ABSTRACT • Introduction: Medication prescribing errors are made all over the world. However, exact data about them are lacking in Lebanon. Our objective was to describe medication errors, including drug-drug interactions in medication orders given to patients admitted to Lebanese hospitals.

Methods: A prospective study was carried out on 313 patients taken from seven Lebanese hospitals; 1826 medication orders were assessed for errors and 456 drug-drug interactions were found. Data was entered and analyzed on SPSS.

Results: Around 40% of medication orders were judged to comprise at least one prescribing error, mainly no ordering of parameters monitoring (20%), unnecessary medication (9%), and no indication (7%). Errors occurred mainly in the pediatrics (50%) and internal medicine wards (40%). Having an infectious or gastro-intestinal problem almost doubled the risk of medication prescribing error. Antiulcer agents, NSAIDs, antibiotics and steroidal agents were the medications mainly involved. Meanwhile, 12 adverse medication events were reported, with an odds ratio of association to a medication error of 7.4 \((p = 0.004)\). As for drug-drug interaction (DDI), prescriptions comprised zero to 29 interactions, involving medications with low margin of safety such as acenocoumarol, amiodarone and valproate. Pharmacodynamic interactions were mainly found (60%). The majority of DDIs were of high clinical significance and well documented (80%), with moderate (59%) to major (17%) severity.

Conclusion: These results highlight the urgency of an intervention to improve patients’ outcomes and avoid deleterious impact of inadequate medication use in Lebanon. The presence of a clinical pharmacist, the inclusion of computerized systems and the application of drug management policies are suggested to decrease medication prescribing errors and enhance the physician attention to DDI.

INTRODUCTION

Medication prescription and administration are delicate tasks, and medication errors are commonly seen in hospitals. They may occur across the entire spectrum of prescribing, dispensing, and administering [1-3]. Reported prescribing error rates vary widely, ranging from 0.3% to
39.1% of written medication orders and from 1% to more than 90% of hospital admissions [4]. Conversely, more than 70% of serious medication errors occur during prescribing [5]; they can be responsible of hospital admissions and complications [6-8], and are costly to the health care system [5].

On the other hand, reported adverse events have a high rate of preventability (57% to 76%), i.e. they are medication errors [5, 9-12]. For example, in children, severe injury or death have been reported by the American Association of Poison Control Centers in children of the United States, due mainly to excessive medication dosing (72%) [13]. Higher rates of medication errors, drug-drug interactions and adverse events are also found in elderly receiving multiple medications for long-term illnesses [14-15]; in this population, a relatively high proportion of adverse drug events may be preventable [16].

In the Middle Eastern region, the situation does not differ from industrialized countries. Prescription writing of physicians was demonstrated to be suboptimal in Bahrain [17], while in Palestine, a wide range of dosing errors was common among patients with renal impairment [18]. In Saudi Arabia, 35% of patients were prescribed medication at a wrong dose, 31% by a wrong route of administration, and 30% with a wrong dosage form. These errors were due to human factors in 47% of cases [19]. In a study over 20 health care centers, 90.5% of infants’ prescriptions comprised at least one error (non specification of duration or dose, dosing error, frequency error, and other errors types), mainly related to inadequate information about medications and nonadherence to basic principles of prescribing by physicians [20].

In Lebanon, 22.4% of elderly outpatients had inadequate prescribed medications (according to Beers’ criteria) [21]. In Lebanese medical centers, several points have been demonstrated in previous research: the incidence of medication-related illnesses is not different from that in Western nations [22], and medication errors are quite possible since the medication use system in Lebanese hospitals is not well monitored [23]. However, published data is still lacking concerning the importance of clinical pharmacy in Lebanese hospitals, particularly in the field of medication prescribing error prevention. The objective of the study was to describe medication prescribing errors, including drug-drug interactions, in medication orders given to patients admitted to Lebanese private and public hospitals.

METHODS

Study design
This is a prospective descriptive study, carried out between October 15th and November 15th 2008.

Setting and participants
The study took place in a convenient sample of hospitals: Seven hospitals in Lebanon (public and private), where PharmD students of the Lebanese University carry out their practicum. Patients were included if they were admitted to the following wards during the study period: Internal Medicine, Intensive Care, Cardiology and Pediatrics. Every PharmD student was required to collect information for the first 10 patients admitted to his rotation ward. No exclusion criteria were adopted.

Procedure and main outcome measures
Patients’ charts were reviewed and physicians were interviewed to fill out a standardized Clinical Research Form (CRF). Collected data included patient medical and medication history, laboratory data (biochemistry, hematology, microbiology, and clinical chemistry data), diagnosis and comorbidities, detailed medication orders and eventual adverse drug events. Data were collected by PharmD students, and CRF were subsequently evaluated by their preceptors (PharmDs & PhDs). No intervention was done in front of physicians to change the prescriptions; CRF were then centrally collected at the department of Clinical Pharmacy.

Only medication prescribing errors were evaluated in this study. The following definition was used: “A clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescribing writing process, there is an unintentional significant (1) reduction in the probability of treatment being timely and effective or (2) increase in the risk of harm when compared with generally accepted practice.” [24]. Information was assessed using two international references [25-26]. The following medication prescribing errors were considered per medication order: inadequate indication, use in case of contraindication, duplicate and unnecessary therapy, inappropriate dosing for the patient’s condition (dosing outside the recommended range, dosing without adaptation in case of renal of liver failure), inadequate specification of parameters to monitor by the physician (absence of or incomplete specification of required parameters), inadequate route of administration, inadequate frequency of administration, and missing information on the chart (missing dose, frequency or route). We note that the last error may be due to the physician lack of specification or the nurse mistranscription.

Drug-drug interactions (DDI) per prescription were completely assessed according to the Drug Interaction Facts book [27]: DDI were classified as of major (life threatening or potentially causing permanent damage), moderate (because they would cause deterioration of patient status), and minor significance (bothersome or causing little effect). The mechanisms of DDI were recorded (pharmacodynamic or pharmacokinetic, and being on absorption, metabolism, distribution or elimination, or unknown). The eventual onset of DDI was described as rapid (within 24 hours) or delayed (days to weeks). On the other hand, DDI’s documentation was found to be as follows: established in the literature (proven in well controlled studies), probable (very likely, but not proven clinically), suspected (may occur; some good data but would need more study), possible (could occur, but data is limit-
ed), or unlikely (doubtful). Finally, the overall clinical significance was divided into clinically significant (if of high to moderate severity, coupled to possible to good documentation), or non clinically significant (otherwise), as described in the Drug Interaction Facts book [27]. Furthermore, interactions were double checked by using the Drug Interaction Checker of the Medscape for Pharmacists [28].

Adverse drug events were also evaluated; they were rated by using Naranjo probability scale criteria: according to their severity, consequences and objective proofs, they were considered definite, probable, possible or unlikely to be linked to the administered medication [29].

Statistical analysis
Data was entered and analyzed on SPSS, version 13.0. For nominal and ordinal variables, frequencies and percentages were presented; for continuous quantitative variables, the mean and standard deviation (SD) were presented. Statistical analyses included using Chi² test and Fisher exact test for nominal and ordinal variables, while Student test was used for continuous variables comparison between two groups, in case of normal distribution and homogeneous variances. In case of non normal distribution or non homogenous variances, Mann-Whitney test was used to compare between two groups. A p-value of less than 0.05 was considered significant, and 95% confidence intervals (CI) were calculated for selected parameters, namely odds ratios (OR).

RESULTS

Patients characteristics and medication orders’ description
Out of 380 returned CRF, 313 were adequately filled out, corresponding to 313 patients involved in the study, whose charts involved 1826 medication orders (Table I). Patients were almost evenly distributed between hospitals, while the majority of medication orders were taken from the internal medicine ward. Less than 10% of medication orders were taken from the intensive care units.

Fifty-four percent of involved patients were males, while 46% were females. The mean age was 44.6 years, with a standard deviation of 28.4. As for age distribution, 9.2% were infants (neonates to 1 year of age), 15.9% were children (1 to 17 years), 39.4% were adults (18 to 64 years), and 35.2% were elderly (65 years and more). The mean serum creatinin was 1.3 mg/dl (SD = 4.2), and mean creatinin clearance was 90.5 ml/min (SD = 46.7); 16.2% had renal failure. Liver function was normal in the majority of cases; only 1.6% were clinically judged to have liver failure. Four percent were reported to be allergic to at least one medication.

Clinical problems and prescribed medications
Out of 313 patients, 38.1% had a cardiovascular system problem, 38.4% had an infection, 19.7% had a lung problem and 11.1% had a gastrointestinal problem. Other problems were less common. Polypharmacy was found in the great majority of patients; only 1.3% had one prescribed medication on their chart; the rest had at least two medications. Prescribed medications’ types were the following mainly antibiotics (18.7%), anticoagulant/antiplatelet agents (13.1%), antihypertensive agents (11.2%) and antiulcer agents (11.2%).

Medication prescribing errors
Out of 313 patients’ prescriptions, only 55 (17.5%; 95% CI [13.3%-21.7%]) were found to have no error, while the rest (82.5%; 95% CI [78.3%-86.7%]) had at least one prescribing error. Per medication order, 60.7% of medication orders were considered with zero error (95% CI [58.5%-62.9%]), while 39.3% of orders had one error or more (95% CI [37.1%-41.5%]); 21.7% of orders had one error, 10.4% had two errors, 3.4% had three errors, and 1.8% had four errors or more per medication order.

Thus, among 1826 medication orders, 1103 errors of various types were found: 20.3% had no adequate specification of parameters to be monitored, 9.3% were unnecessary, 7.1% were non-indicated medications, 4% were prescribed at a lower dose than adequate, 2.8% at an inadequate frequency, 2.8% had missing information from file, 2.7% were prescribed for a too short duration, 2% were prescribed at a higher dose than necessary, and 0.8% for a too long duration. There were a relative contraindication in 1.2%, an absolute contraindication in 0.3%, and an inadequate route of administration in 0.9%.

Here are some examples of the prescribing errors that were found:

- Proton pump inhibitors and intravenous ranitidine were used in many patients outside the Intensive Care Unit without any compelling indication.
- Enoxaparin was used at a low dose of 20 mg once daily for deep venous thrombosis prophylaxis with no obvious reason for dose lowering.
In 37.5% of cases, the DDI involved a toxic or narrow therapeutic window medication. Examples of interactions include: antihypertensives (involved in 46.5% of DDI), non steroidal anti-inflammatory medications and antibiotics (Table II).

Drug-drug interactions’ description
Out of 1822 medication orders in prescriptions of more than two medications, a total of 456 potential DDI were found, present in 46.6% of prescriptions. 165 out of 313 medications were discontinued, 6 were changed, 2 required dose modification, 3 prolonged hospital stay, and 3 necessitated supportive therapy. As for severity, 1 resulted in a serious harm, 3 were considered mild, 7 moderate, and 1 severe. There were conclusive reports in the literature for 10. ADE disappeared after the medication was stopped for 7; it was dose-dependent for 4, and the patient already presented a similar AE for 4. Objective proof was available for 9. Globally, according to Naranjo probability scale, ADE was considered probable for 6, possible for 4 and doubtful for 1.

In orders with medication prescribing errors, there was a significantly higher risk of reporting an adverse events (OR = 7.40 [1.59-34.45]; p = 0.004) (Figure 1); in other words, the adverse event was avoidable.

Here are some examples of some adverse events that were judged avoidable (related to medication prescribing errors):
- Gout crisis that needed medication treatment after high doses of bumetanide, administered without adequate monitoring of uric acid blood levels;
- Extra-pyramidal syndrome after administration of very high doses and for a long duration of metoclopramide to a patient with intractable vomiting;
- Amiodarone was administered to a patient who was already suffering from hypothyroidism, which exacerbated her thyroid status.

Adverse drug events
As for adverse drug events (ADE), 12 (0.7%) were reported. Complete data was available for 11 of them: 4 medications were discontinued, 6 were changed, 2 required dose modification, 3 prolonged hospital stay, and 3 necessitated supportive therapy. As for severity, 1 resulted in a serious harm, 3 were considered mild, 7 moderate, and 1 severe. There were conclusive reports in the literature for 10. ADE disappeared after the medication was stopped for 7; it was dose-dependent for 4, and the patient already presented a similar AE for 4. Objective proof was available for 9. Globally, according to the Naranjo probability scale, ADE was considered probable for 6, possible for 4 and doubtful for 1.

In orders with medication prescribing errors, there was a significantly higher risk of reporting an adverse event (OR = 7.40 [1.59-34.45]; p = 0.004) (Figure 1); in other words, the adverse event was avoidable.

- For some patients, antibiotics were given without stating the duration; this caused some patients to receive the antibiotics for periods longer than necessary.

Subgroups’ comparison of medication prescribing errors
In table I, we present medication prescribing error percentages per ward and type of problem. There is a significant (p < 0.001) difference in medication prescribing errors occurrence between wards, with pediatric ward having the highest (49.4%) and cardiology ward the lowest (27.2%) percentage of errors.

Having an infectious or a gastrointestinal disease are both associated with higher rates of medication prescribing errors, while having a cardiovascular, endocrinology or renal disease are inversely associated with medication prescribing errors (p < 0.05). For other specified problems, no significant differences in percentage of medication prescribing errors were found.

As for types of medications, significantly different rates were found with the lowest prescribing errors for antidiabetic, antianginal and antispasmodic/muscle relaxing agents and the highest for antilucre agents, non steroidal anti-inflammatory medications and antibiotics (Table II).

<table>
<thead>
<tr>
<th>WARD</th>
<th>Orders N</th>
<th>Medication errors</th>
<th>p value</th>
<th>OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Medicine</td>
<td>822</td>
<td>40.3%</td>
<td>&lt; 0.001</td>
<td>1.80 [1.40-2.31]</td>
</tr>
<tr>
<td>Intensive Care Units</td>
<td>167</td>
<td>34.7%</td>
<td>1.42</td>
<td>[0.97-2.08]</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>340</td>
<td>49.4%</td>
<td>2.61</td>
<td>[1.94-3.51]</td>
</tr>
<tr>
<td>Cardiology</td>
<td>448</td>
<td>27.2%</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>PROBLEM TYPE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>850</td>
<td>30.5%</td>
<td>&lt; 0.001</td>
<td>0.54 [0.44-0.65]</td>
</tr>
<tr>
<td>Other problems</td>
<td>938</td>
<td>44.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infectious</td>
<td>585</td>
<td>47.9%</td>
<td>&lt; 0.001</td>
<td>1.84 [1.51-2.26]</td>
</tr>
<tr>
<td>Other problems</td>
<td>1203</td>
<td>33.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>164</td>
<td>47.0%</td>
<td>0.014</td>
<td>1.50 [1.09-2.07]</td>
</tr>
<tr>
<td>Other problems</td>
<td>1624</td>
<td>37.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endocrinology</td>
<td>136</td>
<td>27.9%</td>
<td>0.012</td>
<td>0.61 [0.41-0.90]</td>
</tr>
<tr>
<td>Other problems</td>
<td>1652</td>
<td>38.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renal</td>
<td>92</td>
<td>28.3%</td>
<td>0.047</td>
<td>0.63 [0.40-0.99]</td>
</tr>
<tr>
<td>Other problems</td>
<td>1696</td>
<td>38.6%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEDICATION TYPE</th>
<th>Orders N</th>
<th>Medication errors</th>
<th>p value</th>
<th>OR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antilucre agents</td>
<td>201</td>
<td>59.7%</td>
<td>&lt; 0.001</td>
<td>4.95 [0.06-0.41]</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>26</td>
<td>50.0%</td>
<td>2.08</td>
<td>[1.03-4.20]</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>334</td>
<td>48.8%</td>
<td>3.60</td>
<td>[1.51-8.55]</td>
</tr>
<tr>
<td>Steroids</td>
<td>65</td>
<td>44.6%</td>
<td>2.39</td>
<td>[1.09-5.26]</td>
</tr>
<tr>
<td>Antipyretics</td>
<td>48</td>
<td>39.6%</td>
<td>1.93</td>
<td>[0.91-4.10]</td>
</tr>
<tr>
<td>Bronchodilators</td>
<td>101</td>
<td>39.6%</td>
<td>2.23</td>
<td>[0.99-5.04]</td>
</tr>
<tr>
<td>Hypolipemic agents</td>
<td>67</td>
<td>38.6%</td>
<td>1.35</td>
<td>[0.63-2.90]</td>
</tr>
<tr>
<td>Neuropsychiatric meds</td>
<td>56</td>
<td>37.5%</td>
<td>1.88</td>
<td>[0.87-4.04]</td>
</tr>
<tr>
<td>Laxatives</td>
<td>11</td>
<td>36.4%</td>
<td>1.30</td>
<td>[0.76-2.23]</td>
</tr>
<tr>
<td>Thyroid medications</td>
<td>6</td>
<td>33.3%</td>
<td>1.15</td>
<td>[0.75-1.76]</td>
</tr>
<tr>
<td>Supplements</td>
<td>27</td>
<td>33.3%</td>
<td>1.45</td>
<td>[0.41-2.84]</td>
</tr>
<tr>
<td>Analgesics</td>
<td>60</td>
<td>31.7%</td>
<td>1.58</td>
<td>[0.74-3.39]</td>
</tr>
<tr>
<td>Antiad-ceutals</td>
<td>235</td>
<td>25.1%</td>
<td>1.35</td>
<td>[0.58-3.14]</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>203</td>
<td>23.2%</td>
<td>1.22</td>
<td>[0.53-2.82]</td>
</tr>
<tr>
<td>Antispasmodics/</td>
<td>14</td>
<td>21.4%</td>
<td>1.09</td>
<td>[0.63-1.74]</td>
</tr>
<tr>
<td>Antianginal agents</td>
<td>38</td>
<td>21.1%</td>
<td>1.06</td>
<td>[0.54-2.07]</td>
</tr>
<tr>
<td>Antidiabetic agents</td>
<td>31</td>
<td>19.4%</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

*For other problems, no significant differences in percentage of medication prescribing errors were found.
anticoagulant and antiplatelet agents (30.7%), neuro-psychiatric medications (20.9%), antibiotics (20.9%), and gastrointestinal tract medications (16.9%). For severity, 19.5% of DDI were classified as major, 60.7% were considered moderate, and 19.7% were of minor severity according to the Drug Interactions Facts book [27].

As for involved mechanisms in DDI, 62.1% were pharmacodynamic interactions, while the rest were pharmacokinetic. The onset of DDI would be rapid in 35.3% of cases, and delayed in 64.7% of cases. On the other hand, DDI’s documentation was found to be as follows: 21.5% were established in the literature, 15.6% were probable, 29.4% were suspected, 29.6% were possible and 3.9% were unlikely or doubtful [28].

For the overall clinical significance of the potential DDI, more than 80% are clinically significant: 17.8% were severe and well documented, 27.5% were moderate and well documented, 3.9% were minor and well documented, 24.3% were major to moderate and possible, while 16.4% were minor and possible or were unlikely [28]. No statistically significant differences in the rate of clinically important interaction were found between subgroups; \( p > 0.05 \) between gender, age classes, wards and types of problems. However, there was a trend toward a higher rate of adverse drug events in patients with at least one clinically significant drug interaction in their prescription (5.6% versus 2.4% in patients with no clinically significant interaction in their prescription \( p = 0.15; \text{OR} = 2.38 [0.71-7.97] \)); moreover, patients with adverse events had a trend towards a higher number of clinically significant DDI in their prescription (0.55 versus 0.34; \( p = 0.15 \)).

DISCUSSION

In this study, we found that around 40% of medication orders comprised at least one medication prescribing error. The most common errors were no specification of adequate parameters to be monitored (20%), unnecessary or duplicate therapy (9%), and the use of non-indicated medication (7%). All over the world, reported prescribing error rates vary widely [4]; in a systematic review, median error rate was 7% (2-14%) of medication orders, 52 (8-22%) errors per 100 admissions in developed countries (US and UK), much lower than our results [30]. Lower results were even found in Germany (57 per thousand of medication orders) [11]. In other studies, almost 28% of the prescriptions evaluated contained one or more errors or potential errors [31]. In Saudi Arabia, all analyzed files contained at least one prescribing error, but the error was classified as serious in only 0.98% of patients’ files [19]. These results are closer to ours. We note that prescribing errors variability between studies is partly due to variations in defining and severity evaluation of prescribing errors, methods used to collect error data and settings of the studies [30]. Thus, our study design does not allow for drug error incidence comparison, but mainly the nature and frequency of drug errors.

The most common factors generally associated with medication prescribing errors are related to knowledge regarding medication therapy and patient factors consideration, in addition to nomenclature factors (incorrect medication name, dosage form, or abbreviation) and dosage calculation [31]. Although the most serious errors originate in prescribing decision [32-33], monitoring problems are also reported to cause adverse drug events and even to be preventable causes of hospital admissions for outpatients [12]. This is also similar to what we found, where monitoring specifications were not given and thus, monitoring was not done. Accordingly, health care practitioners and systems must incorporate adequate error reduction, prevention, and detection mechanisms into the routine provision of care [34-35]. High-risk agents should be closely monitored based on patient and medication administration characteristics [36-37].

As for drug-drug interaction (DDI), 46.6% of prescriptions involved at least one interaction; medications with low margin of safety could be involved in one third of DDI, such as acenocoumarol, amiodarone, and valproate; the majority of DDI were of high clinical significance (55%), with moderate (60%) to major (20%) severity. Our results are similar to those of researchers in developing countries: the overall frequency of potential DDI was 49.7% in a Brazilian teaching hospital [3] and 57.8% in the psychiatric department of a Thailand hospital [38]. However, lower rates are found in developed countries, such as in the United States: 0.63% of clinically important DDI [39]. Similar to our findings, patient factors generally found to be associated with increased risk of DDI were high age, a high number of concurrently used medications and of prescribers [15, 40-41]. Interactions can have significant implications due to medication-related morbidity and mortality [39]. The trend for a higher rate of adverse events we found is thus easily explainable. In fact, patients do suffer adverse drug

**Figure 1.** Medication prescribing errors association with reported adverse events. In medication orders where there was at least one medication prescribing error, there was a significantly higher rate of adverse events compared with medication orders with no prescribing error.
reactions from major drug-drug interactions [42]. For example, in the Netherlands, the most frequently occurring clinical consequence of DDI was an increased risk of bleeding (22.0%), hypotension (14.9%), nephrotoxicity (12.6%) and electrolyte disturbances (10.5%). Almost half (48.6%) of the DDI could be managed by monitoring laboratory values [43]. However, many physicians may be unaware of DDI [44-45]. In Singapore, specialists were less likely to correctly identify interactions than generalists, while a previous experience with DDI-caused harm predicted better DDI knowledge [46]. Thus, health care professionals’ ability to recognize potential DDI is important in reducing the risk of potential DDI and their consequences.

In settings where pharmacists have been integrated into medication therapy management processes, patient outcomes have improved [47-51]. Combining the presence of a pharmacist and computerized alerting systems is useful [52-55]. Thus, targeted education, collaborative medication selection, and pharmaceutical care are strongly encouraged [43, 56-57]. The hospital and clinical pharmacists fulfill vital roles in improving medication safety [58-59], as an essential part of the quality improvement process [60]. Going back to Lebanon, physicians and nurses are aware of the importance of clinical pharmacy [61], pharmacists have enough education and are willing to work as clinical pharmacists [62] and hospital official accreditation by the Lebanese Ministry of Health requires the presence of clinical pharmacists [63]. Moreover, clinical pharmacy is known all over the world to be cost effective [47, 64], and was shown to minimize cost of pharmaceutical care in a Lebanese hospital [65]. Despite all this, hospital directors are still reluctant to employ clinical pharmacists: we hope that this study will encourage them to do so.

We are aware of the limitations of this study: a selection bias is possible, since the hospitals that participated may not represent all Lebanese hospitals, and patients’ charts that were analyzed may not represent all Lebanese patients. Moreover, having both adults and children in the same analysis may overestimate or underestimate the medication errors results, since medication prescribing errors vary with the age of the patient [37]. An information bias is also possible, since missing data cannot be ruled out due to inadequate filling of patients’ charts by nurses. Moreover, the prescribers’ characteristics were not taken into account to analyze the occurrence of medication prescribing errors and DDI. Larger scale and specific prescribers’ and patients’ types oriented studies are expected to improve the precision of the obtained results.

CONCLUSION

In conclusion, we have shown in this work that potential medication prescribing errors and drug-drug interactions are quite common in Lebanese hospitals; we have also shown their strong association with adverse events’ occurring. Thus, whatever system is chosen by Lebanese hospitals, reducing medication prescribing errors should be explicitly included in accreditation policy of the Lebanese Ministry of Health. Clinical pharmacy implementation, computerized systems and the application of drug management policies are definitely efficient and cost effective solutions.

CONFLICT OF INTEREST: None to declare.

REFERENCES


