



Original article

The role of drug information centers to improve medication safety in Saudi Arabia - a study from healthcare professionals' perspective

Mansour Almuqbil^{a,b,*}, Lamees Alrojaie^c, Haya Alturki^d, Abdullah Alhammad^a, Yasmin Alsharawy^d, Aljawharah Alkoraishi^d, Abdulaziz Almuqbil^e, Sara Alrouwajeh^d, Syed Wajid^a, Mohamed N. Al-Arifi^a^a Clinical Pharmacy Department, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia^b Department of Pharmacy Practice, College of Pharmacy, AlMaarefa University, Diriyah, 13713 Riyadh, Saudi Arabia^c Pharmaceutical Services Department, King Saud Medical City, Riyadh, Saudi Arabia^d Pharmacy Services Department, King Khalid University Hospital, King Saud University, Saudi Arabia^e College of Medicine, Imam Mohammed Ibn Saud Islamic University, Riyadh, Saudi Arabia

ARTICLE INFO

Article history:

Received 29 July 2021

Accepted 29 January 2022

Available online 8 February 2022

Keywords:

Drug information services

Medication errors

Patient safety

Health

ABSTRACT

Background and objective: The primary function of the Drug Information Center (DIC) is to provide drug-related information to healthcare professionals. The purpose of this research was to assess the use of drug information centers by health care the professionals to improve medication safety in Saudi Arabia.**Methods:** A retrospective study was carried out at King Khalid University Hospital's drug and poison information center (DPIC). During the study period, requests received by drug information specialists were saved in the DPIC questions' bank. Patients' demographic, type of drug information request, caller information, number of references used, medications, class of medication, medication error type and subclass were assessed and analyzed using descriptive analysis. Medication error types were captured based on nature of questions.**Results:** A total of 243 drug information inquiries were assessed. Most of the inquiries were about adult population (n = 168; 69.1%). Most drug information inquiries were received from pharmacists (n = 117; 48.1%), followed by physicians (n = 94; 38.7%), then nurses (n = 23; 9.5%). Prescribing error were the most type of medication error prevented by drug information specialists (n = 214; 88.1%) followed by dispensing errors (n = 11; 4.5%). Approximately half of the medication errors in this study were near-misses (n = 110; 45.3%), followed by potential near misses (n = 84; 34.6%). Only, (n = 49; 20.2%) were identified as errors.**Conclusion:** This study highlights the role of drug information specialists in providing evidence-based information and helps in preventing possible medication errors which will enhance the safety of the services provided to the patients.© 2022 The Author(s). Published by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Despite the accessibility to drug information, health care professionals' opportunities and capabilities for searching and critically evaluating drug information might be limited (Amundstuen

et al., 2016). Finding the best evidence and interpreting the outcomes into clinically meaningful information that applied to specific patient was difficult (Amundstuen et al., 2016). The primary function of the Drug Information Center (DIC) is to answer drug-related questions from healthcare professionals by identifying and interpreting scientific literature, then applies these findings to specific clinical situations and discusses possible solutions with the Enquirer (Amundsen et al., 2016; Al-Arifi et al., 2015, Amundstuen et al., 2016, Manosalva et al., 2016). According to the Pan American Health Organization (PAHO), DIC are operational units that provide scientific information about drugs in timely manner (Nova Manosalva et al., 2016). Historically, the first drug information center in Saudi Arabia opened its doors in 1978, at King Saud university, college of pharmacy (Alomi 2016). In 1980,

* Corresponding author at: Clinical Pharmacy Department, College of pharmacy, King Saud University, Riyadh 11451, Saudi Arabia.

E-mail address: mmetwazi@ksu.edu.sa (M. Almuqbil).

Peer review under responsibility of King Saud University.



Production and hosting by Elsevier

King Khalid University Hospital (KKUH) opened its drug and poison information center (DPIC). The first ministry of health (MOH) DPIC was established in 1989 at Riyadh central hospital as part of clinical pharmacy services. The center's responsibilities include answering questions, educating healthcare professionals through educational lectures and publishing pharmacy newsletter that is distributed monthly across all MOH hospitals (Alomi 2016; Alomi et al., 2019). A previous study conducted in Saudi Arabia found that Drugdex, Textbooks, Iowa Drug Information Services (IDIS), PubMed, and Poisonsindex were the most common resources used to answer drug-related questions. The time devoted to the service ranged from five minutes to weeks (Asiri et al., 2007). Another study conducted in King Saud Medical City found that a total of 139 inquiries were received by DPIC over one year. Most of the inquiries were from pharmacists (61.2%), followed by physicians (23.7%), and then nurses (10.10%). Around half of the questions were about drug dosage and administration, with Lexi comp[®] serving as the primary source of information (Almazrou et al., 2017).

Medication errors are defined as any preventable event that leads to inappropriate use of medications or patient harm (NCCMERP; Dos Santos et al., 2015). Such events may be related to professional practice, health care products, procedures, and system including prescribing, order communication, product labeling, packaging, nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use. The World Health Organization (WHO) identified medication error as a target area to enhance patients' safety as it directly affects mortality and morbidity (Assiri et al., 2019, Lu et al., 2011).

Our study investigated the role of DPIC in hospital settings, and how it could decrease the number of medication errors by responding to health care provider or patients inquires which in turn would result in better quality and safety of the services provided to the patient. Therefore, the aim of this study is to assess the impact and utilization of DPIC in providing drug information and improving medication safety.

2. Methods

2.1. Study design, setting, and population

A retrospective study was conducted to evaluate the impact of drug information centers in improving medication safety. The study was conducted in DPIC at KKUH, an 850-bed tertiary academic hospital in Riyadh, Saudi Arabia. A total of 2975 questions were received in the period between November 2016 to December 2018 and all of the questions were saved in the questions' bank. After receiving each call, employees or trainees under the supervision of their preceptor fill out a form which includes the details of the question and caller.

2.2. Ethical approval

This study was approved by Institutional Review Board, College of Medicine, King Saud University, on 6 May 2019, the reference number was 19/0614/IRB.

2.3. Data collection sheet and procedure

The data collection sheet was created and filled from the DPIC questions bank. It includes information about patient demographics, the type of question, the type of answer, the caller information, the reference/s used to answer, number of references used, medication/s, class of the medication, type of the medication error, and the subclass of medication error. Questions were received from physicians, pharmacists, nurses, interns, residents, and patients.

The types of medication errors were prescribing, dispensing, administration, or monitoring stage. The subclass of medication error was wrong frequency, wrong route of administration, wrong medication, wrong dose, wrong dosage form, wrong strength, wrong duration, drug-drug interaction, drug-disease interaction, drug-food interaction, drug-herb interaction, wrong time, wrong storage, expired medication, wrong patient, and others. The type of the questions that included in the study were about dosage, administration, pregnancy, lactation, side effect, adverse drug event, interactions, compatibility, stability, pharmacokinetics, identification, vaccines, dose adjustment, and extemporaneous preparation. While the questions that were related to non-drug-related, medication approval and availability were excluded.

Potential near-miss as when a physician asked about wrong information before prescribing, the near-miss is when a pharmacist asked about wrong information before dispensing, and Medication error was defined as when the caller asked about wrong information that exists currently (Al Rahbi et al., 2014; Brand and Kraus 2006, Alamri et al., 2017)

2.4. Statistical analysis

Data were initially collected in Excel sheet and analyzed using SPSS version 26. Descriptive analysis, numbers, and percentages, were used to describe the data and identify the most type and subclass of medication error.

3. Results

A total of 1336 drug information requests were assessed during the study period, with 243 drug information requests being included in the final analysis. Fig. 1 showed the inclusion/exclusion process. Most of the inquiries were about adult population (69.1%). Around half of the inquiries were from pharmacists (48.1%), followed by physicians (38.7%) then nurses (9.5%). The demographics and inquiries history showed in Table 1.

Most of the medication errors prevented by drug information specialists were prescribing errors (88.1%) followed by administration errors (6.6%) and dispensing errors (4.5%). Among the identified MEs, around half of them were near misses (45.3%), (34.6%) of them were potential near miss and (20.2%) were identified as errors (Fig. 2).

Outpatient pharmacy accounted for (15.5%) of the questions received, while (13.1%) were from the inpatient pharmacy followed by discharge pharmacy and gynecology department (Table 2). Most of the (86.4%) requests were answered by the use of only one reference, while (8.6%) of the drug information requests were solved by the use of two drug information resources (Fig. 3). The type of questions received by the DPIC and the references used to answer are showed in Table 3.

Regarding the class of drugs, most of the drug information requests were about antibiotics (13.6%) followed by antihypertensive agents (11.1%), anticoagulants (8.5%), and anticonvulsants (6.8%) (Table 4).

4. Discussion

Pharmaceuticals are medicinally active substances that are used to treat, prevent, or diagnose diseases. However, obtaining the correct information for the proper use of such substances is difficult, which may have resulted in medication-related harms or errors, as well as poor health outcomes and increased risk of morbidity and mortality among patients. (Al Rahbi et al., 2014). Previous research found that pharmacists are the most common drug information providers because either they received formal training or

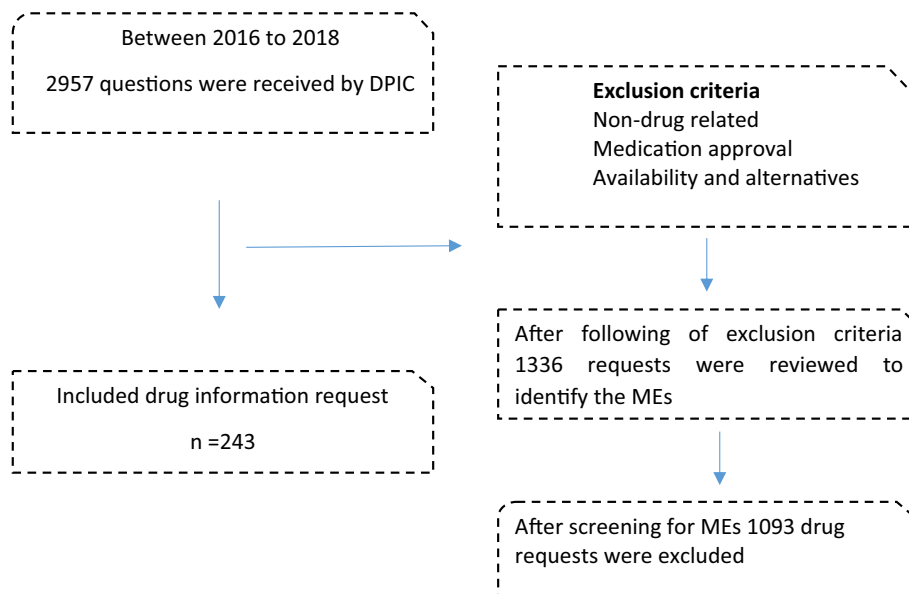


Fig. 1. Flowchart of the inclusion process.

Table 1 Patients' and caller demographic, types, and class of medication error (n = 243).

	n (%)
Gender of caller	
Male	63 (25.9)
Female	123 (50.6)
Missing	57 (23.5)
Age group of patients	
Adult	168 (69.1)
Pediatric	43 (17.7)
Missing	32 (11.0)
Caller	
Physician	94 (38.7)
Pharmacists	117 (48.1)
Nurse	23 (9.5)
Resident	4 (1.6)
Intern	2 (0.8)
Patients	3 (1.2)
Type of medication errors answered by a Drug information specialist	
Prescribing error	214 (88.1)
Dispensing error	11 (4.5)
Administration error	16 (6.6)
Monitoring error	2 (0.8)
Subclass of medication error answered by a Drug information specialist	
Drug-drug interactions	46 (18.9)
Wrong frequency	30 (12.3)
Wrong route administration	12 (4.9)
Wrong medication	60 (24.7)
Wrong dose	51 (21.0)
Wrong dosage form	11 (4.5)
Other*	33 (13.5)

* Drug-food/herb interaction, drug-disease interaction, wrong time wrong storage wrong patient.

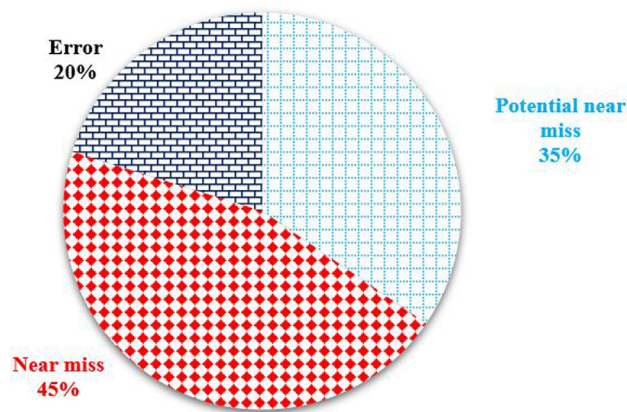


Fig. 2. Medication error types identified by drug information specialists.

Table 2 Medication errors detected at hospital departments.

Hospital departments	n (%)
Outpatient pharmacy	45 (15.5)
Inpatient pharmacy	38 (13.1)
Discharge pharmacy	13 (4.5)
ICU pharmacy	5 (1.4)
Clinical units	13 (4.5)
Gynecology ward	11 (3.8)
Others	118 (48.5)

are supervised by a drug information specialist, which may aid in controlling medication-related errors (Brand and Kraus 2006). Therefore, it is essential to include qualified pharmacists to achieve optimum patient outcomes.

A descriptive study conducted in Brazil identified and described medication errors related to drug information inquiries reported that most of them were potential errors (Dos Santos et al., 2015). These findings were also supported by the results of the present

study which found a higher rate of potential errors. That indicates the helpful actions taken by DPIC pharmacists who responded effectively to drug related inquiries raised by other health-care professionals which in turn will ensure an optimal patient care and prevent possible errors. Our study found that most of the errors take place during prescribing, and that was reported by Dos Santos et al. as well (Dos Santos et al., 2015). Qureshi et al. (2011) These findings were confirmed also in other review that reported prescribing errors as the most preventable types of MEs since they occur in the early stages., Council (2021): Medication errors are defined as any preventable event that leads to inappro-

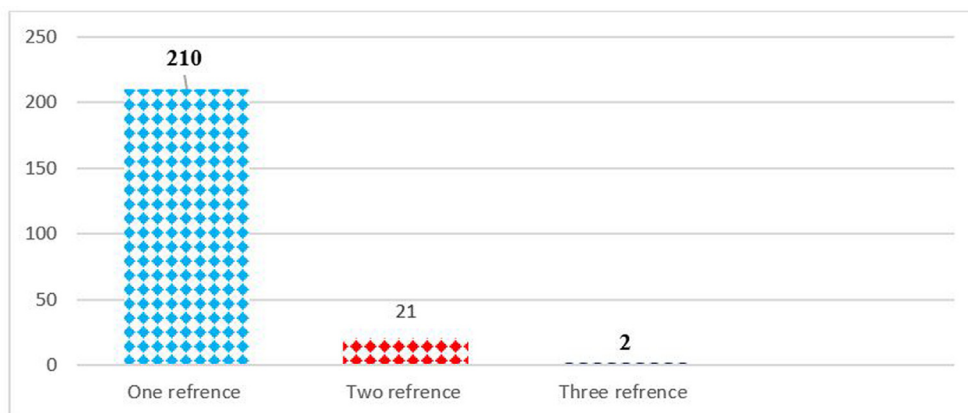


Fig. 3. Number of reference used to answer.

Table 3
Types of questions received by DPIC and references used to answer.

Types of questions received	n (%)
Dosage & administration	155 (63.8)
Pregnancy	11 (4.5)
Lactation	10 (4.1)
Adverse drug event	4 (1.65)
Interactions	42 (17.2)
Compatibility, Stability	4 (1.65)
Pharmacokinetics	3 (1.23)
Identification	2 (0.82)
Vaccines	5 (2.06)
Dose Adjustment	4 (1.65)
Extemporaneous preparation	2 (0.82)
Others	1 (0.41)
Types of references used	
The Hospital Protocols	9 (3)
Medication data base (i.e. Lexicomp, Micromedex, Sanford Guide)	201 (76)
International institute therapeutic Guidelines (i.e. ADA, AHA, CDC, ACOG, RCOG)	14 (5)
Medication Package insert	20 (8)
Articles published in indexed journals	6 (2)
Harriet Lane Handbook	2 (1)
Occupational and patient safety Guidelines (i.e ISMP, NIOSH)	4 (2)
Missing	10 (4)

ADA; American diabetes association, AHA; American Heart Association, CDC; Centers for Disease Control and Prevention, ACOG; American College of Obstetricians and Gynecologists, RCOG; Royal College of Obstetricians and Gynaecologists, ISMP; Institute for Safe Medication Practices, NIOSH; National Institute for Occupational Safety & Health.

appropriate use of medications or patient harm (NCCMERP; Dos Santos et al., 2015).

In this study, most of the drug information requests were received from pharmacists followed by physicians. These results were similar to a previous study published by Almazrou et al. who reported that the majority of the drug information inquiries were received from pharmacists followed by physicians then nurses (Almazrou et al., 2017). While another two studies by Alamri et al in 2017 and Alkathheeri et al. in 2021 reported physicians being the most common enquirers of drug information (Alamri et al in 2017; Alkathheeri et al., 2021). That was consistent with other studies conducted in different countries which observed physicians as the most common enquirers (Aspden 2004; Aston and Young 2009).

In this study, most of the questions were about dosage and administration followed by interactions then pregnancy and lactation among others. Similar study published by Chauhan et al reported drug identification as the most type of questions followed

Table 4
Class of medication included in the inquiries.

Class of medication	n(%)
Anticoagulant	20 (8.5)
Antiplatelet	2 (0.9)
Antibiotic	32 (13.6)
Antihypertensive (Angiotensin-converting-enzyme inhibitors, Calcium channel blocker, Beta-blocker, Angiotensin II receptor blocker)	26 (11.1)
Anticonvulsant	16 (6.8)
Antidiabetic	14 (6.0)
Other	133 (54.7)

by drug safety or contraindication, adverse drug reactions and questions related to pregnancies (Chauhan et al., 2013).

Regarding the references used to answer drug information requests in this study, the most reported references were medications data-base (i.e. Lexicomp, Micromedex, Sanford Guide). While Asiri et al reported Drugdex, reference books, Iowa Drug Information Services (IDIS), PubMed and Poisonsdex as the most common resources used to answer drug information requests (Asiri et al in 2007). Similarly, another recent study by Alamri et al reported that Lexi-Comp's Drug Information Handbook, Micromedex, IDIS and Up-to-date as the most used references to answer the drug information questions (Alamri et al., 2015). The most resource of drug information used in the United States was Lexi-Comp, while many international and national studies discovered Micromedex to be another option chosen by health care providers for drug-related information (Hanrahan and Cole 2014; Moorman et al 2017). That difference across studies might be related to the resources availability at the study site and pharmacist or health care provider preference.

A study conducted in Saudi Arabia estimated the information-seeking behavior and awareness regarding DPICs among physicians found that, approximately half of the physicians used DPICs services to collect drug-related information followed by formulary addition request and poison-related inquiries. These findings once again highlight the role of pharmacist in providing unbiased and accurate drug information, focusing on patient-oriented evidence (Almazrou et al., 2019).

There are certain limitations to the current study. The findings came from a single institution in Saudi Arabia's capital with a small sample size which may affect the generalizability of the results. Also, the detection of medication errors was reliant on the willingness of drug information providers to write description of the questions, which could result in underestimating some types of error.

5. Conclusion

Our findings highlight the role of DPIC pharmacists in enhancing the quality of health services by providing evidence-based information to the enquirer. Also, it shows their role in preventing possible medication errors which will improve patient safety.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

The authors of this study extend their appreciation to Researchers Supporting Project (Project number RSP-2021/81), King Saud University, Saudi Arabia.

References

- Amundstuen Reppe, L., Spigset, O., Schjøtt, J., 2016. Drug Information Services Today: Current Role and Future Perspectives in Rational Drug Therapy. *Clin. Ther.* 38 (2), 414–421.
- Alomi YH, AL. National Drug Information Center Services through Ministry of Health Hotline Calling Center (937) in Saudi Arabia. . 2016.
- Alomi, Y.A., Alghamdi, S.J., Alattyh, R.A., 2019. History and Strategies of Drug Information Services at Ministry of Health in Saudi Arabia. *Pharmacol. Toxicol. Biomed. Rep.* 5 (1), 1–3.
- Asiri, Y.A., Al-Arif, M.N., Al-Sultan, M.S., Gubara, O.A., 2007. Evaluation of drug and poison information center in Saudi Arabia during the period 2000–2002. *Saudi Med J.* 28 (4), 617–619.
- Almazrou, D.A., Ali, S., Alzhrani, J.A., 2017. Assessment of Queries Received by the Drug Information Center at King Saud Medical City. *J Pharm Bioallied Sci.* 9 (4), 246–250. https://doi.org/10.4103/jpbs.JPBS_166_17.
- Assiri, G.A., Alkhenizan, A.H.M., Al-Khani, S.M., Grant, L.M., Sheikh, A., 2019. Investigating the epidemiology of medication errors in adults in community care settings. A retrospective cohort study in central Saudi Arabia. *Saudi Med J.* 40 (2), 158–167.
- Al Rahbi, H.A., Al-Sabri, R.M., Chitme, H.R., 2014. Interventions by pharmacists in out-patient pharmaceutical care. *Saudi Pharm J.* 22 (2), 101–106. <https://doi.org/10.1016/j.jsps.2013.04.001>.
- Alamri SA, Ali Al Jaizani R, Naqvi AA, Ghamdi MSA. Assessment of Drug Information Service in Public and Private Sector Tertiary Care Hospitals in the Eastern Province of Saudi Arabia. *Pharmacy (Basel)*. 2017 Jul 4;5(3):37.
- Alkatheeri, A.A., Aljohani, Y.M., Alshamrani, A.A., Alsalim, M.A., Bakheet, N., Alsalmi, A.A., Alzahrani, Y.A., 2021. Impact of drug information services on patient safety at East Jeddah Hospital in Saudi Arabia; a retrospective study. *Int. J. Pharm. Res.* 13 (1).
- Aspden, P., 2004. Patient safety: achieving a new standard for care. Institute of Medicine, USA.
- Aston, E., Young, T., 2009. Enhancing the reporting of “near miss” events in a children’s emergency department. *J. Emerg. Nurs.* 35 (5), 451–452.
- Al-Arif, M.N., AlDhawali, A., Aldohyan, M., Wajid, S., Babelgaith, S.D., Rajab, S., Al Hammad, A.M., 2015. A survey on pharmacist opinion about pharmaceutical care in Saudi Arabia. *Asian J. Pharm.* 9 (4), 277–282.
- Brand, K.A., Kraus, M.L., 2006. Drug Information Specialists. *Am. J. Health Syst. Pharm.* 63, 712–714. <https://doi.org/10.2146/ajhp050242>.
- Chauhan, N., Mittal, A., Moin, S., Pandey, A., Bajaj, U., 2013. Indian aspects of drug information resources and impact of drug information centre on community. *J. Adv. Pharm. Technol. Res.* 4 (2), 84. <https://doi.org/10.4103/2231-4040.111524>.
- dos Santos, L., Winkler, N., dos Santos, M.A., Martinbiancho, J.K., 2015. Description of medication errors detected at a drug information centre in Southern Brazil. *Pharmacy practice.* 13 (1), 524. <https://doi.org/10.18549/PharmPract.2015.01.524>.
- Hanrahan, C.T., Cole, S.W., 2014. Assessment of drug information resource preferences of pharmacy students and faculty. *J. Med. Libr. Assoc.* 102 (2), 117–121. <https://doi.org/10.3163/1536-5050.102.2.012>.
- Lu, C.Y., Roughead, E., 2011. Determinants of patient-reported medication errors: a comparison among seven countries. *Int. J. Clin. Pract.* 65 (7), 733–740.
- Moorman, K.L., MacDonald, E.A., Trovato, A., Tak, C.R., 2017. Assessment and use of drug information references in Utah pharmacies. *Pharm. Pract. (Granada)* 15 (1), 839. <https://doi.org/10.18549/PharmPract.2017.01.839>.
- Manosalva, M.A.N., López Gutiérrez, J.J., Cañas, M., 2016. Drug information centers: An overview to the concept. *Centros de información de medicamentos Una visión global del concepto.* 45 (2), 243–255.
- Nova Manosalva, M.A., López Gutiérrez, J.J., Cañas, M., 2016. Drug information centers: An overview to the concept. *Revista Colombiana de Ciencias Químico-Farmacéuticas.* 45 (2), 243–255.
- Qureshi, N.A., Neyaz, Y., Khoja, T., Magzoub, M.A., Haycox, A., et al., 2011. Physicians’ medication prescribing in primary care in Riyadh city, Saudi Arabia. Literature review, part 3: prescribing errors. *EMHJ - Eastern Mediterranean Health Journal* 17 (2), 140–148, 2011 <https://apps.who.int/iris/handle/10665/118092>.
- The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP). What is a Medication Error? Available at <https://www.nccmerp.org/about-medication-errors>. Last accessed on July 6, 2021.