008 survey. As such, other questions of interests or other potential risk factors were not able to be included in the final regression model. Nonetheless, key demographic and risk variables were included in the final model and the Commonwealth Fund data provided this study with a reputable and large data set.

Conclusions

The final regression model indicates that there are a number of risk factors associated with the likelihood of experiencing a health care error among the eight countries studied. Although some demographic factors, including age and education level, do play a role, risk factors with the greatest ability to predict experiencing an error encompassed issues with coordination and continuity of care and provider knowledge of a patient's medical history. Ensuring that providers have access to necessary patient information across both hospital and community settings, and educating patients as to the importance of keeping their providers up-to-date, could greatly reduce the risks associated with experiencing an error. Greater development and use of electronic health records and organizational practices aimed at continuity of care may help to achieve this. Furthermore, greater understanding by patients of the risks associated with health care could help to engage patients in participating in error-prevention strategies. Overall, the identification of risk factors can help policymakers and organizations to proactively reduce the likelihood of patients experiencing an error through greater examination of system- and organization-level practices.
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References


