

Original Research

Dispensing errors in Lebanese community pharmacies: incidence, types, underlying causes, and associated factors

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Abstract

Objectives: To assess the incidence, types, the causes of as well as the factors associated with dispensing errors in community pharmacies in Lebanon.

Methods: An observational cross-sectional study was conducted in 286 pharmacies located all over Lebanon. Data were collected by senior pharmacy students during their experiential learning placement. Collected data included information on the types of dispensing errors, the underlying causes of errors, handling approaches, and used strategies for dispensing error prevention. Data were analyzed using multiple logistic regression to determine factors that were associated with dispensing errors.

Results: In the twelve thousand eight hundred sixty dispensed medications, there were 376 dispensing errors, yielding an error rate of 2.92%. Of these errors, 67.1% (252) corresponded to dispensing near-miss errors. The most common types of dispensing errors were giving incomplete/incorrect use instructions (40.9% (154)), followed by the omission of warning(s) (23.6% (89)). Work overloads/time pressures, illegible handwriting, distractions/interruptions, and similar drug naming/packaging were reported as the underlying causes in 55% (206), 23.13% (87), 15.15 % (57), and 7% (26) of the errors respectively. Besides, high prescription turnover volume, having one pharmacist working at a time, and extended working hours, were found to be independent factors that were significantly associated with dispensing errors occurrence ($p < 0.05$).

Conclusions: This study sheds light on the need to establish national strategies for preventing dispensing errors in community pharmacies to maintain drug therapy safety, considering identified underlying causes and associated factors.

Keywords

Medication Errors; Drug Prescriptions; Pharmacies; Pharmacists; Professional Practice; Quality Assurance, Health Care; Multivariate Analysis; Cross-Sectional Studies; Lebanon

INTRODUCTION

During the last two decades, medicine use has tremendously increased.¹ Although this substantial and increasing medication use has improved patients' health outcomes, it was coupled with an increased prevalence of medication errors. Medication error prevalence rates were estimated to range between 2%-94% depending on the practice setting, with the highest prevalence in primary healthcare.¹⁻⁶

The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) defines a medication error as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer".⁷ Medication errors can occur at any level of the medication use process, such as prescribing, transcribing, dispensing, administration, or monitoring.⁸ When medication errors occur, they pose significant health and economic burdens on the patient and the health care system, including increased use of healthcare services, medication-related hospital admissions, and even death.⁹⁻¹¹ Besides, they affect the patient's trust in the healthcare system and the patient's satisfaction from the healthcare providers. Moreover, their presence reflects a failure in the work system.¹¹

Dispensing errors are one of the main types of medication errors.¹² They are defined as discrepancies between prescribed medicines and the medicines that the pharmacy delivers to the patient, including the dispensing of medicine with inferior pharmaceutical or informational quality.¹² The rates of dispensing errors were estimated to range between 0.04-55% depending on the study setting, method, and operational definitions.¹³⁻²³

Many studies have attempted to describe dispensing error types and their underlying causes. Dispensing a wrong drug, dispensing a wrong strength, dispensing a wrong dosage form, dispensing a wrong quantity, failure to supply the drug, and labeling errors (wrong drug name on the label; wrong strength on the label; wrong directions and warnings on the label; wrong quantity on the label; wrong patient name on the label) were among the reported types of dispensing errors.¹⁴⁻²³ Besides, the causes of dispensing errors were commonly attributed to drugs having similar names/packaging, the poor handwriting of physicians, heavy workloads, time pressures, lone worker, and frequent interruptions.^{15,16,20-23}

However, most of these studies were conducted in the in-patient setting and developed countries. The medication use process and pharmacy practice are quite different between the hospital and the community setting, on the one hand, and between developing and developed countries, on the other hand. Thus, it remains unclear whether these studies' results can be extrapolated to developing countries' community settings.

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Moreover, evidence from the literature suggested that more research is needed on dispensing errors in community pharmacies in the middle- and low-income countries and specifically on the underlying causes of these errors.¹² Therefore, we thought to conduct this study to gain insights into the incidence, types, handling strategies, underlying causes of, and associated factors with dispensing errors at the community pharmacy setting. Understanding the types of dispensing errors and their underlying causes and associated factors provides policymakers with opportunities to tailor strategies and standardized protocols to improve patient safety related to the national level's medication use process. According to our knowledge, this is the first study that has examined the dispensing errors at the community pharmacy level in Lebanon.

METHODS

This is a prospective observational study that used a cross-sectional design with a convenience sampling approach. The study was conducted in community pharmacies located in Beirut city (capital of Lebanon) and four Lebanese governorates (Mount Lebanon, North, South, and Beqaa) between July and August 2017. Community pharmacists who agreed to participate in this study provided oral consent before study initiation. Since this study was an observational one and not experimental, clinical, or interventional, an oral consent form was deemed appropriate by the Institutional Review Board of Beirut Arab University that approved the study. The oral consent was obtained from the community pharmacists after explaining the purpose and objectives of this study, assuring that the participation to this study is voluntary, and that all collected data are treated with confidentiality.

Data was collected using a data collection form that was designed to serve the purpose of the study. The data collection form was developed after a thorough review of the literature in this regard.^{7,14-23} The final draft of the data collection form was pilot tested in ten pharmacies by ten students who were asked to fill this initial data collection form at the incidence of a dispensing error (for a total of ten dispensing errors). Feedbacks on the form were collected and the form was revised accordingly. The dispensing errors that were collected using the initial form were not included in the final study sample.

The data collection form was divided into three sections. The first section collected general information about the pharmacy, such as its location, opening hours, the number of pharmacists per shift, working hours per shift, applied strategies (such as policies and procedures, staff training, special arrangements for storing drugs) for medication error prevention and reporting. Special arrangements included the emphasis on drug name differences using methods such as "Tall Man" lettering, storing medications that look/sound-alike medications in separate locations, or non-alphabetical order, placing reminders on the storage shelves for medications carrying special warnings, or requiring special attention while being dispensed. The second section collected specific information on the dispensing error, including its category ("dispensing near-miss error" or "dispensing error", its type (wrong drug,

Table 1. Operational definitions

- Dispensing error: is a discrepancy between a prescribed medicine and the medicine that was delivered to the patient.
- Dispensing near-miss error: is a discrepancy between a prescribed medicine and the medicine that was prepared to be delivered to the patient. The discrepancy was detected internally by a pharmacy staff member before the medicine reached the patient.

wrong dose, wrong dosage form, incorrect/incomplete labeling, incorrect/incomplete use instructions, omissions of additional warning(s)), the time of its occurrence (beginning of the shift, peak hours of the shift, or the end of the shift), and its causes (lack of experience, workload/time pressures, distractions/interruptions, illegible handwriting, similar medicines naming/packaging) as reported by the concerned staff (Table 1). The third section collected how the pharmacist dealt with the error towards the patient (apologies, financial compensation, and others) and the staff who committed the error (training staff, monetary decompensation, warning/firing staff, and others).

The data collection form was filled by senior pharmacy students (3rd, 4th, and 5th level students of the bachelor's degree) during their experiential learning program. Each student was placed in a community pharmacy for eight hours/day shift five consecutive days over two months. Students who agreed to volunteer in this study received adequate training on the study objectives, materials, and the data collection form before study initiation. Each student was asked to observe the filling of fifty consecutive prescribed medications (from prescription reception to medication dispensing), and to fill the data collection form only at the occurrence of a dispensing error.

Statistical analysis

An expert in drug safety reviewed collected data, and the errors were firstly grouped in their respective category (dispensing near-miss error category or dispensing error category), then analyzed. The statistical analysis was performed using SPSS version 20 (IBM, Corp., Atlanta, GA, USA). All data entered into the computer were double-checked for accuracy by random assessment of the collected data, and the data entered. Descriptive statistics were applied for data variables. The Chi-Square test was used to measure the difference in dispensing errors across error categories and times of error occurrence. Results were considered significant if the p-value<0.05.

Univariate and multivariate logistic regression analyses were used to identify independent factors associated with dispensing error occurrence. In the univariate analysis, pharmacy prescription turnover volume per shift, number of pharmacists per shift, working hours per shift, time of the shift, presence of implemented methods for dispensing errors prevention, as well as the method(s) implemented were consecutively tested to examine associations with "dispensing error" as the outcome variable. The multivariate logistic regression model included all variables having a P-value < 0.2 in unadjusted analyses. All tests were two-sided, and a P-value of 0.05 or less was considered statistically significant.



Dispensing errors; n (%)	Dispensing near-miss error	Dispensing error	Total	p-value ^a
Incomplete/incorrect directions for use	141 (42)	13 (33.3)	154 (40.9)	0.861
Omissions of additional warning(s)	79 (23.4)	10 (25.6)	89 (23.6)	0.76
Wrong Dosage Form	42 (12.5)	3 (7.7)	45 (12)	0.38
Wrong Drug Dose	39 (11.6)	6 (15.4)	45 (12)	0.49
Wrong Drug	36 (10.5)	7 (18)	43 (11.4)	0.34
Total	337 (89.6)	39 (10.4)	376 (100)	0.45

^a Pearson's Chi-square test was used

RESULTS

A total of 286 pharmacies participated in this study. The pharmacies were distributed as follows: 100 (35%) in Beirut city (Capital of Lebanon), 86 (30%) in Mount Lebanon, 77 (27%) in North Lebanon, and 23 (8%) were located in Beqaa governorates. Twelve thousand eight hundred sixty prescribed medications were filled in the pharmacies during the study period; out of these, 376 dispensing errors were reported, yielding an error rate of 2.92%. Of these errors, 67.1% (252) corresponded to "dispensing near-miss" errors and 32.9% (124) to "dispensing" errors.

As shown in Table 2, several types of medication errors were reported at the dispensing level. The most common type was giving incomplete/incorrect use instructions (40.9% (154)), which was followed by the omission of warning (s) (23.6% (89)), dispensing a wrong dose (12% (45)), dispensing a wrong dosage form (12% (45)), and dispensing a wrong drug (11.4% (43)). When comparing the distribution of medication error types between the two dispensing error categories, no statistical difference was observed for any of the types. Moreover, Table 3 shows that most of the dispensing errors occurred at the peak hours of the shift, and there was no statistically significant difference between the distribution of dispensing errors types across the shift times, except for giving incomplete/incorrect use instructions that were significantly more observed at the peak hours of the shift (p-value<0.05).

The underlying causes of dispensing errors were work overloads/time pressures reported in 55% (206) of the errors, illegible handwriting reported in 23.13% (87) of the errors, distractions/interruptions reported in 15.15% (57) of the errors, and confusions due to similar drug naming/packaging (look alike/sound alike) reported in 7% (26) of the errors.

Pharmacies' responses to medication errors varied according to their category. Apologies to patients, blaming, and warning to staff, in addition to corrective actions, were applied when the errors were falling under the "dispensing error" category, whereas blaming of staff and corrective actions were applied when the errors were falling under the "dispensing near-miss error" category.

None of the pharmacies reported having strategies, documented written policies and procedures, or standardized written protocols for error prevention or reporting. However, some methods were implemented for dispensing error prevention: 25% (72) of the pharmacies adopted special arrangements (Tall Man letters, physical separation, alerts on the systems, and alert signs on the packaging/shelves), 20% (58) implemented independent double-checking, and 3% (9) relied on staff training. Around 9% (26) of the pharmacies relied on two methods at the same time to prevent dispensing errors (double-checking and special arrangements 5% (15) and special arrangements and staff training 4% (11).

As shown in Table 4, dispensing errors were significantly more likely to occur in pharmacies having a prescription turnover volume of 100 prescriptions per day shift or more compared to those having a prescription turnover volume of fewer than 100 prescriptions/per day shift (aOR: 2.3; 95%CI:1.85-3.01; p-value<0.05), in pharmacies where the staff has extended working hours per day shift (i.e., ≥8hours/day shift) (aOR: 2; 95%CI: 1.5-2.8; p-value<0.05), in pharmacies that had one pharmacist/ day shift (aOR: 3.3; 95%CI: 2.5-4.7; p-value<0.05), and in those relying on staff training only for dispensing error prevention (aOR: 1.8; 95%CI: 1.1-2.71; p-value<0.05). Dispensing errors were significantly less likely to occur in the pharmacies that had implemented one or more method(s) for dispensing error prevention (p-value<0.05). Besides, among the implemented methods, the use of special arrangements and the simultaneous use of two methods were significantly associated with less dispensing error occurrence (p-value<0.05). Moreover, when comparing the use of one method versus the simultaneous use of two methods, it was found that the simultaneous use of two methods would further decrease the likelihood of medication error occurrence by fifty percent (OR: 0.49; 95%CI: 0.35-0.69; p-value<0.05).

DISCUSSION

The findings of this study showed that the dispensing error rate was 2.92%. Various rates of dispensing errors ranging between 0.04 and 55% have been reported in the

Types of medication errors; n (%)	Beginning	Peak hours	End	P-value ^a
Incomplete/incorrect directions for use; n= 154	30 (19.5)	100 (65)	24 (15.5)	0.084
Omissions of additional warning(s); n = 89	27 (30.4)	31 (34.8)	31 (34.8)	0.463
Wrong dose; n = 45	14 (31.1)	16 (35.6)	15 (33.3)	0.204
Wrong drug; n = 43	14 (32.5)	16 (37.2)	13 (30.3)	0.503
Wrong dosage form; n = 45	13 (29)	17 (37.7)	15 (33.3)	0.219
Total; n = 376	98 (26.1)	180 (47.8)	98 (26.1)	0.0001*

^a Pearson's Chi-square test was used
* = statistically significant (P ≤ 0.05)



Variable	Unadjusted Odd Ratio* (95% CI) ^a	p-value	Adjusted Odds Ratio* (95% CI) ^b	p-value
Pharmacy prescription turn over ≥ 100 prescriptions/shift (n=296/8480)**	1.99 (1.60-2.46)	0.013	2.30 (1.85-3.01)	0.001
Working hours per shift < 8 (n=160/8484)**	Reference			
≥ 8 (n=216/4000)**	2.85 (1.75-4.21)	0.020	2.00 (1.50-2.80)	0.010
Number of pharmacist ≥ 2 (n=140/6458) **	Reference			
One (n=236/6026)**	1.80 (1.52-2.85)	0.018	3.30 (2.50-4.70)	0.020
Time of the shift Beginning (n=76/2751)**	Reference			
Peak hours (n= 210/6642)**	1.10 (0.7-1.15)	0.387	-	
End (n= 90/3121)**	1.05 (0.79-1.40)	0.607	-	
Applied methods for error prevention None (n=180/4560)**	Reference			
Use of one method of the below (n=154/5084)	0.77 (0.62-0.96)	0.020	0.56 (0.35-0.74)	0.001
Special arrangements (n=48/2880)**	0.42 (0.31-0.58)	0.001	0.47 (0.28-0.68)	0.002
Double checking (n=36/1504)**	0.61 (0.42-0.87)	0.010	0.74 (0.51-0.94)	0.001
Staff training (n=70/700)**	3.85 (2.90-5.38)	0.001	1.8 (1.10-2.71)	0.010
Two methods of the above versus none (42/2840)**	0.37 (0.27-0.53)	0.001	0.22 (0.15-0.45)	0.001
Two methods versus one	0.49 (0.35-0.69)	0.02	--	

^a Pearson's Chi-square test was used to calculate the unadjusted odds ratio (uOR)
^b Multivariate logistic regression was used to calculate the adjusted odds ratio (aOR)
 *Odds for dispensing error occurrence versus non-occurrence
 ** Number of dispensing errors versus total number of dispensed medications
 - denotes not calculated

literature.¹³⁻²³ However, it is challenging to compare reported rates of dispensing errors directly across studies, owing to differences in study design, methodology, operational procedures, denominators (such as total numbers of prescriptions, numbers of dispensed doses, or numbers of prescribed medications), as well as dispensing practices. Moreover, although this rate is low, it should still be considered because it can translate into many errors due to the high volumes of medications dispensed each day by community pharmacies.¹⁷

As in other studies, several dispensing error types occurred. They included giving incomplete/incorrect instructions, dispensing a wrong drug, a wrong dosage form, or a wrong dose, as well as omissions of additional warnings.¹⁴⁻²³ Moreover, as reported by other studies, the "dispensing error" rate was significantly lower than the "dispensing near-miss error" rate, and therefore the errors were detected and corrected while the medications were still in possession of the pharmacist.^{18,19,21} This finding reflects the effectiveness of control systems adopted at the pharmacies, such as but not limited to double-checking and alerts embedded into the pharmacy computer system. Besides, dispensing errors were significantly more observed at the peak hours of the shift. This result was also found to be the case in previous studies.^{20,22} Indeed, community pharmacists in Lebanon are in charge of the core activities related to drug dispensing, i.e., receiving the prescription, checking for drug availability, checking prepared drugs by the pharmacy technician, billing, and completing third-party payer paperwork, as well as counseling the patients on prescribed drugs. The pharmacist is also expected to perform other activities like putting/receiving drug orders, answering phone calls, and answering patients' inquiries about their drug therapies.²⁴ Pharmacists are expected to have higher workloads related to dispensing and non-dispensing activities at peak hours of the shift. Some studies indicated an association between a high workload

and low quality of pharmacy services, as indicated by the failure to provide drug counseling and detect dispensing errors.^{25,26}

Pharmacists are also expected to be exposed to frequent interruptions, distractions, and time pressures at the shift's peak time. These factors are well known to cause dispensing errors.²⁷⁻²⁹ Besides, all of these factors were reported to be among the underlying causes of this study's errors.

Illegible handwriting of physicians was also among the underlying causes of dispensing errors in this study. This is a familiar cause of medication errors in the literature.^{10,23,30,31} Illegible handwritten prescriptions can lead to misinterpretation by the pharmacist who is dispensing the prescription, leading to errors in the dispensed medication. The implementation of computerized prescriptions has been reported to be the most effective strategy for preventing medication errors in hospitalized patients.¹⁷ It is less evident in the community setting which strategies will be most effective for preventing dispensing errors. However, computerized prescriptions would certainly enhance patient safety by including all required information written in a readable way and by providing automatic clinical-decision support.³⁰⁻³³

Another reported underlying cause of dispensing errors was the presence of medicines that look or sound alike. This has also been reported to cause medication errors by some studies.²⁷⁻²⁹ This finding reflects the lack of special arrangements such as, but not limited to, physical separation, alerts on labels/shelves/computers, and other systems in some pharmacies. It also highlights the need for initiatives to be taken by regulatory authorities to eliminate this cause by developing national guidelines for storing and dispensing drugs that look or sound alike. It also highlights the need to add an alert system to the pharmacy dispensing software that would warn the pharmacist about

possible confusion when dispensing look or sound alike medicines.³⁴

Consistent with other studies, factors related to the work's organizational aspects were found to be associated with dispensing error occurrence in this study.^{12,35} These were notably the presence of one pharmacist at work at a time and working for extended hours. Errors are more likely to occur when tasks are carried out after hours by a busy staff working with inadequate resources and poor support [36]. These findings lead us to believe that increasing the number of pharmacists during high activity periods may significantly reduce error rates. Moreover, there is evidence that regular breaks and time off for meal improves focus and therefore, may also help reduce dispensing error occurrence.³⁷⁻³⁹

In addition to these factors, high prescription turnover volume was associated with dispensing error occurrence. Indeed, a high prescription volume can translate into a high workload, which is, as discussed above, reported to be associated with an increased risk of medication error occurrence. Moreover, the number of dispensing errors was positively and significantly correlated with prescription turnover volume.⁴⁰

Finally, pharmacies that have implemented methods for error prevention had fewer dispensing errors. This finding supports the evidence that the adoption of additional control measures may reduce dispensing error rates. Some of the effective control measures, as demonstrated in this study, were the use of special arrangements for drugs stored in the pharmacy, alerts built into the pharmacy dispensing software, in addition to performing triangle check (i.e., checking actual drugs against the drugs' labels and the prescription), double-checking and regular staff training/retraining. These were also recommended by others.^{37-38,41}

This study has several strengths, such as being multi-center, having data generated based on observation during routine practices and not depending on self-reporting of errors, and being among few other studies addressing dispensing errors in community pharmacies of developing countries. However, one limitation of the current study is that the rate of dispensing errors might have been roughly estimated for many reasons. First, it was noted that all pharmacies do not have written protocols for reporting dispensing errors. The absence of a medication reporting system that is readily accessible, with written procedures on how to report dispensing errors, makes the detection of all dispensing errors difficult. Second, the staff's blaming and warning at the incidence of an error, which was reported to be one of the adopted approaches, would have discouraged the staff who made the error to report it due to fears from disciplinary actions or being negatively evaluated. Finally, students were placed in community pharmacies for limited hours per day. Therefore, students could not observe the dispensing errors that would have occurred after leaving their training site. Despite this

limitation, this study has yielded information about the types of dispensing errors, the underlying causes, and the factors associated with dispensing errors in a developing country's community pharmacy setting. It also shed light on the need to establish national strategies for reducing dispensing errors to maintain the high quality and safety of drug therapies, considering the identified underlying causes of and the factors associated with dispensing errors.

CONCLUSIONS

This study showed that dispensing errors of different types occur in community pharmacies, notably in those with a high prescription turnover rate, one pharmacist working at a time, pharmacists working for extended hours, and those not having implemented methods for error prevention. Further improvements addressing these factors still need to be applied because even if the rate of dispensing errors was low, they could significantly compromise patient safety globally. From the perspective of the pharmacy distribution system and quality assurance, pharmacy managers should consider developing policies and procedures to identify errors at each step of the dispensing process and voluntary non-punitive reporting systems to identify areas for improvement in this process. Moreover, the implementation of structured educational sessions for community pharmacists organized by the pharmacists' order might also be a useful means for decreasing dispensing error rates by raising awareness on dispensing error types, their causes, and preventive measures. Finally, further research would be directed toward determining effective strategies for minimizing dispensing errors and improving patient safety in the community pharmacy setting.

CONFLICT OF INTEREST

The authors declared no conflicts of interest concerning the research, authorship, and publication of this article.

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References

1. World Health Organization. Medication errors technical series on safer primary care medication errors. <http://apps.who.int/iris/bitstream/10665/252274/1/9789241511643-eng.pdf?ua=1> (accessed Nov 5, 2019)



2. Koper D, Kamenski G, Flamm M, Böhmdorfer B, Sönnichsen A. Frequency of medication errors in primary care patients with polypharmacy. *Fam Pract*. 2013;30(3):313-319. <https://doi.org/10.1093/fampra/cms070>
3. Wittich CM, Burkle CM, Lanier WL. Medication errors: an overview for clinicians. *Mayo Clin Proc*. 2014;89(8):1116-1125. <https://doi.org/10.1016/j.mayocp.2014.05.007>
4. Assiri GA, Shebl NA, Mahmoud MA, et al. What is the epidemiology of medication errors, error-related adverse events and risk factors for errors in adults managed in community care contexts? A systematic review of the international literature. *BMJ Open*. 2018;8(5):e019101. <https://doi.org/10.1136/bmjopen-2017-019101>
5. Medication Errors and Adverse Drug Events . Agency for HealthCare Research and Quality. Available from: <https://psnet.ahrq.gov/primer/medication-errors-and-adverse-drug-events> (accessed Nov 5, 2019)
6. Lisby M, Nielsen LP, Brock B, Mainz J. How are medication errors defined? A systematic literature review of definitions and characteristics. *Int J Qual Health Care*. 2010;22(6):507-518. <https://doi.org/10.1093/intqhc/mzq059>
7. US Food and Drug Administration. Medication Errors. <http://www.fda.gov/drugs/drugsafety/medicationerrors/> (accessed Dec 1, 2019).
8. Community pharmacy patient safety errors increase by 64%. <http://www.pharmaceutical-journal.com/news-and-analysis/news/community-pharmacy-patient-safety-errors-increase-by-64/20205334.article> (accessed Dec 1, 2019).
9. Zhou S, Kang H, Yao B, Gong Y. Analyzing Medication Error Reports in Clinical Settings: An Automated Pipeline Approach. *AMIA Annu Symp Proc*. 2018;2018:1611-1620.
10. Boehringer PA, Rylander J, Dizon DT, Peterson MW. Improving the quality of the order-writing process for inpatient orders in a teaching hospital. *Qual Manag Health Care*. 2007;16(3):215-218. <https://doi.org/10.1097/01.qmh.0000281057.92305.57>
11. Walsh EK, Hansen CR, Sahm LJ, Kearney PM, Doherty E, Bradley CP. Economic impact of medication error: a systematic review. *Pharmacoepidemiol Drug Saf*. 2017;26(5):481-497. <https://doi.org/10.1002/pds.4188>
12. Cheung KC, Bouvy ML, De Smet PA. Medication errors: the importance of safe dispensing. *Br J Clin Pharmacol*. 2009;67(6):676-680. <https://doi.org/10.1111/j.1365-2125.2009.03428.x>
13. Campbell PJ, Patel M, Martin JR, et al. Systematic review and meta-analysis of community pharmacy error rates in the USA: 1993-2015. *BMJ Open Qual*. 2018;7(4):e000193. <https://doi.org/10.1136/bmjopen-2017-000193>
14. Ibrahim OM, Ibrahim RM, Meslamani AZA, Mazrouei NA. Dispensing errors in community pharmacies in the United Arab Emirates: investigating incidence, types, severity, and causes. *Pharm Pract (Granada)*. 2020;18(4):2111. <https://doi.org/10.18549/pharmpract.2020.4.2111>
15. Aldhwhaihi K, Schifano F, Pezzolesi C, Umaru N. A systematic review of the nature of dispensing errors in hospital pharmacies. *Integr Pharm Res Pract*. 2016;5:1-10. <https://doi.org/10.2147/iprp.s95733>
16. Abdel-Qader DH, Al Meslamani AZ, Lewis PJ, Hamadi S. Incidence, nature, severity, and causes of dispensing errors in community pharmacies in Jordan. *Int J Clin Pharm*. 2021;43(1):165-173. <https://doi.org/10.1007/s11096-020-01126-w>
17. Cina JL, Gandhi TK, Churchill W, et al. How many hospital pharmacy medication dispensing errors go undetected?. *Jt Comm J Qual Patient Saf*. 2006;32(2):73-80. [https://doi.org/10.1016/s1553-7250\(06\)32010-7](https://doi.org/10.1016/s1553-7250(06)32010-7)
18. Pervanas HC, Revell N, Alotaibi AF. Evaluation of medication errors in community pharmacy settings: A retrospective report. *J Pharm Technol*. 2016;32(2):71-74. <https://doi.org/10.1177/8755122515617199>
19. de Las Mercedes Martínez Sánchez A. Medication errors in a Spanish community pharmacy: nature, frequency and potential causes. *Int J Clin Pharm*. 2013;35(2):185-189. <https://doi.org/10.1007/s11096-012-9741-0>
20. Darbshire PL, Zhao JC, Sodhi A, Anderson CM. Student observations of medication error reporting practices in community pharmacy settings. *Res Social Adm Pharm*. 2019;15(7):902-906. <https://doi.org/10.1016/j.sapharm.2019.02.009>
21. Ashcroft DM, Quinlan P, Blenkinsopp A. Prospective study of the incidence, nature and causes of dispensing errors in community pharmacies. *Pharmacoepidemiol Drug Saf*. 2005;14(5):327-332. <https://doi.org/10.1002/pds.1012>
22. Asmelashe Gelayee D, Binega Mekonnen G. Perception of Community Pharmacists towards Dispensing Errors in Community Pharmacy Setting in Gondar Town, Northwest Ethiopia. *Biomed Res Int*. 2017;2017:2137981. <https://doi.org/10.1155/2017/2137981>
23. Al-Worafi YM, Alseragi WM, Seng LK, et al. Dispensing errors in community pharmacies: a prospective study in Sana'a, Yemen. *Arch Pharm Pract*. 2018;9(4):1-3.
24. World Health Organization. The role of the pharmacist in the health care system. Geneva: WHO; 1994.
25. Hassell K, Seston EM, Schafheutle EI, Wagner A, Eden M. Workload in community pharmacies in the UK and its impact on patient safety and pharmacists' well-being: a review of the evidence. *Health Soc Care Community*. 2011;19(6):561-575. <https://doi.org/10.1111/j.1365-2524.2011.00997.x>
26. Shao SC, Chan YY, Lin SJ, et al. Workload of pharmacists and the performance of pharmacy services. *PLoS One*. 2020;15(4):e0231482. <https://doi.org/10.1371/journal.pone.0231482>
27. Knudsen P, Herborg H, Mortensen AR, Knudsen M, Hellebek A. Preventing medication errors in community pharmacy: root-cause analysis of transcription errors. *Qual Saf Health Care*. 2007;16(4):285-290. <https://doi.org/10.1136/qshc.2006.022053>
28. Rajah R, Hanif AA, Tan SSA, et al. Contributing factors to outpatient pharmacy near miss errors: a Malaysian prospective multi-center study. *Int J Clin Pharm*. 2019;41(1):237-243. <https://doi.org/10.1007/s11096-018-0762-1>
29. James KL, Barlow D, McArtney R, Hiom S, Roberts D, Whittlesea C. Incidence, type and causes of dispensing errors: a review of the literature. *Int J Pharm Pract*. 2009;17(1):9-30. <https://doi.org/10.1211/ijpp.17.1.0004>
30. Albarak 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(6):522-527. <https://doi.org/10.1016/j.isps.2014.02.013>
31. Kenawy AS, Kett V. The impact of electronic prescription on reducing medication errors in an Egyptian outpatient clinic. *Int J Med Inform*. 2019;127:80-87. <https://doi.org/10.1016/j.ijmedinf.2019.04.005>



32. Bates DW, Slight SP. Medication errors: what is their impact?. *Mayo Clin Proc.* 2014;89(8):1027-1029. <https://doi.org/10.1016/j.mayocp.2014.06.014>
33. Hughes RG, Ortiz E. Medication errors: why they happen, and how they can be prevented. *Am J Nurs.* 2005;105(3 Suppl):14-51. <https://doi.org/10.1097/00000446-200503001-00005>
34. Campmans Z, van Rhijn A, Dull RM, Santen-Reestman J, Taxis K, Borgsteede SD. Preventing dispensing errors by alerting for drug confusions in the pharmacy information system-A survey of users. *PLoS One.* 2018;13(5):e0197469. <https://doi.org/10.1371/journal.pone.0197469>
35. Teinilä T, Grönroos V, Airaksinen M. A system approach to dispensing errors: a national study on perceptions of the Finnish community pharmacists. *Pharm World Sci.* 2008;30(6):823-833. <https://doi.org/10.1007/s11096-008-9233-4>
36. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. *QJM.* 2009;102(8):513-521. <https://doi.org/10.1093/qjmed/hcp052>
37. Nair R, Kappil D, Woods T. 10 strategies for minimizing dispensing errors. <https://www.pharmacytimes.com/publications/issue/2010/january2010/p2pdispensingerrors-0110>
38. ISMP. Improving Medication Safety in Community Pharmacy: Assessing Risk and Opportunities. https://www.ismp.org/sites/default/files/attachments/2018-02/ISMP_AROC_whole_document.pdf (accessed Sep 30, 2020)
39. Szeinbach S, Seoane-Vazquez E, Parekh A, Herderick M. Dispensing errors in community pharmacy: perceived influence of sociotechnical factors. *Int J Qual Health Care.* 2007;19(4):203-209. <https://doi.org/10.1093/intqhc/mzm018>
40. Salhotra R, Tyagi A. Medication errors: They continue. *J Anaesthesiol Clin Pharmacol.* 2019;35(1):1-2. https://doi.org/10.4103/joacp.joacp_88_19