Potential drug-drug interactions among hospitalized patients in a developing country

Abstract

Background: Drug-drug interactions (DDIs) may often lead to preventable adverse drug events and health damage. Particularly in hospitals, this might be an important factor as multiple drug therapies are common. The objective of this study was to identify the frequency and levels of potential DDIs in internal medicine wards in an Iranian university hospital.

Methods: A cross-sectional study was conducted by reviewing charts of 448 hospitalized patients in internal medicine wards of a teaching hospital, from November 2014 to May 2015. “Lexicomp drug interaction software” and Micromedex Drug-Reax system were used for screening the potential DDIs. The identified DDIs were categorized by level of severity. Logistic regression was applied to determine the odds ratio for specific risk factors of potential DDIs e.g., age, gender, hospital stay and number of medications.

Results: The mean age of patients was 61 years, the length of hospital stay for patients was 9 days and the number of drugs per patient was 9. Potential interactions were detected in 386 patients. The most common types of interactions were type C (78.6%), moderate (60.9%) and delayed onset (56.5%). There was a significant association of the occurrence of potential DDIs with seven or more numbers of prescribed medications (OR: 0.048, 95% CI: 0.02-0.12, p<0.0001).

Conclusion: The present study has recorded a high prevalence of potential DDIs in internal medicine wards. Patients with polypharmacy were at high risk for DDIs. Education, computerized prescribing systems, drug information, and pharmaceutical care are important measures that were recommended to minimize harm associated with DDIs.

Keywords: Drug interactions, Internal medicine, Hospital pharmaceutical service, Iran.

Drug-drug interaction (DDI) constitutes one of the potential mechanisms leading to often preventable adverse drug events and health damage (1). Multiple drug therapies are very common for the treatment of various medical illnesses. Such therapy may be the potential source of DDI. According to published studies, 1% of all hospital admissions are caused by DDIs, corresponding to 16% of all patients hospitalized due to adverse drug reactions (ADR) (2, 3). At least 15% of the patients admitted to hospitals have one DDI at admission (4). The clinical outcome of a potential DDI is often unknown, and epidemiological data dealing with this problem are rare. A study conducted in Switzerland reported that 56.2% of patients are exposed to one or more major or moderate potential DDIs (pDDIs) in internal medicine wards (5). Another study by Galley et al. showed that from a total of 160 patients in the internal medicine ward, 221 cases of interaction exists, in which 24 were of the major type, 15 of the moderate type and 82 minor interactions. Also the presence of certain diseases such as renal failure, or the use of more than 6 drug items, could increase the probability of drug interactions (6).
According to the World Health Organization (WHO), as of 2000, Iran ranks 58 in health care and 93 in health-system performance (7). Based on the last census taken at Statistical Center of Iran (SCI) in 2003, Iran possesses 730 medical establishments (e.g. hospitals, clinics) with a total of 110797 beds. The country is in an epidemiological transition and faces a double burden of diseases. In hospital settings, doctors and other health care professionals are mostly overburdened (8).

Medication therapy is the most common method of treatment in Iran. Average items per prescription ranged from 3.68 in cardiologists to 2.06 in dermatologist’s prescriptions, which is higher as compared with other parts of the world (9).

In most of the hospitals, the established clinical pharmacy system does not exist to monitor and optimize medication use. Irrational use of medicines is a common and crucial problem in Iran. Several studies showed that the Iranian population is at higher risk to potential DDIs (10-14). Overall, data on the occurrence and consequences of DDIs within the hospital, especially in medical inpatients are scarce.

Therefore, the objective of this study was to identify the frequency and levels of potential DDIs in internal medicine wards in a large university hospital in Isfahan, Iran and found their association with patient’s age, length of hospital stay and number of prescribed medications.

**Methods**

A cross-sectional study was conducted at the Alzahra Teaching Hospital of Isfahan, Iran. The hospital is an 850-bed teaching institution serving a population of approximately 1.7 million inhabitants. This study was approved by the Ethics Committee of the Pharmacy Faculty of Isfahan University of Medical Sciences. Between November 2014 to May 2015, patients admitted consecutively to all internal medicine wards (Pulmonary, Nephrology, Hematology, Cardiovascular, Gastrointestinal) were included in the study. Patients were admitted due to different diagnosis covering the entire field of internal medicine. Permission was obtained from hospital authorities to consult the patient’s medical record for research purpose. Drugs prescribed during the hospital stay and discharge were retrieved from medical records and drug Kardex. The following information was collected: patient’s age, gender, length of hospital stay, reasons for admission, detail of medication therapy provided in the hospital and severity and significance of drug interaction. All regular and PRN (pro-ра-nata, means as required) medications were included. All information was recorded on a standardized form. The severity and significance of drug interaction were analyzed using Lexi-Comp on desktop drug interaction software (Lexi-Comp, Inc., Ohio, USA). Significance of drug interactions was divided into 5 categories (A to X) which was presented in table 1.

**Table 1. Significance of drug-drug interaction**

<table>
<thead>
<tr>
<th>Risk Degree</th>
<th>Necessary Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Undefined Interaction</td>
<td>Information has shown no pharmacokinetic or pharmacodynamics interaction between selected drugs.</td>
</tr>
<tr>
<td>B</td>
<td>No Measurement</td>
<td>Information has shown that the selected drugs may be interacting with each other. However, small evidence from clinical concerns exists about taking these medicines together.</td>
</tr>
<tr>
<td>C</td>
<td>Monitor therapy</td>
<td>Data has shown that certain components of selected medicines may interact with each other via a distinct clinical mechanism. The advantages of both drug consumptions should be more than risks.</td>
</tr>
<tr>
<td>D</td>
<td>Taking care reform</td>
<td>Data has shown that the two selected drugs may be interacting with each other through a specific physical mechanism. A patient-specific evaluation should be carried out to detect advantages of the dual consumption compared to hazards. Certain reactions to understand the advantages and minimize the use of two drugs together should be done. These actions include aggressive monitoring, experimental dose changes, and alternative medicine selection.</td>
</tr>
<tr>
<td>X</td>
<td>Avoidance of concomitant use of two drugs</td>
<td>Data has shown that certain components of the two drugs may interact with each other via a distinct clinical mechanism. Hazards associated with the combined use of two drugs are commonly more than the advantages. These drugs are usually considered together as contraindicated drugs.</td>
</tr>
</tbody>
</table>
Furthermore, Micromedex database (Thomson Reuters Healthcare Inc., Greenwood Village, Colorado, United states) (15), was used for DDIs analysis, which categorized interactions according to the degree of severity (contraindicated, major, moderate, minor). The program also provides information about the underlying mechanism and classifies onset of adverse drug reactions (rapid, delayed, unspecified), and potential adverse outcome of an interaction. Data were presented as proportions, means and standard deviations, or medians. Logistic regression was applied to identify the association of occurrence of pDDIs with patient’s age, gender, length of hospital stay and number of prescribed medications.

Exposure to pDDIs was the dependent variable in the model (0: absent, 1: present). The following variable was included in the model as predictors of pDDIs: patient’s age (1=below 60 years, 2=60 years or older), gender (1=male, 2=female), hospital stay (1=less than 6 days, 2=6 days or above), and number of prescribed medications (1= less than 7, 2=7 or above). The odds ratio (OR) and respective confidence interval (CI) was calculated for each variable. A p-value of <0.05 was considered statistically significant. SPSS for windows Version 20 (SPSS, Inc., Chicago, IL, USA) was used for all statistical analyses.

**Table 2. General characteristics of patients in internal medicine wards.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Patient: N(%)</td>
</tr>
<tr>
<td>Male</td>
<td>263 (58.7)</td>
</tr>
<tr>
<td>Female</td>
<td>185 (41.3)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>15 (3.3)</td>
</tr>
<tr>
<td>21-40</td>
<td>82 (18.3)</td>
</tr>
<tr>
<td>41-60</td>
<td>126 (28.1)</td>
</tr>
<tr>
<td>61-80</td>
<td>160 (35.7)</td>
</tr>
<tr>
<td>81-100</td>
<td>65 (14.5)</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td></td>
</tr>
<tr>
<td>≤ 3</td>
<td>2 (0.4)</td>
</tr>
<tr>
<td>3-7</td>
<td>144 (23.1)</td>
</tr>
<tr>
<td>&gt;7</td>
<td>302 (67.4)</td>
</tr>
<tr>
<td>Prescribed medications per patient</td>
<td></td>
</tr>
<tr>
<td>&lt; 3</td>
<td>15 (3.3)</td>
</tr>
<tr>
<td>3-6</td>
<td>130 (29)</td>
</tr>
<tr>
<td>&gt; 7</td>
<td>303 (67.6)</td>
</tr>
</tbody>
</table>

**Table 3. Prevalence of potential drug-drug interactions (pDDIs) in internal medicine wards.**

<table>
<thead>
<tr>
<th>Type of prevalence</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall prevalence *</td>
<td>Patient: N (%)</td>
</tr>
<tr>
<td></td>
<td>386 (86.2)</td>
</tr>
<tr>
<td>Severity of pDDIs</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>71 (15.8)</td>
</tr>
<tr>
<td>B</td>
<td>243 (54.2)</td>
</tr>
<tr>
<td>C</td>
<td>352 (78.6)</td>
</tr>
<tr>
<td>D</td>
<td>168 (42)</td>
</tr>
<tr>
<td>X</td>
<td>41 (9.2)</td>
</tr>
<tr>
<td>Major</td>
<td>217 (48.4)</td>
</tr>
<tr>
<td>Moderate</td>
<td>273 (60.9)</td>
</tr>
<tr>
<td>Minor</td>
<td>129 (28.8)</td>
</tr>
<tr>
<td>Rapid</td>
<td>188 (42)</td>
</tr>
<tr>
<td>Delayed</td>
<td>253 (65.5)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>172 (38.4)</td>
</tr>
<tr>
<td>Number of pDDIs per patient</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>100 (22.3)</td>
</tr>
<tr>
<td>3-5</td>
<td>89 (19.9)</td>
</tr>
<tr>
<td>6-9</td>
<td>82 (18.3)</td>
</tr>
<tr>
<td>≥ 10</td>
<td>115 (25.7)</td>
</tr>
</tbody>
</table>

* Overall prevalence means presence of at least one pDDI regardless of type of severity.

**Results**

Of the 448 patients, 263 (58.7%) were males and 185 (41.3%) were females. Most patients were between 61 and 80 years of age (35.7%; mean age 57.8±20.2 years). Median age was 61 years. The median hospital stay was 9 days (13.1±14.4, range 2-220 days). The number of concomitant prescription medications ranged from 1 to 28 (mean: 9.1±4.3) and 73.3% of patients took more than four drugs. Table 2 shows the general characteristics of patients in internal medicine wards. The number of potential DDIs found for each patient in the wards ranged from 0-61 interactions and the mean potential DDI for each patient was 7.6±8.8 interactions. In total, 3350 pDDIs were found in patients. Overall, 11.8% patients had at least one pDDI regardless of type of severity. Moderate pDDIs were most prevalent (60.9%) followed by major pDDIs (48.8%) and minor pDDIs (28.8%). Contraindicated pDDIs were recorded only in 9.2% of patients. Table 3 shows the frequency of DDIs regarding the A to X category. The most type of interactions was C category (78.6%).
More than 25% of our patients were exposed to more than 10 pDDIs during their hospital stay. In 22.3% cases, patients were presented with one or two pDDIs. Of 386 identified pDDIs, most were delayed onset (56.5%) followed by rapid onset (42%). The onset of pDDIs in 38.4% of cases were unspecified. Table 4 shows the patient’s characteristics and type of interactions in different internal medicine wards. More than 90% of patients in the pulmonary ward had pDDIs. Most frequently identified major or moderate interactions resulted in 27% of all pDDIs (907 out of 3350).

Their frequencies, levels of severity, onset and potential adverse outcomes were presented in table 5. In logistic regression analysis, there was a significant association of the occurrence of pDDIs with seven or more numbers of prescribed medications (OR: 0.048; 95% CI:0.02-012, p<0.0001). The association was not significant in case of the patient’s gender (OR: 1.02; 95% CI=0.56-1.81, p=0.94), patient’s age of 60 years less or more (OR: 0.94; 95% CI=0.51-1.7, P=0.85) and hospital stay of 6 days less or more (OR: 0.82; 95% CI:0.4-1.5, P=0.54).

Table 4. Patients’ characteristics and prevalence of potential drug-drug interaction (DDI) in different internal medicine wards.

<table>
<thead>
<tr>
<th>Wards</th>
<th>Age Mean±SD</th>
<th>Hospital stay (Days)</th>
<th>Prescribed medications per patient</th>
<th>Total</th>
<th>PDDIs severity (N (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A 14</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>61.7±19.8</td>
<td>18.4±23</td>
<td>10.1±4.3</td>
<td>123</td>
<td>(97.6)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>56.3±20.7</td>
<td>12.1±7.6</td>
<td>8.9±4.4</td>
<td>145</td>
<td>(87.3)</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td>57.3±18.9</td>
<td>7.9±3.7</td>
<td>7.2±3.4</td>
<td>54</td>
<td>(76.4)</td>
</tr>
<tr>
<td>Nephrology/</td>
<td>54.8±20.3</td>
<td>10.2±5.9</td>
<td>9.5±3.9</td>
<td>64</td>
<td>(85.3)</td>
</tr>
<tr>
<td>hematology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

In the present study, we found that nearly all of the patients admitted to the internal medicine wards, experienced at least one potential DDI, during their hospitalization. On average, this group of patients experienced 7.6 DDIs. Approximately, 67% of these patients were prescribed more than six drugs, which is the only factor that had significant association with the occurrence of pDDIs. Similar studies report a trend of increasing prevalence of potential DDIs with the increase in the number of drugs prescribed (16-19). Research worldwide has shown that polypharmacy (5 or more drugs) contributes to the increased risk of potential DDIs (20, 21). Overall, the mean number of prescription drugs in our study was more than similar studies conducted in similar settings (5, 16, 22). In our center, usually multiple physicians visit the patients and we do not have a system to alert about the potential DDI. Prescribing medicine with a computerized physician order entry (COPE) system with DDI alerts, may be promoted rational therapy in medical wards and decrease DDI occurrence (23, 24). A study by Rijkom et al., (25) shows that computerized DDI alerts may be a useful tool to prevent adverse drug events within hospitals. Ismail et al., (22) reported the overall prevalence of 52.8% of at least one pDDIs in 400 medical inpatients. Major and moderate pDDIs were recorded in 23% and 63.6% of patients, respectively. In our study, the overall prevalence of pDDIs (86.2%) and also major pDDIs was higher as compared with the above report. The prevalence of moderate pDDIs (or C type) was similar to the aforementioned study. Rates ranging from 43% to 56.2% have been described in internal medicine wards for all potential DDIs. Despite variation in study design, these published reports suggest a high prevalence of pDDIs in internal medicine wards, which is even higher in our study.

The most prevalent type of interactions observed in our study was type C (78.6%). Type C drug interaction will not cause any serious and fatal consequences and need careful monitoring to avoid and minimize the negative outcomes of these interactions. However, we found that 41 (9.2%) patients have type X interactions, which could be harmful and life-threatening for patients. The rates of contraindicated or type X interactions were from 0.2-2.4% in other studies (12, 22, 25, 26).
Table 5. Most frequently identified major or moderate interactions, their levels and potential adverse outcomes.

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Frequency</th>
<th>Severity</th>
<th>Onset</th>
<th>Potential adverse outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin + heparin</td>
<td>51</td>
<td>Major</td>
<td>Rapid</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Aspirin + clopidogrel</td>
<td>33</td>
<td>Major</td>
<td>Delayed</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Enoxaparin + warfarin</td>
<td>28</td>
<td>Major</td>
<td>Unspecified</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Aspirin + warfarin</td>
<td>22</td>
<td>Major</td>
<td>Delayed</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Digoxin + furosemide</td>
<td>16</td>
<td>Major</td>
<td>Delayed</td>
<td>Risk of digoxin toxicity</td>
</tr>
<tr>
<td>Ciprofloxacin + insulin</td>
<td>14</td>
<td>Major</td>
<td>Rapid</td>
<td>Hypoglycemia</td>
</tr>
<tr>
<td>Clopidogrel + enoxaparin</td>
<td>13</td>
<td>Major</td>
<td>Unspecified</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Atorvastatin + azithromycin</td>
<td>9</td>
<td>Major</td>
<td>Delayed</td>
<td>Increase risk of myopathy</td>
</tr>
<tr>
<td>Midazolam + morphine</td>
<td>8</td>
<td>Major</td>
<td>Delayed</td>
<td>Increase sedation</td>
</tr>
<tr>
<td>Ceftazidim + warfarin</td>
<td>7</td>
<td>Major</td>
<td>Unspecified</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Clopidogrel + warfarin</td>
<td>6</td>
<td>Major</td>
<td>Unspecified</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Ciprofloxacin + warfarin</td>
<td>5</td>
<td>Major</td>
<td>Delayed</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Losartan + spironolactone</td>
<td>4</td>
<td>Major</td>
<td>Delayed</td>
<td>Hyperkalemia</td>
</tr>
<tr>
<td>Diazepam + morphine</td>
<td>4</td>
<td>Major</td>
<td>Unspecified</td>
<td>Increase sedation</td>
</tr>
<tr>
<td>Pantoprazole + warfarin</td>
<td>51</td>
<td>Moderate</td>
<td>Unspecified</td>
<td>Increase effect of warfarin</td>
</tr>
<tr>
<td>Atorvastatin + clopidogrel</td>
<td>33</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Risk of blood clotting</td>
</tr>
<tr>
<td>Aspirin + enoxaparin</td>
<td>28</td>
<td>Moderate</td>
<td>Rapid</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Aspirin + captopril</td>
<td>25</td>
<td>Moderate</td>
<td>Rapid</td>
<td>Decrease effect of captopril</td>
</tr>
<tr>
<td>Digoxin + pantoprazole</td>
<td>22</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Digoxin toxicity</td>
</tr>
<tr>
<td>Losartan + warfarin</td>
<td>18</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Decrease effect of warfarin</td>
</tr>
<tr>
<td>Levofloxacin + prednisolone</td>
<td>17</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase risk of tendon rupture</td>
</tr>
<tr>
<td>Atorvastatin + digoxin</td>
<td>16</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Digoxin toxicity</td>
</tr>
<tr>
<td>Diazepam + valproic acid</td>
<td>14</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Excessive sedation</td>
</tr>
<tr>
<td>Digoxin + spironolactone</td>
<td>12</td>
<td>Moderate</td>
<td>Rapid</td>
<td>Digoxin toxicity</td>
</tr>
<tr>
<td>Captopril + furosemide</td>
<td>11</td>
<td>Moderate</td>
<td>Rapid</td>
<td>Acute hypotension, renal insufficiency</td>
</tr>
<tr>
<td>Levothyroxine + warfarin</td>
<td>8</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase risk of bleeding</td>
</tr>
<tr>
<td>Phenytoin + valproic acid</td>
<td>7</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Decrease level of valproic acid</td>
</tr>
<tr>
<td>Cyclosporine + diltiazem</td>
<td>7</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase cyclosporine toxicity</td>
</tr>
<tr>
<td>Ciprofloxacin + prednisolone</td>
<td>6</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase risk of tendon rupture</td>
</tr>
<tr>
<td>Ciprofloxacin + methadone</td>
<td>5</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase QTc interval</td>
</tr>
<tr>
<td>Meropenem + valproic acid</td>
<td>5</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Decrease level of valproic acid</td>
</tr>
<tr>
<td>Ciprofloxacin + Magnesium Oxide</td>
<td>4</td>
<td>Moderate</td>
<td>Rapid</td>
<td>Decrease level of ciprofloxacin</td>
</tr>
<tr>
<td>Lamotrigin + valproic acid</td>
<td>4</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Increase level of lamotrigin</td>
</tr>
<tr>
<td>Gentamycin + vancomycin</td>
<td>4</td>
<td>Moderate</td>
<td>Delayed</td>
<td>Nephrotoxicity, ototoxicity</td>
</tr>
</tbody>
</table>

Although this result is much lower than the frequency found in this study, the difference may partially be explained by the study design and characteristics of the population. As this type of interactions could be harmful for patients, physicians and pharmacists should be aware of them and keep patients under close surveillance. No statistically significant differences were found between age, gender and length of hospital stay regarding DDIs in our study, which is in agreement with a number of studies about gender (17, 27), but in disagreement with other studies that report a positive association between older age and length of hospital stay and potential DDIs (18, 28). Some of these studies conducted in different settings. Ismail et al., (22) found a significant association of the occurrence of pDDIs with patient age 60 years or more (OR: 2.1, P: 0.003), hospital stay of 6 days or longer (OR: 2.6, P: 0.001) and seven or more numbers of prescribed medications (OR: 5.9, P<0.001). Finding of our study suggests that patients on polypharmacy are exposed to...
pDDIs. The two most active substances involved in potentially clinically significant interactions were ciprofloxacin and aspirin. Ciprofloxacin is an antibiotic from quinolones class which has two important DDIs: decreased absorption with magnesium, calcium, iron and zinc and inhibit specific cytochrome p-450 isozymes responsible for metabolism of many drugs including methylxanthines. The consequence of interaction could be an increase in the plasma concentrations of some drugs, which in the case of theophylline could be life-threatening (29). The most frequent DDI of oral ciprofloxacin was with insulin. Ciprofloxacin increases the effect of insulin and may increase or decrease blood sugar. Careful monitoring of blood glucose is important. Potential DDIs have also been described with aspirin. The most important is the DDI with other antiplatelet or anticoagulant drugs (such as heparin, warfarin, enoxaparin, and clopidogrel) which may increase the risk of bleeding (30). These combinations are sometimes necessary during treatment. As a consequence, patients should always be carefully monitored.

Following are the potential limitations of this study. We did not investigate the actual effects of the identified pDDIs. Studies are needed to identify actual clinical consequences of these interactions. The present study was carried out in one hospital, so its exact external validity is not known. Yet, we anticipate a similar pattern in internal medicine wards of other hospitals, particularly in the developing world. We identified the association of pDDIs with specific risk factors. Studies can be designed to investigate the contribution of other factors such as use of a specific class of drugs, multiple prescribers, a specific diagnosis and type and number of comorbid illnesses.

In conclusion the findings of the present study showed a high prevalence of DDIs in internal medicine wards. Most of the interaction was of moderate severity, nonetheless, major pDDIs were also recorded in substantial numbers and similar to other international studies show an exponential growth in major DDIs. Exposing patients to a greater number of prescription drugs, four or more, proved to be a significant predictor of DDIs. Prescription of drugs with a low risk for DDIs and careful monitoring for possible adverse drug reactions (ADR) are measures to minimize harm associated with DDIs. We also recommend the development and use of computerized DDI alerts tool to prevent ADRs events within the hospital.

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References


