RISK FACTORS FOR MEDICATION ERRORS AMONG CHRONICALLY ILL ADULTS

Kawkab Shishani, PhD, Majd T. Mrayyan, PhD
The Hashemite University, Jordan

ABSTRACT

Purpose: To examine risk factors for medication errors among non-institutionalized ambulatory patients with chronic medical conditions in Jordan.

Methods: This study utilized a descriptive cross-sectional design. We recruited 312 patients from three comprehensive primary health care centers. Data were collected on present health problems and prescribed medication through review of medical records and patient interviews.

Results: Patients had a mean (±SD) age of 62 (± 8.9) years (range 55-90), 60% were men, and 37% were illiterate. Approximately 33% had hypertension only, 23% had diabetes only, and 30% had diabetes and hypertension concurrently. Lack of knowledge in benefits (odds ratio (OR), 4.27, 95% confidence interval (CI), 3.10-5.88; P<0.001), lack of knowledge in side effects (OR, 2.54, 95% CI, 1.50-4.32; P<0.001), lack of knowledge in management of side effects of prescribed medications (OR, 2.10, 95% CI, 1.30-3.95; P<0.001), total number of prescribed medications (OR, 1.90, 95% CI, 1.26-2.38; P<0.001), and level of education (OR, 4.50, 95% CI, 3.20-5.56; P<0.001), were associated with higher odds of medication errors.

Conclusion: Patient literacy and their knowledge about medications and their side-effects are associated with medication errors in ambulatory patients with chronic disease.

Keywords: Jordan, risk factors, medication error, old, chronically ill.
INTRODUCTION

Increased attention has been given to the risks associated with medication use. Patients’ use of medication that does not conform to health care providers’ instructions regarding appropriate self-medication results in non-compliance [1]. Inappropriate self-medication has the potential for serious consequences such as medication errors.

Medication errors are either patient-related or clinician-related. This paper defines medication errors as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of patient or consumer [2]. Inappropriate use of medication is related to poor knowledge in medications [3], treatment complexity [4], and level of education [5]. Poor knowledge in medications puts patients at risk of non-compliance [6]. Medications and drugs are used interchangeably throughout this paper and they both refer to any medication prescribed by a health care provider to treat a chronic health condition.

Chronically ill adults are becoming high-cost users of prescription medications. Taking prescription medications
inappropriately is costly in terms of hospitalizations and health care services. It is estimated that the annual cost of drug related morbidity and mortality in the United States is approximately 76.6 billion dollars [7]. Moreover, approximately 28.2% of all hospital admissions are a result of drug-related morbidity and mortality [8].

Medication errors are prevalent in the community. Approximately 15% of the overall medication errors occur in patients’ homes [9]. In fact, mortality related to outpatient medication errors are three times greater than for inpatients (Risk Ratio = 3.0, CI = 2.53-3.35) [10].

To our knowledge, no studies have examined self-medication practices among chronically ill adults in Jordan in community settings; few have examined this issue in Arab countries. Jordan is part of the Middle East. This region has in common many specific similarities such as language, culture, and religion. Therefore, outcomes of this study can be applied to other Arab countries. This study aims to answer the following research questions:

1. What are the most prevalent chronic health illnesses in adults in Jordan?

2. Is there a relationship between knowledge in prescribed medications, educational level, number of chronic illnesses and medications and medication errors?

**Knowledge deficit**

A group of physicians conducted a study to measure the extent to which elderly patients attending an outpatient clinic acquired basic knowledge in their medications. The study concluded that at least one third did not know the purpose of their medications and approximately half of the subjects did not know the correct dosage schedule of several medications; these
medications included digoxin, furosemide, and hydralazine [11]. Fineman and DeFelice (1990) also demonstrated that poor knowledge about medication is common among the elderly [3].

**Number of illnesses and medications**

Chronically ill adults consume at least five prescription medications [12]. Therefore, they are more prone to receive a complex treatment [13]. An increase in medication complexity is associated with decreased knowledge in medications ($r = .37$) [4].

**LITERACY**

Pharmacists provide patients with basic information about medication by labeling the medications with dose and frequency. Unfortunately, half of the adults have a deficiency in reading [14]. Benson and Forman (2002) examined health literacy among a retired population living in a community dwelling. One third of the subjects were unable to adequately comprehend written information related to their medications [15]. Additionally, exploration of health literacy of 2,659 patients’ ability to read and understand medical instructions and health care information (e.g. prescription bottle labels) revealed that a high proportion of the patients were unable to read or understand written basic instructions. Medication errors were significantly correlated with the inability to read or understand written basic instructions [5].

**METHODOLOGY**

Research design

This study utilized a descriptive correlational design to examine risk factors for medication errors among non-institutionalized chronically ill adults in Jordan. This study was part of a larger study to assess educational needs of chronically ill adults [16]. Chronically ill adults were recruited from multiple outpatient settings using a convenience sampling technique.
Sample and setting

The target population for this study was all adults (≥18 years) with chronic illnesses. Eligibility criteria included that individuals had at least one chronic illness and had been taking medications for at least one year.

Subjects were recruited from three major comprehensive primary health care centers. According to the Ministry of Health, there are 38 comprehensive primary health centers located in the 20 directorates of the Ministry of Health in Jordan. The three centers were selected because they covered about half of the overall annual visits to the 38 comprehensive primary health centers. Selection of the comprehensive primary health centers was based on the number and type of visits at these centers. These centers are located in the inner city. The comprehensive primary health centers in Jordan work for extended hours and provide a variety of services. To ensure representativeness, the annual numbers of visits according to age groups were compared across the primary health centers in the 20 directorates.

 Procedures

The human subjects’ approval was obtained from the Ministry of Health for ethical conduct of research. Three research assistants were selected and trained (by the primary investigator) for data collection to ensure standardization of protocol. Research assistants were senior nursing students. Training included handling possible requests from subjects regarding explanations of certain items or words and back demonstration.

Once eligible participants were identified, they were informed of the study purpose, benefits, and risks. Confidentiality of information and the voluntary nature of participation were explained and the opportunity to ask questions or discuss the study with family members was offered. Upon verbal approval to
participate in the study, subjects were asked to be interviewed immediately or at some point later in their homes. All of the subjects selected to be interviewed immediately. The length of each interview was approximately half an hour.

**Measurement**

Data collection consisted of two methods: (1) medical record abstraction for medication information and health history as this information was considered more accurate if obtained from health professional notes; (2) direct subject interviews of demographic data were collected on living arrangements, age, gender, smoking status, residence, employment, and educational level. The educational level responses included illiteracy, elementary school, middle school, secondary school, and college. Subjects were asked to read the consent forms. Illiterate subjects reported that they were illiterate and asked the research assistants to read for them. A copy of the survey is available on request.

After completion of demographic data collection, each subject's data collection forms contained two sections about medications; the prescribed medication list, and the self-report medication list. The prescribed medication list contained all of the medications prescribed in the medical records in terms of name, dose, and frequency. This abstracted information from the medical records was used as a "gold standard" to compare to when assessing the subjects' accuracy of knowledge in medications. Next, respondents were asked to list their medications in terms of their names, benefits, dose, frequency, and management of side effects; this list was called the self-report medication list. Level of knowledge for each item (name, dose, and frequency) was assessed by comparing the medication list abstracted from the medical records to the subjects' self-reports. The qualification of the three research assistants (RAs) who collected the data were being fourth year
undergraduate nurse students and having completed a pharmacology class in their undergraduate program. Additionally, the PI served as a resource for any case where the RAs could not determine whether the self-reported benefit of medication was correct or incorrect. Those who knew the appropriate medication-related information, for all or at least two thirds of their medications, were considered as “knowledgeable”. On the other hand, those who knew half or less about their medications were considered as not-knowledgeable. Medication error was assessed by asking the subjects if they were taking their medications as prescribed based on their entire regimen. Responses ranged from “I take all my medications as prescribed”, “take most of my medications as prescribed”, “take half of my medication as prescribed”, “take less than half of the prescribed medication”, “do not take any of my medications as prescribed”. Medication error was counted as an event when subjects reported they were not taking medications as prescribed.

Statistical analysis procedures were performed using SPSS for Windows (version 11.5). Descriptive statistics were used to generate frequencies and percentages for chronic illnesses, knowledge in medications (name, dose, frequency, benefits, side effects, and management of side effects) and demographic characteristics. Logistic regression (forward stepwise method) was utilized to examine the relationship between the independent variables subject’s knowledge in medication (benefits, side effects, and management of side effects of medications), educational level, number of chronic illnesses and medications) and the outcome variable medication error.

RESULTS
Sample characteristics
A total of 312 subjects were recruited between February 2005 and October 2005. Their demographic characteristics are shown
in Table 1. Of these, 60% were men (187) and 40% women (125); the average age (mean SD) of the total sample was 66 years (±2.9). The total number of subjects who were illiterate was 37% (115). Illiteracy was higher in men (n=61, 54%) than in women (n=54, 46%). Non-smokers (83%) outnumbered smokers (16%) in the current study. About 18% of diabetic patient were smokers, 16% of hypertensive patients were smokers. Most of the subjects were taking up to four medications.

<table>
<thead>
<tr>
<th>Baseline characteristics</th>
<th>% (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>60 (187)</td>
</tr>
<tr>
<td>Female</td>
<td>40 (125)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>1.3 (4)</td>
</tr>
<tr>
<td>Married</td>
<td>86 (259)</td>
</tr>
<tr>
<td>Widowed</td>
<td>.3 (38)</td>
</tr>
<tr>
<td>Divorced</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>Living arrangements</strong></td>
<td></td>
</tr>
<tr>
<td>Live with spouse</td>
<td>85 (267)</td>
</tr>
<tr>
<td>Live with children</td>
<td>12 (37)</td>
</tr>
<tr>
<td>Live with others</td>
<td>1.3 (4)</td>
</tr>
<tr>
<td>Live alone</td>
<td>1.3 (4)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>55-65</td>
<td>68 (215)</td>
</tr>
<tr>
<td>66-75</td>
<td>28 (88)</td>
</tr>
<tr>
<td>76-85</td>
<td>3 (8)</td>
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<tr>
<td>86-95</td>
<td>.3 (1)</td>
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<tr>
<td><strong>Education level</strong></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>37 (115)</td>
</tr>
<tr>
<td>Elementary school</td>
<td>23 (71)</td>
</tr>
<tr>
<td>Middle school</td>
<td>22 (67)</td>
</tr>
<tr>
<td>Secondary school</td>
<td>10 (30)</td>
</tr>
<tr>
<td>College</td>
<td>8 (29)</td>
</tr>
<tr>
<td><strong>Have health insurance</strong></td>
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<tr>
<td>Yes</td>
<td>85 (263)</td>
</tr>
<tr>
<td>No</td>
<td>15 (48)</td>
</tr>
<tr>
<td><strong>Smoking status</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16 (51)</td>
</tr>
<tr>
<td>No</td>
<td>83 (258)</td>
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<tr>
<td><strong>Number of cigarettes smoked per day</strong></td>
<td></td>
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<tr>
<td>Less than 5</td>
<td>3 (2)</td>
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</table>
Baseline characteristics % (n)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>(n)</th>
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<tbody>
<tr>
<td>5-10</td>
<td>15</td>
<td>(8)</td>
</tr>
<tr>
<td>10-15</td>
<td>31</td>
<td>(6)</td>
</tr>
<tr>
<td>15-20</td>
<td>46</td>
<td>(24)</td>
</tr>
<tr>
<td>More than 20</td>
<td>3</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Have Hypertension

104 (33)

Have Diabetes Mellitus

72 (23)

Have Hypertension and Diabetes Mellitus

95 (30)

Due to missing values rounding may not add up to 100%

Prevalence of common chronic illnesses

The total number of illnesses based on the medical records ranged from 1-3. The most common chronic conditions prevalent were diabetes and hypertension. About 33% (104) had hypertension, 23% (72) had diabetes, and 30% (95) had diabetes and hypertension concurrently. Out of the 95 cases who had diabetes and hypertension concurrently, 65 (70%) had hypertension first, 16 (17%) diabetes first, and 12 (13%) had both illnesses at the same time. The prevalence of the above illnesses was higher in men compared to women. However, the difference was not significant between both groups ($\chi^2 = 0.89, p = 0.64$).

Risk factors for medication errors

The table below presents the bivariate analysis performed using a correlation matrix (Table 2). This summarizes the relationships between the dependent and independent variables. Knowledge in the benefits of medications was significantly correlated with medication errors ($p<0.05$).

<table>
<thead>
<tr>
<th></th>
<th>Baseline characteristics</th>
<th>Knowledge in benefits</th>
<th>Knowledge in side effects</th>
<th>Knowledge in management of side</th>
<th>Level of education</th>
<th>Age</th>
<th>Medication error</th>
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</tbody>
</table>
Using logistic regression, five variables were found to be significantly associated with medication error ($\chi^2_{\text{model}} [5] = 185$, $p<.00$) (see Table 3). In this model, knowledge in the benefits [OR = 4.27, 95% CI = (3.10, 5.88), $p<0.001$], knowledge in the side effects [OR = 2.54, 95% CI = (1.50, 4.32), $p<0.001$], knowledge in the management of side effects [OR = 2.10, 95% CI = (1.30, 3.95), $p<0.001$], illiteracy [OR = 4.50, 95% CI = (3.20, 5.56), $p<0.001$], and total number of prescribed medications [OR = 1.90, 95% CI = (1.26, 2.38), $p<0.001$] were associated with self-medication error. This model demonstrated goodness of fit with the data ($\chi^2_{\text{H-L}}[5] = 8.80$, $p = .65$) and was able to correctly classify 85% of the patients.

Of the 312 patients, only 6.4% (20) self-reported medication errors. Knowledge in medication (benefits, side effects, and management of side effects) was negatively associated with medication errors whereas illiteracy and number of medications were associated positively with medication errors. The risk for medication error was the highest among patients who did not have knowledge in the benefits. Patients who did not know the benefits reported committing medication errors four times more than those who knew the benefits of medications. Additionally, illiterate patients were five times at risk to report medication errors compared to literate patients.

**Table 3.** Risk factors for medication errors.
Factors | Odds-Ratio | 95% Confidence Interval | P-value
---|---|---|---
Knowledge in benefits | 4.27 | 3.10 – 5.88 | 0.00
Knowledge in side effects | 2.54 | 1.50 – 4.32 | 0.00
Knowledge in management of side effects | 2.10 | 1.30 – 3.95 | 0.00
Number of prescribed medications | 1.90 | 1.26 – 2.38 | 0.00
Level of education | 4.50 | 3.20 – 5.56 | 0.00
Model $\chi^2$ | 185 | | 0.00
 Hosmer-Lemeshaw $\chi^2$ | 8.8 | | 0.65

DISCUSSION

Five risk factors for self-medication errors among chronically ill adults in Jordan were identified. Chronically ill adults’ knowledge in their medications (e.g., benefits, side effects, and how to manage side effects), level of education, and number of medications prescribed were significantly associated with medication errors.

A significant number of the subjects in this study did not know how to write or read. According to the Department of Statistics, 10.3% of the adults in Jordan are illiterate [17]. Patients who cannot read will not benefit from the written instructions enclosed with their medications [4]. Low educational level and poor knowledge put chronically ill adults at risk for not taking medications appropriately [18]. Patients do not receive inadequate instructions [19].

Most of the patients who participated in this study were diabetic, hypertensive, or both. This was consistent with the prevalence rates reported by the Jordanian Higher Health Council [20]. Medications prescribed for chronic health conditions need to be taken as prescribed. Patients need to know what and why they are taking medications before asking them to comply. At the same time, patients need to know what the side effects are and how to manage them. Improved knowledge in medications is associated
with better outcomes [21]. Ineffective management of side effects of medication may jeopardize patients’ safety. For example, antihypertensive medications have hypotensive side effects. The older adult may be more sensitive to a drug’s hypotensive effects [22]. Patients who are not well-informed about safety precautions might suffer from injuries due to falls. Almost half of the Joint Commission standards are directly related to safety, addressing such issues as medication uses (JCAHO) [23].

Medication use practices is a global issue. The world Health Organization held two international conferences in 1997 and 2004 to improve use of medicines. The 2004 conference recommendations included that countries should teach the importance of patient counselling on prescription drugs. The conference also urged countries to implement educational programmes for consumers regarding medication use (ICIUM) [24]. Patients’ use of medication has impact on effective management of chronic health condition. Effective management of the chronic health conditions has the potential both to reduce hospital bed occupancy and improve the quality of life for patients [25].

Limitations

One of the limitations of this study is recall bias. The interaction with the researchers provides the patients with some form of social support. In order to keep receiving attention or support, subjects may give information to please the research assistants. However, to ensure that medication errors were assessed accurately, patients’ responses on taking medications appropriately were compared to the self-reported list of medication. For example, a subject reporting incorrect dose although reporting taking medication as prescribed was considered a medication error. This study examined selected factors in relation to medication errors. Future studies need to look at other factors such as types of medications, health
perceptions of patients, and severity of diseases. Also future studies can make comparisons between prescription and non-prescription medications.

Nevertheless, this study has several important strengths. The sample was large, drawn from community settings. This was the only study ever done in outpatient medical settings in Jordan. In addition, five important factors were identified that have impact on medication errors.

Conclusion

This study demonstrated that chronically ill adults are at high risk for medication errors because of poor knowledge in medications, increase in number of prescribed medications, and low educational level. These factors are modifiable. Health care providers are urged to do a comprehensive assessment on their patients once a diagnosis has been established and medications are prescribed and customize interventions to ensure appropriate self-medication practices. Health care providers must continue assessing medication use behaviors during follow-up visits.

REFERENCES


