Medication error trends in Middle Eastern countries: A systematic review on healthcare services

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Abstract:
Medication errors (MEs) are a critical worldwide concern and can cause genuine clinical ramifications for patients. Studies concerning such errors have not been undertaken as much in the Middle Eastern region. The aim of this study was to systematically review and identify studies done in the Middle Eastern nations to recognize the principle contributory factors included and to estimate the prevalence in the region. A review of the retrospective, prospective, cohort, and case–control studies based on MEs in the Middle Eastern nations was directed in January 2020 utilizing the accompanying databases: Embase, Medline, PubMed, Ebsco, Cochrane, Scopus, and Prospero. The search methodology incorporated all ages and in English only dating back to 2010. The search methodology included articles about MEs in the Middle East with errors in people of all ages, articles in English, and articles dating back to 2010. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses appraisal instrument was used to assess the quality of the included articles. Individual data extraction, pooled analysis, and the accompanying databases were used for data analysis of the MEs in eligible studies. Fifteen of the 18 articles reviewed from four Middle Eastern countries had low risk of bias, while three out of 18 had medium risk of bias. A total of 58,221 reported people were studied, with a total of 34,730.9 reported MEs. The pooled analysis showed that numbers of errors were mainly prescribing errors (n = 22,715.25), general prescription errors (n = 8097.16), and commission errors (n = 158.2). Iran had the highest rate amid the reported administration errors, at 25.07% (599.11/2388.9). Measuring a patient’s clinical laboratory values was another less common type of prescription ME. Lebanon reported to have the highest monitoring errors, with a rate of 13.13% (277.91/2117). A negative trend was shown in the amount of MEs in the vast majority of the nations under the examination. The under-reporting or uncertain information recommended that significant changes are needed in the healthcare sector. There is solid need of literature on healthcare services in the region to completely understand and address the MEs and issues.

Keywords:
Administration error(s), dispensing error(s), drug error(s), medication error(s), Middle East, prescription mistake(s)

Background
Medication errors (MEs) have impacted patient over the decades and are conveying serious concerns worldwide.[1] They are rated as one of the highest causes of death and are considered one among the most common causes of morbidity and mortality in the hospital setting.[2] Bates et al. found that MEs were occurring at a rate of 5/100 medication orders.[3]

In definition, ME is “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer.”[1] ME
events may be related to professional practice, healthcare products, procedures, and systems.\textsuperscript{[4,5]} These include prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.\textsuperscript{[4,5]} Many studies suggested that, despite global advances in healthcare practices, about 1 in 3 antibody-dependent enhancement was almost always associated with MEs and was preventable.\textsuperscript{[4,5]}

MEs and adverse drug reactions are one among the main triggers of preventable deaths and the most important challenges threatening the patient’s safety. The highly common error was inappropriate medication use and most frequently occurred in the administration process.\textsuperscript{[6]} Medication process included prescribing, ordering, dispensing, administration, discharge summery, transcription, and monitoring; ME could have occurred at any point in this process. Healthcare professionals (HCPs) such as physicians, nurses, and pharmacists were involved.\textsuperscript{[6‑8]}

The cause of these errors was that the drug might be given at the wrong time, to the wrong patient, wrong drug administration or dispensing, and wrong dose and dosage form.\textsuperscript{[6‑8]} Other causes of ME are failing to order the right drug, the drug form being not available, and lack of knowledge.\textsuperscript{[8]} These errors might be active, latent, or error-producing conditions such as pressure, overlaps, and fatigue.\textsuperscript{[7]} One key restriction emphasized in various studies is the absence of an approach to measure and determine errors where, in the Middle East countries, especially in the underdeveloped counties, lack of knowledge among HCPs was determined as a contributory cause.\textsuperscript{[7]}

The aim of this study was to critically review, synthesize, and demonstrate available indication of MEs among patients in different healthcare settings in the Middle Eastern countries, highlighting the different errors that may occur.

**Materials and Methods**

This systematic review of the retrospective, prospective, cohort, and case–control studies adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines for reporting. PRISMA checklist is attached as an additional file.

**Inclusion criteria**

The study was aimed at collecting the causes and occurrences of MEs in the region; we used only studies that occurred and were reported in the countries recognized as the Middle Eastern countries such as Saudi Arabia, Oman, Iran, and Bahrain. We also used studies that included both Middle Eastern countries and non-Middle Eastern countries by simple separation and by using only the data from the desired counties. Certain types of studies that were beneficial to the study were considered as they were often helpful in explaining the causes of the ME discussed. Studies included retrospective, prospective, cohort, and case–control. All studies published between 2010 and 2020 were included.

**Exclusion criteria**

Countries that were not recognized as the Middle Eastern countries were not included. Articles and studies before 2010 were an exclusion criterion. Errors not related to medication were excluded. Articles not written in the English language were excluded from the study.

**Keywords**

Keywords used in the search to narrow down the search and make the results more concise and tailored to our study included medication error, dispensing error, Middle East report, prescription mistakes, administration error, drug errors. Words that explained MEs were also used in the search such as drug, mistakes, incorrect drug error, incorrect dose error, wrong route of administration error. Boolean operators, AND and OR, were utilized in the search to further narrow the results.

**Terms definition**

- **Prescription error**: Most common type of error relating to errors in the prescription writing process\textsuperscript{[8]}
- **Administrative error**: Refers to any errors that involves a difference between what the patient was given and what the prescription ordered\textsuperscript{[8]}
- **Omission error**: Failure of patient to take or of HCP to administer an ordered dose to a patient\textsuperscript{[8]}
- **Commission error**: As opposed to omission, this is the error of administering the wrong procedure, drug, or site\textsuperscript{[8]}
- **Transcription error**: Is any difference found between the physician medication order and the medication order that was transcribed regarding a patient\textsuperscript{[8]}
- **Monitoring error**: The lack of an appropriate drug therapy review process\textsuperscript{[8]}
- **Interaction error**: A prescribing process error where drugs that interact are prescribed to a patient due to the lack of knowledge on interactions.\textsuperscript{[8]}

**Search strategy**

To gather enough data on the research topic, databases and tools employed in the study include Medline, Ebsco, Cochrane, PubMed, Scopus, Prospero, and Embase. The search method in these databases included using keywords mentioned below in various combinations with the exclusion and inclusion criteria using Boolean operators.
Review process
A quality evaluation of the literature was directed by an independent reviewer, who evaluated each of the significant papers dependent on the appraisal tool adjusted from Lisbay, Nielsen & Mainz. The criteria were adjusted to apply to any ME study, instead of just simple observational studies. After disregarding duplicates, the key phrases delivered many articles going back to 2010, with the exception of one article dated back to 2008. Just studies of the occurrence and nature of MEs in the Middle Eastern countries were incorporated. All quality analysis was based on the PRISMA reporting criteria.

The review process and evaluation for the risk of bias for each article were based on the PRISMA reporting criteria used for the evaluation of the quality of an article; this includes a number of criteria or requirements; and based on the presence or absence of these PRISMA reporting criteria in each article, the risk of bias was allotted. Those articles having most of the required criteria on the list allotted low risk of bias (high quality) and those articles that do not meet most of the requirements allotted a medium risk of bias (good quality).

Results
Out of the studies reviewed and extracted, 18 articles with complete information were used in the review. The articles were then further assessed to types of MEs studied in each article and pooled analysis. Middle Eastern countries such as Saudi Arabia, Iran, Bahrain, and Lebanon were the countries involved in the analysis.

General data extraction
After disregarding duplicates, the search terms delivered many articles going back to 2010. Just studies of the occurrence and nature of MEs in the Middle Eastern countries were incorporated giving a total of 567. The title and abstract were then explored for applicability, and an amount of references screened were found to be 120 [Figure 1]. Of these, 88 were erased due to the fact that they were not identified with MEs in the Middle Eastern countries; another 8 were identified with adverse effects and common errors, and studies about MEs by and large; 4 focused on guidelines for the safety of patient. Subsequently, 24 references were at first esteemed applicable. In any case, just 18 of these concentrated the occurrence of MEs specifically in the Middle Eastern countries with complete outcome data; the rest were considered unimportant.

Quality assessment
After application of the internal study quality, it was discussed with the reviewer. Internal and external reviews of 18 studies were done. The following extractions were done according to the following figures: 15 out of 18 total articles had low risk of bias, while 3 out of 18 had medium risk of bias. Out of 9 prospective cohort studies, 8 were determined to have low risk of bias. Out of 6 retrospective cohort studies, 4 were determined with a low risk of bias as well. Out of 3 cross-sectional studies, all showed low risk of bias [Figure 2].

Countrywide distribution
Eighteen articles were chosen out from the Middle Eastern countries that met the inclusion criteria of the research. Five (27.8%) of the studies were from Iran, 8 (44.4%) studies were done in Saudi Arabia, 3 studies (16.6%) were from Bahrain, and 2 (11.1%) were Lebanon. Studies on MEs were not found for other Middle Eastern countries such as Kuwait, Yemen, Iraq, and Syria [Table 1].

Pooled analysis
From the 18 articles identified, a total of 58,221 populations were studied, which included a total of 34,730.9 identified errors. Some articles did not represent all the fields that were looked for in this research [Table 2]. The largest number of errors was mainly prescription drug errors related: about 22715.25
in omission errors, 8097.16 in general prescription drug errors, and 1585.2 in commission errors. Concomitantly, there was about 781.91 transcription errors and 629.11 administration errors. Monitoring errors were observed to be 346.14. 83.84 skill-related errors were found. Finally, 95.3 interaction errors in total were found [12-28] [Figure 3].

**Prescription drug errors**

Overall prescription drug errors were the highest reported type of ME between the Middle Eastern countries. Lebanon had the highest general prescription error rate amid reported MEs, at 74.52% (1577.68/2117). [27,28] Iran was second highest with a reported rate of 54.16% (1293.99/2388.9). [14-18]

Following were rates of 45.68% (2458.79/5382) and 4.33% (1076/24843) from Saudi Arabia [12-14] and Bahrain, [19-26] respectively.

**Omission errors**

Failure to prescribe a drug product indicated for a patient was found to be the highest type of prescription drug errors reported in the Middle East. Bahrain reported to have the most omission errors among prescription MEs with a rate of 89.28% (22,180/24,843). [12-14] Second highest of omission errors reported was Saudi Arabia with a rate of 7.68 (413.49/5382). [19-26] Iran and Lebanon follow with a rate of 5.09% (121.76/2388.9) [14-18] and 0%, respectively [27,28] [Figure 4].

**Table 1: Data spreadsheet with country-wise distribution**

| Study | Total sample (%) | Total case errors (%) | Prescription drug errors (%) | Monitoring errors (%) | Drug interactions (%) | Transcription errors (%) | Commission errors (%) | Omission errors (%) |
|-------|------------------|-----------------------|-----------------------------|-----------------------|-----------------------|--------------------------|-----------------------|---------------------|
| Bahrain |                 |                       |                             |                       |                       |                          |                       |                     |
| Al Khaja et al. (2018) | 2090 | 712 | 712 | - | - | - | - | - |
| Aljasmi et al. (2018) | 992 | 439 | 364 | - | - | - | - | - |
| Al Khaja et al. (2008) | 16,091 | 23,692 | - | - | - | - | - | 1512 | 22180 |
| Iran |                 |                       |                             |                       |                       |                          |                       |                     |
| Afsaneh et al. (2014) | 1031 | 707 | 127 | 53 | 37 | 102 | - | 78 |
| Tahere et al. (2018) | 379 | 205 | 94 | 2 | - | - | - | - |
| Zeraatchi et al. (2013) | 1291 | 204 | 124 | - | - | 31 | - | 33 |
| Izadpanah et al. (2018) | - | 41.9 | 0.50 (1.2) | - | - | - | 3.39 (8.1) | 6.82 (16.3) |
| Karimian et al. (2018) | 17,988 | 1231 | 948.49 (77.05) | 1.23 (0.10) | - | - | - | 3.94 (0.32) |
| Saudi Arabia |                 |                       |                             |                       |                       |                          |                       |                     |
| Assiri et al. (2019) | 2000 | 162 | 150 | 12 | - | - | - | - |
| Al-Dorzi et al. (2019) | 414 | 98 | 98 | - | - | - | - | - |
| Albarrak et al. (2014) | 398 | 76 | 44 | - | 2 | - | - | - |
| Al-Khani et al. (2013) | 203 reports | 2073 | 2073 | - | - | - | - | - |
| Al-Dhawailie (2011) | 1580 | 113 | 93.79 (83) | - | 11.3 (10) | 7.91 (7) | - | - |
| Khoja et al. (2011) | 5299 | 990 | 621 | - | - | 369 | - | - |
| Al-Jeraisy et al. (2011) | 2380 | 1333 | 1016 | - | 45 | 272 | - | - |
| Abdulghani et al. (2017) | 3085 | 537 | 53.7 (10) | - | - | - | 69.81 (13) | 413.49 (77) |
| Lebanon |                 |                       |                             |                       |                       |                          |                       |                     |
| Al-Hajie et al. (2012) | 1826 | 1103 | 617.68 (56) | 223.91 (20.3) | - | - | - | - |
| Chamoun et al. (2016) | 1174 | 1014 | 960 | 54 | - | - | - | - |
| Total | 58,221 | 34,730.9 | 8097.16 | 346.14 | 95.3 | 781.91 | 1585.2 | 22,715.25 |
Commission errors
Medication being prescribed, or dispensed incorrectly, were another common type of prescription ME. Bahrain had the highest commission prescription error rate of about 6.09% (1512/24,843).[12‑14] Saudi Arabia was the second highest, with a reported rate of 1.30% (69.81/5382).[19‑26] Iran[14‑18] and Lebanon[27,28] follow with rates of 0.14% (3.39/2388.9) and 0%, respectively.

Transcription errors
Deviations and missteps in transcribing medication orders were a less common type of prescription ME. Saudi Arabia had the highest rate amid reported MEs at 12.06% (648.91/5382).[19‑26] Iran was second highest with a reported rate of 5.57% (133/2388.9).[14‑18]

Monitoring errors
Measuring a patient’s clinical laboratory values was another less common type of prescription ME. Lebanon reported the highest with a rate of 5.35% (56.23/2388.9) followed by Saudi Arabia[19‑26] and Bahrain[12‑14] with the least rates of 0.22% (12/5382)[12‑14] and 0%, respectively.

Interaction errors
Drug-to-drug interaction errors were the least common type of prescription medication. Iran reported to have the highest interaction errors among the Middle Eastern countries with a rate of 1.54% (37/2388.9).[14‑18] Saudi Arabia was the second highest, with a reported rate of 1.08% (58.3/5382).[19‑26]

Administration errors
Wrong patient, medication, time, dose, and route were the other types of ME reported among the Middle Eastern countries. Iran had the highest rate amid reported administration errors at 25.07% (599.11/2388.9).[14‑18] Saudi Arabia was the second highest, with a reported rate of 0.56% (30/5382).[19‑26] Skill-related errors were the most common type of administration error reported. Iran had the highest rate amid reported MEs at 0.37% (8.84/2388.9).[14‑18] Bahrain was the second highest, with a reported rate of 0.30% (75/24,843).[12‑14]

Discussion
The aim of this review was to review studies of MEs in the Middle East. This review indicated that there have been scarcely any investigations of MEs in the Middle East. Furthermore, the quality of investigations in the Middle East was poor. Poor information on ME reporting and pharmacology was a main consideration in a large number of the articles. This review has indicated that the studies on MEs distributed in Middle Eastern nations are constrained.

Year-wise trends were seen throughout the Middle Eastern countries. Lebanon’s overall MEs reported increased 20% from 2012 to 2016.[28] From 60.4% case errors total in Al-Hajje et al.’s study to 86.4% in Chamoun et al.’s study, MEs did not decrease but rather increase, respectively. Types of MEs reported were the exact same (prescription drug errors, and prescription monitoring errors).[27,28] The vast majority of the investigations in the Middle Eastern nations assessed MEs during the prescribing stage, with general prescription errors being 23.3% of all MEs reported. A high rate of prescribing MEs is known to be a worldwide issue.[27,28] In a previous study made
to identify and quantify prescription errors, majority had prescription errors, and this is consistent with our discoveries.[29] Sixty-five percent of the prescriptions were found to have a total of 1012 errors. These errors were mostly minor such as spelling, date omissions, and patient information.

Taking into account the per prescription tally error in the Al Khaja et al.’s study[12,14], overall a decreasing trend of MEs has been occurring in Bahrain. Limited data are available to be able to distinguish a fair trend in Bahrain’s reported ME rates. Saudi Arabia also had an overall decreasing trend of MEs, of about 47.9% from 2011 to 2019. Finally, looking at Iran, it is shown that there are 84.7% of drug items with reported errors and each drug item had more than one incident, making the total case errors more than the total sample. It is conceivable that the prescribing pace of prescribing mistakes in the Middle Eastern nations is higher than that revealed in different nations on the planet; however, it could likewise be because of methodological contrasts.

Lebanon follows with the second most reported MEs. General prescription error was the highest reported ME at a rate of 89.28% (22,180/24,843).[12‑14] Commission error was the second highest type of error in Bahrain at a rate of 6.09% (1512/24,843).[12‑14] Less common was prescription drug errors at a rate of 4.33% (1076/24,843).[12‑14] Finally, skill-related errors were also reported at a low rate of 0.30% (75/24,843).[12‑14] In the study of Al Khaja et al., there are 84.7% of drug items with reported errors and each drug item had more than one incident, making the total case errors more than the total sample. It is conceivable that the prescribing pace of prescribing mistakes in the Middle Eastern nations is higher than that revealed in different nations on the planet; however, it could likewise be because of methodological contrasts.

Among the Middle Eastern countries, Bahrain reported the most MEs. Omission prescription error was the highest reported ME at a rate of 89.28% (22,180/24,843).[12‑14] Commission error was the second highest type of error in Bahrain at a rate of 6.09% (1512/24,843).[12‑14] Less common was prescription drug errors at a rate of 4.33% (1076/24,843).[12‑14] Finally, skill-related errors were also reported at a low rate of 0.30% (75/24,843).[12‑14] In the study of Al Khaja et al., there are 84.7% of drug items with reported errors and each drug item had more than one incident, making the total case errors more than the total sample. It is conceivable that the prescribing pace of prescribing mistakes in the Middle Eastern nations is higher than that revealed in different nations on the planet; however, it could likewise be because of methodological contrasts.

Lebanon follows with the second most reported MEs. General prescription error was the highest reported ME at a rate of 89.28% (22,180/24,843). Monitoring errors were also reported at a rate of 13.13% (277.91/2117). Site and location have a contributing effect to risk of MEs. In Bahrain, family physicians versus general practitioners were studied a reported frequency of 52.5% and 76.4% physician committed errors, respectively.[14] One study reported ME trends and effects related to environment.[31] The risk of MEs declined 35.4% (mean) in

Table 2: Pooled data for administration errors country-wise distribution pattern

| Study | Total sample (%) | Total case errors (%) | Administration errors (%) | Skill related (%) |
|-------|------------------|-----------------------|---------------------------|------------------|
| Bahrain | Al Khaja et al. (2018) | 2090 | 712 | - | - |
| | Aljasmi et al. (2018) | 992 | 439 | - | 75 |
| | Al Khaja et al. (2008) | 16,091 | 23,692 | - | - |
| Iran | Afseh et al. (2014) | 1031 | 707 | 310 | - |
| | Tahere et al. (2018) | 379 | 205 | 109 | - |
| | Zeraatchi et al. (2013) | 1291 | 204 | 16 | - |
| | Izadpanah et al. (2018) | - | 41.9 | 22.3 (53.3) | 8.84 (21.1) |
| | Karimian et al. (2018) | 17,988 | 1231 | 141.81 (11.52) | - |
| Saudi Arabia | Assiri et al. (2019) | 2000 | 162 | - | - |
| | Al-Dorzi et al. (2019) | 414 | 98 | - | - |
| | Alballak et al. (2014) | 398 | 76 | 30 | - |
| | Al-Khane et al. (2013) | 203 reports | 2073 | - | - |
| | Al-Dhawailie (2011) | 1580 | 113 | - | - |
| | Khoja et al. (2011) | 5299 | 990 | - | - |
| | Al-Jeraisy et al. (2011) | 2380 | 1333 | - | - |
| | Abdulghani et al. (2017) | 3085 | 537 | - | - |
| Lebanon | Al-Hajje et al. (2012) | 1826 | 1103 | - | - |
| | Chamoun et al. (2016) | 1174 | 1014 | - | - |
| Total | 58,221 | 34,730.9 | 629.11 | 83.84 |
differences in healthcare services in the Middle Eastern countries were relatively few in number or nonexistent. Some of the articles’ quality was either poor or not concise. A negative trend in the amount of ME was identified in most of the countries under the study. There is strong need of literature on healthcare services in the region. The under-reporting or inconclusive data suggested major reforms are required in healthcare sector.

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Conflicts of interest
There are no conflicts of interest.

References
1. Bates DW, Cullen DJ, Laird N, Petersen LA, Servi D, et al. Incidence of adverse drug events and potential adverse drug events. Implications for prevention. ADE Prevention Study Group. JAMA 1995;274:29-34.
2. Salameh L, Abu Farha R, Bashieti I. Identification of medication discrepancies during hospital admission in Jordan: Prevalence and risk factors. Saudi Pharm J 2018;26:125-32.
3. Bates DW, Boyle DL, Vander Vliet MB, Schneider J, Leape L. Relationship between medication errors and adverse drug events. J Gen Intern Med 1995;10:199-205.
4. Aronson JK. Medication errors: Definitions and classification. Br J Clin Pharmacol 2009;67:599-604.
5. Alsulami Z, Conroy S, Choonara I. Medication errors in the Middle East countries: A systematic review of the literature. Eur J Clin Pharmacol 2013;69:995-1008.
6. Fathi A, Hajizadeh M, Moradi K, Zandian H, Dezhkameh M, Kazemzadeh S, et al. Medication errors among nurses in teaching hospitals in the west of Iran: What we need to know about prevalence, types, and barriers to reporting. Epidemiol Health 2017;39:e2017022.
7. Thomas B, Paudyal V, MacLure K, Pallivallapila A, McKay J, El Kassem W, et al. Medication errors in hospitals in the Middle East: A systematic review of prevalence, nature, severity and contributory factors. Eur J Clin Pharmacol 2019;75:1269-82.
8. MedDRA. Meddra.org. Available from: https://www.meddra.org/. [Last accessed on 2020 Dec 08].
9. Libsy M, Nielsen LP, Mainz J. Errors in the medication process: Frequency, type, and potential clinical consequences. Int J Qual Health Care 2005;17:15-22.
10. Allan EL, Barker KN. Fundamentals of medication error research. Am J Hosp Pharm 1990;47:555-71.
11. Prisma-statement.org. The PRISMA Group. 16 March, 2018. Available from: http://prisma-statement.org/. [Last accessed on 2020 Apr 02].
12. Al Khaja KA, Ahmed Isa H, Veeramuthu S, Sequeira RP. Potentially inappropriate prescribing in older adults with hypertension or diabetes mellitus and hypertension in a primary care setting in Bahrain. Med Princ Pract 2018;27:241-9.
13. Aljasmi F, Almalood F, Al Ansari A. Prevalence of medication

Conclusions
This study suggested a definitive ME reported in Middle-eastern countries. There are several different types of reported errors; most studies related to MEs
errors in primary health care at Bahrain Defence Force Hospital—Prescription-based study. Drug Healthc Patient Saf 2018;10:1-7.

14. Al Khaja KA, Al-Ansari TM, Sequeira RP. An evaluation of prescribing errors in primary care in Bahrain. Int J Clin Pharmacol Ther 2005;43:294-301.

15. Vazin A, Delfani S. Medication errors in an internal intensive care unit of a large teaching hospital: A direct observation study. Acta Med Iran 2012;50:425-32.

16. Zaree TY, Nazari J, Asghary Jafarabadi M, Alinia T. Impact of psychosocial factors on occurrence of medication errors among Tehran public hospitals nurses by evaluating the balance between effort and reward. Saf Health Work 2018;9:447-53.

17. Zeraatchi A, Talebian MT, Nejati A, Dashti-Khavidaki S. Frequency and types of the medication errors in an academic emergency department in Iran: The emergent need for clinical pharmacy services in emergency departments. J Res Pharm Pract 2013;2:118-22.

18. Izadpanah F, Nikfar S, Bakhshi Imcheh F, Amini M, Zargaran M. Assessment of frequency and causes of medication errors in pediatrics and emergency wards of teaching hospitals affiliated to Tehran University of Medical Sciences (24 hospitals). J Med Life 2018;11:299-305.

19. Karimian Z, Kheirandish M, Javidnikou N, Asghari G, Ahmadizar F, Dinarvand R. Medication errors associated with adverse drug reactions in Iran (2015-2017): A P-method approach. Int J Health Policy Manag 2018;7:1090-6.

20. Assiri GA, Alkhenizan AH, Al-Khani SA, Grant LM, Sheikh A. Investigating the epidemiology of medication errors in adults in community care settings. A retrospective cohort study in central Saudi Arabia. Saudi Med J 2019;40:158-67.

21. Al-Dorzi HM, Eissa AT, Khan RM, Harbi SA, Aldabbagh T, Arabi YM. Dosing errors of empirical antibiotics in critically ill patients with severe sepsis or septic shock: A prospective observational study. Int J Health Sci (Qassim) 2019;13:48-55.

22. Albarrak AI, Al Rashidi EA, Fatani RK, Al Ageel SI, Mohammed R. Assessment of legibility and completeness of handwritten and electronic prescriptions. Saudi Pharm J 2014;22:522-7.

23. Al-Khani S, Moharram A, Aljadhey H. Factors contributing to the identification and prevention of incorrect drug prescribing errors in outpatient setting. Saudi Pharm J 2014;22:429-32.

24. Al-Dhawailie AA. Inpatient prescribing errors and pharmacist intervention at a teaching hospital in Saudi Arabia. Saudi Pharm J 2011;19:193-6.

25. Khoja T, Neyaz Y, Qureshi NA, Magzoub MA, Haycox A, Walley T. Medication errors in primary care in Riyadh City, Saudi Arabia. East Mediterr Health J 2011;17:156-9.

26. Al-Jeraisy MI, Alanazi MQ, Abolfotouh MA. Medication prescribing errors in a pediatric inpatient tertiary care setting in Saudi Arabia. BMC Res Notes 2011;4:294.

27. Abdulghani KH, Aseeri MA, Mahmoud A, Abulezz R. The impact of pharmacist-led medication reconciliation during admission at tertiary care hospital. Int J Clin Pharm 2018;40:196-201.

28. Al-Hajje A, Awada S, Rachidi S, Chahine NB, Azar R, Zein S, et al. Medication prescribing errors: Data from seven Lebanese hospitals. J Med Liban 2012;60:37-44.

29. Chamoun NR, Zenne R, Mansour H. Impact of clinical pharmacy interventions on medication error nodes. Int J Clin Pharm 2016;38:1436-44.

30. Manias E, Cranswick N, Newall F, Weiner C, Williams A, et al. Medication error trends and effects of person-related, environment-related and communication-related factors on medication errors in a paediatric hospital. J Paediatr Child Health 2019;55:320-6.

31. Ali AK. Pharmacovigilance trend analysis of medication errors. Value Health. 2016;19:A276.

32. Yarmohammadian MH, Mohammadinia L, Tavakoli N, Ghalriz P, Haghshenas A. Recognition of medical errors' reporting system dimensions in educational hospitals. J Educ Health Promot 2014;3:76.

33. Mohan P, Sharma AK, Panwar SS. Identification and quantification of prescription errors. Med J Armed Forces India 2014;70:149-53.

34. Iraipour A, Farzi S, Saghaei M, Ravaghi H. Effect of interprofessional education of medication safety program on the medication error of physicians and nurses in the intensive care units. J Educ Health Promot 2019;8:196.