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PHARMACIST'S ROLE IN REPORTING AND PREVENTING MEDICATION ERRORS AT A GENERAL HOSPITAL IN MAKKAH, SAUDI ARABIA

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ABSTRACT: Background: Medication errors significantly impact patient morbidity and mortality. Due to their specialized expertise, pharmacists are essential in detecting and averting these errors. **Methods:** This study evaluated pharmacists' roles in reporting and preventing medication errors at King Faisal Hospital in Makkah, Saudi Arabia. Using a cross-sectional method, we analyzed medication error reports to understand the rate, causes, and types of errors during the study period. A questionnaire further probed pharmacists' interventions in reducing these errors. **Results:** Of the 45 pharmacists surveyed (average age: 34.91 ± 3.9 years), 1,738 medication errors were reported between September 2021 and July 2022, peaking in October 2021. Key causes were prescribing errors (26%), dispensing errors (16%), and dosing errors (10%), with the remaining 48% attributed to various other factors. Common interventions included liaising with physicians for emergency order verification, preventing unintended dispensation, and correcting dosing mistakes. **Conclusion:** Predominant medication errors arose from prescribing, dispensing, dosing, omission, improper dosage, and incorrect frequency. Miscommunication in drug orders, characterized by illegibility or ambiguity, was a major error contributor. Upon detecting errors, pharmacists frequently reported to supervisors, communicated with physicians for clarity, informed responsible parties to correct and prevent repeat occurrences, and championed more training to address these issues proactively.

INTRODUCTION: Medication errors are recognized as one of the most prevalent medical mistakes, impacting approximately 1.5 million individuals each year. They stand as the primary cause of adverse events among hospitalized patients⁸.

According to the National Coordinating Council for Medical Reporting and Prevention and the World Health Organization (WHO), a medication error is defined as any preventable incident that could result in inappropriate medication use or patient harm while the medication is within the purview of healthcare professionals, patients, or consumers¹⁶.

These errors can be categorized based on when they occur within the prescription cycle: prescribing, supplying, or administering errors¹². Prescribing errors arise when physicians select the incorrect medication for patients, encompassing

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errors in dosage, quantity, indication, or the use of contraindicated medications⁷. Dispensing errors encompass the entire process, from obtaining a prescription at the pharmacy to delivering the dispensed drug to a patient. These errors account for 24% of all medication errors, occurring most frequently with drugs that share similar names or appearances². Conversely, administration errors transpire when the medication received by the patient deviates from the prescribed therapy, including improper administration procedures and the provision of faulty or expired products³⁻¹¹.

Interventions aimed at preventing medication errors are considered a critical and intricate process, as the treatment of medication errors often demands sophisticated resources¹³. One effective intervention involves pharmacists participating in prescription reviews, leading to the detection and avoidance of a significant number of pharmaceutical errors that have the potential to cause severe harm¹⁰. Clinical pharmacists play a pivotal role in ensuring the safe administration of medications¹⁵. In our study, we aimed to pinpoint the pharmacists' role in reducing medication errors in hospitals.

MATERIALS AND METHODS: This is a cross-sectional study conducted at King Faisal Hospital in Makkah, Saudi Arabia (KSA). The study protocol received approval from the Ministry of Health's Institutional Review Board in Makkah, part of the Makkah Health Care Cluster, with IRB Number: H-02-K-076- 0522-725. The primary objective of this study is to analyze medication errors reported between September 2021 and July 2022. We aim to assess the rate, causes, and types of medication errors that occurred within the hospital during this specified study period. Additionally, we administered a questionnaire to 45 pharmacists at King Faisal Hospital to identify

interventions employed by pharmacists to reduce and prevent medication errors. This questionnaire comprised three sections. The first section gathered demographic information about the participating pharmacists, while the second section delved into the efforts made by pharmacists in the reduction and prevention of medication errors. The third section aimed to identify any barriers encountered in these endeavors (Appendix I).

Prior to conducting this survey, the questionnaire underwent validation using a convenience sample of 30 respondents, who were subsequently excluded from the main study. The questionnaire's validity and reliability were meticulously evaluated, yielding a Cronbach's alpha value exceeding 0.7 for all items, including knowledge, barriers, and facilitators. Any data collected before the designated study period was excluded from our analysis.

Data collection was performed using Microsoft Excel software and subsequently prepared for statistical analysis. The statistical analysis was carried out using SPSS 22nd edition. Qualitative data were presented in terms of frequency and percentages and were compared using the Chi-squared (χ^2) test. The significance level for this study was set at 0.05.

RESULTS: In the current study, a total of 45 pharmacists participated to investigate their opinions regarding the causes of medication errors and their efforts to prevent them. The participants had a mean age of 34.91 ± 4.5 years. Of the participants, 58% were male and 42% were female. Furthermore, 81.3% of the included pharmacists held a bachelor's degree, 12.3% held a master's degree, 3.2% had a diploma, and 3.2% held a Ph.D. degree. The mean number of years of experience as a pharmacist was 8.6 ± 6 years **Table 1**.

TABLE 1: DEMOGRAPHICS AND EXPERIENCE OF THE INCLUDED PHARMACISTS

			Mean
Gender	Age		34.91 ± 4.05
		Male	26 (58%)
Type of your clinical pharmacy degree:		Female	19 (42%)
		Bachelor	36 (81.3%)
		Diploma	1 (3.2%)
		Masters	7 (12.3%)
		PhD	1 (3.2%)
No. of experience years as a clinical pharmacist			8.6 ± 6

Common causes of Medication Error, According to the Pharmacists' View: Fig. 1 illustrates that the majority of pharmacists (74.2%) strongly agreed on the importance of including specific information in the patient's medical file.

This information includes the patient's personal details (e.g., age and sex). Additionally, 61.3% of respondents emphasized the significance of documenting the patient's medical history, while 71% stressed the importance of prescribing medications using their generic names. Furthermore, 64.5% emphasized the need for clear and proper documentation of dose concentrations in both numeric values and milligrams. Regarding medication interactions, 67.7% of pharmacists expressed a strong agreement with the necessity of checking for potential interactions between prescribed medications. Additionally, 71% of respondents agreed that each prescribed medication should adhere to clinical guidelines. In terms of medication availability, 61.3% agreed that it is essential to inquire about the availability of prescribed medications in their department. Likewise, 64.5% concurred that antimicrobial

medications should be prescribed solely in accordance with clinical guidelines. Lastly, 64.5% also agreed that dose adjustments should be made for each medication based on the patient's health condition.

The most frequently reported causes of medication errors among the included pharmacists, as presented in Table 2, were as follows: prescribing errors (26%), dispensing errors (16%), and dosing errors for certain medications (10%). The remaining 48% of errors were attributed to various other factors, as indicated by the pharmacists' responses. These included 3.2% for drug interactions, 3.2% for Look-Alike Sound-Alike (LASA) medications, and workforce-related issues. Some pharmacists mentioned specific high-alert medications such as heparin, enoxaparin, potassium chloride (KCL), and human albumin, while others referred to concerns with anti-seizure medications, antibiotic dosing problems, or errors in writing the administration route (e.g., IV instead of IM or vice versa). Additionally, a few pharmacists cited technical IT problems that could contribute to prescribing errors.

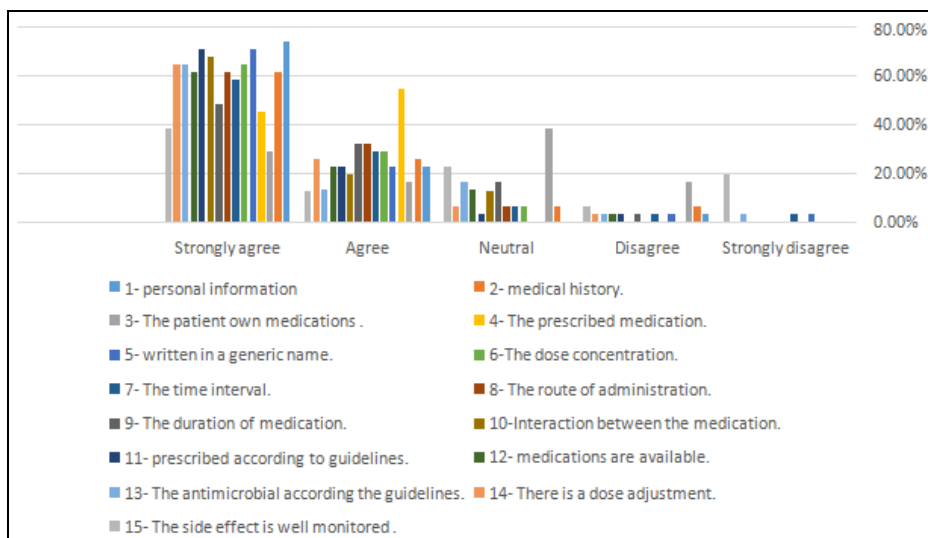


FIG. 1: PHARMACISTS' INTERVENTION DURING THE MEDICATION STAGES

TABLE 2: COMMON CAUSES OF MEDICATION ERROR MENTIONED BY THE PHARMACISTS

		Count	%
Mention the most common medication error causes in your department (mention causes)	No double check when entering the order/ notfollowing privilege policy/workload	1	3.2%
	1) no complete information	1	3.2%
	2) wrong diagnosis or indication		
	3) bypassing of interactions or duplication alerts		
	Anti-Seizure Medication	1	3.2%
	Cephalosporin (iv), kcl iv, bacterium	1	3.2%
	Dosing and route	1	3.2%

Dosing of some medication	9	10%
Heparin route, Enoxaparin dose, and HumanAlbumin dose.	1	3.2%
Incomplete written prescribed medication	1	3.2%
IT problem Wrong entry Change to IM or IV in medication taken s/c	1	3.2%
Missing doses, drug, drug interaction, misuseof antibiotics	1	3.2%
Prescribing	21	26%
dispensing	10	16%
Technically, LASA medication, workload	1	3.2%
There aren't any medication errors in mydepartment.	1	3.2%
Drug interactions	1	3.2%
Wrong dose - wrong frequency- wrongdosage form	1	3.2%
Wrong dose, wrong frequency,	1	3.2%
Wrong entry	1	3.2%

In relation to the impact of workforce and standard procedures within drug facilities on medication error occurrence, **Fig. 2** provides insights. Approximately half of the pharmacists (51.6%) disagreed with the notion that the number of clinical pharmacists is sufficient to manage the workload. Similarly, almost half (48.4%) disagreed with the idea that other hospital pharmacists adequately support clinical pharmacists in their duties. However, a significant portion (29%) of pharmacists strongly agreed that the facility's board consistently provides clinical pharmacists with the

necessary training to enhance their knowledge and expertise. Additionally, 35.5% of respondents agreed that effective communication between physicians, clinical pharmacists, and nurses is consistently maintained. Furthermore, 45.2% of clinical pharmacists expressed strong agreement with the requirement to submit a monthly medication error report to their facility's board. Similarly, 41.9% of the included pharmacists strongly agreed that the facility's board supports their recommendations aimed at reducing medication errors within the facility.



FIG. 2: WORKFORCE AND STANDARD PROCEDURES OF DRUG FACILITIES EFFECT

In our study, we included medical errors that occurred between September 2021 and July 2022 based on predefined inclusion criteria. The data for this study were gathered from various wards within our hospital, as depicted in **Fig. 3**. Our study classified medication errors into various types, as outlined in **Table 3**. The data revealed that Omission Error was the most common type of medication error in the months of September (46.4%), November 2021 (32.4%), February 2022

(45.4%), March 2022 (68.5%), and April 2022 (58%). Improper dosage was the predominant medication error type in the months of May 2022 (54.5%), June 2022 (24.5%), and July 2022 (25.9%). Additionally, Wrong Frequency emerged as the most prevalent type of medication error in the months of October 2021 (24.3%), December 2021 (31.7%), January 2022 (32.7%), June 2022 (32.9%), and July 2022 (25.9%).

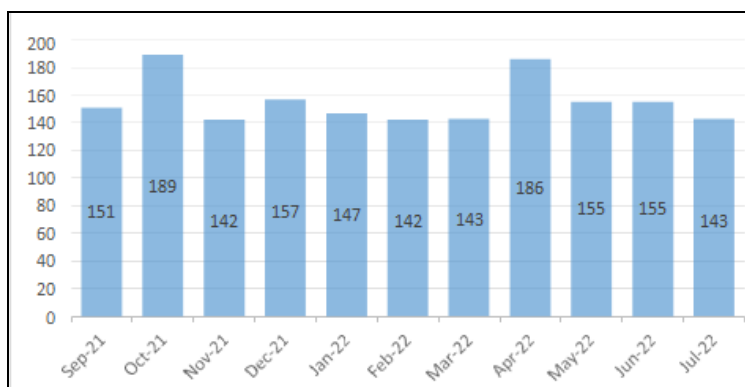


FIG. 3: THE NUMBER OF MEDICAL ERRORS REPORTED PER MONTH

Types of Medication error	Sep-21		Oct-21		Nov-21		Dec-21		Jan-22	
Omission error	70	46.4%	35	18.5%	46	32.4%	2	1.4%	27	18.4%
Improper dose (over, under, or extra dose)	31	20.5%	23	12.2%	25	17.6%	35	24.5%	38	25.9%
Wrong patient	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wrong drug	2	1.3%	1	0.5%	1	0.7%	5	3.5%	3	2.0%
Wrong strength/concentration	0	0.0%	1	0.5%	3	2.1%	0	0.0%	0	0.0%
Wrong route	1	0.7%	2	1.1%	2	1.4%	6	4.2%	0	0.0%
Wrong frequency	23	15.2%	46	24.3%	45	31.7%	47	32.9%	48	32.7%
Wrong rate of infusion	0	0.0%	0	0.0%	0	0.0%	1	0.7%	0	0.0%
Wrong duration	18	11.9%	14	7.4%	9	6.3%	32	22.4%	18	12.2%
Wrong dosage form	0	0.0%	2	1.1%	0	0.0%	0	0.0%	0	0.0%
Wrong time of administration	0	0.0%	1	0.5%	0	0.0%	0	0.0%	1	0.7%
Deteriorated/expired technique	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Deteriorated/expired medication	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Monitoring errors-clinical intervention or information	0	0.0%	1	0.5%	0	0.0%	0	0.0%	0	0.0%

TABLE 3: TYPES OF MEDICATION ERRORS PER MONTH

Types of medication error	Feb 2022	Mar 2022	April 2022	May 2022	June 2022	July 2022	Types of medication error	Feb 2022	Mar 2022	April 2022	May 2022	June 2022	
Omission error	18.50%	46	18.50%	46	18.50%	46	Omission error	18.50%	46	18.50%	46	18.50%	46
Improper dose (over, under, or extra dose)	12.20%	25	12.20%	25	12.20%	25	Improper dose (over, under, or extra dose)	12.20%	25	12.20%	25	12.20%	25
Wrong patient	0.00%	0	0.00%	0	0.00%	0	Wrong patient	0.00%	0	0.00%	0	0.00%	0
Wrong drug	0.50%	1	0.50%	1	0.50%	1	Wrong drug	0.50%	1	0.50%	1	0.50%	1
Wrong strength/concentration	0.50%	3	0.50%	3	0.50%	3	Wrong strength/concentration	0.50%	3	0.50%	3	0.50%	3
Wrong route	1.10%	2	1.10%	2	1.10%	2	Wrong route	1.10%	2	1.10%	2	1.10%	2
Wrong frequency	24.30%	45	24.30%	45	24.30%	45	Wrong frequency	24.30%	45	24.30%	45	24.30%	45
Wrong rate of infusion	0.00%	0	0.00%	0	0.00%	0	Wrong rate of infusion	0.00%	0	0.00%	0	0.00%	0
Wrong duration	7.40%	9	7.40%	9	7.40%	9	Wrong duration	7.40%	9	7.40%	9	7.40%	9
Wrong dosage form	1.10%	0	1.10%	0	1.10%	0	Wrong dosage form	1.10%	0	1.10%	0	1.10%	0

The results presented in Fig. 4 indicate that physician orders played a pivotal role in medication error occurrence throughout all months. This stage

accounted for the highest percentage of errors, with figures ranging from 85% to 98.6%. Specifically, in September 2021 (88.7%), October 2021 (86%),

November 2021 (95.8%), December 2021 (96.5%), January 2022 (98.6%), February 2022 (88.7%), March 2022 (86.2%), April 2022 (85%), May 2022 (96.5%), June 2022 (98.6%), and July 2022 (53.7%). In addition to physician orders, a few other stages were implicated but to a lesser extent. Transcription and the entering process were identified as contributing factors in September 2021 (3.3%) and February 2022 (5.3%).

Administration process was highlighted in October 2021 (12.2%), November 2021 (2.1%), March 2022 (12.2%), April 2022 (9%), and July 2022 (25.9%). In June 2022 (5.4%) and December 2021 (3.5%), dispensing and drug delivery were identified as factors. Notably, no monitoring errors related to drug levels, allergies, interactions, or clinical aspects were detected during the study period.

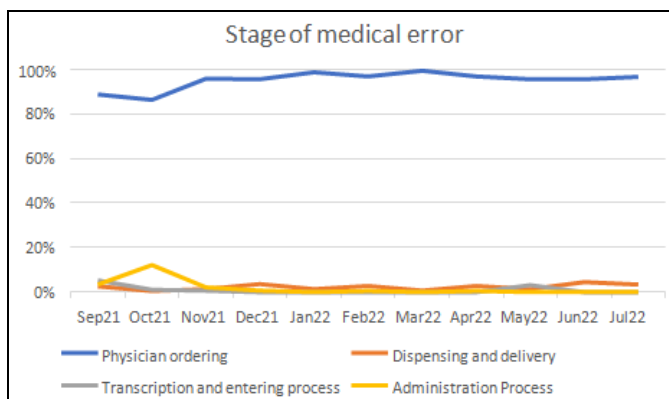


FIG. 4: STAGES OF MEDICATION ERROR PER MONTH

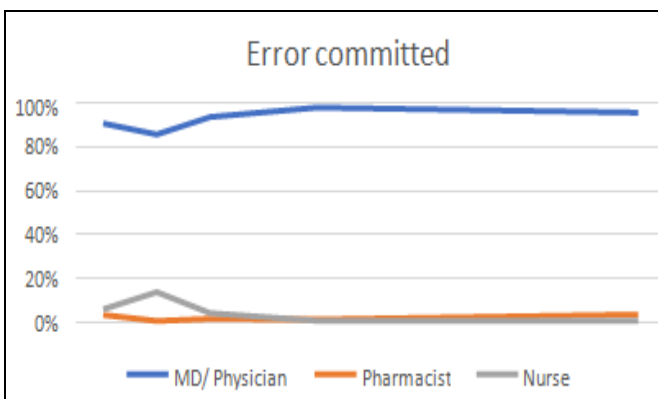


FIG. 5: COMMITTED PERSONNEL OF MEDICAL ERRORS

Fig. 5 illustrates that physicians were the most frequently implicated personnel in medication errors when compared to other medical staff, with nurses ranking second and pharmacists occupying the third position after nurses. No other medical staff members were found to be involved in committing medication errors during the study period.

circumstances or events with the potential to cause an error, constituted 1% of the cases **Fig. 6**.

In the current study, medication errors were categorized into eight subtypes based on their outcomes as follows: (A) circumstances/events with the potential to cause an error; (b) errors that occurred but did not reach the patient (near misses); (c) errors that occurred but did not result in harm; (d) errors that reached the patient and required monitoring; (e) errors that reached the patient and resulted in temporary harm, necessitating intervention; (f) errors that reached the patient and resulted in permanent harm; and (g) errors that reached the patient and required life-sustaining intervention. The data revealed that during the study period, the majority of reported and detected outcomes of errors fell into Category B, where errors did not reach the patient (96%). Category C, which included errors that reached the patient but did not cause harm, accounted for 3% of the cases, while Category A, which represented

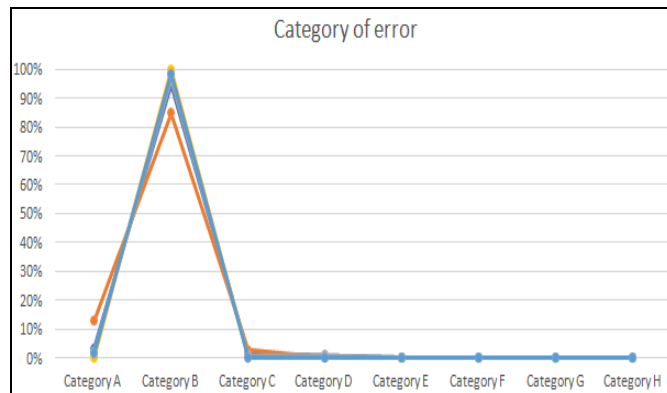


FIG. 6: MEDICATION ERROR OUTCOMES PER MONTH

Table 4 presents the distribution of reported medication errors, with the majority of errors being reported by pharmacists, followed by nurses. Specifically, in September 2021, pharmacists reported 115 errors, while nurses reported 36 errors. In subsequent months, the pattern continued, with pharmacists reporting the majority of errors: October 2021 (140), November 2021 (125), December 2021 (157), January 2022 (145), February 2022 (116), March 2022 (140), April 2022 (169), May 2022 (155), June 2022 (145), and July 2022 (141). On the other hand, nurses reported

a smaller number of errors in the following months: April 2022 (17), June 2022 (12), and July 2022 (2). October 2021 (49), November 2021 (17), January 2022 (2), February 2022 (26), March 2022 (3), Notably, no medication errors were reported by nurses in December 2021 and May 2022.

TABLE 4: MEDICAL ERRORS WERE REPORTED ACROSS MONTHS

Medication Error Reported by:	Sep-21		Oct-21		Nov-21		Dec-21		Jan-22	
Nurse	36	23.8%	49	25.9%	17	12.0%	0	0%	2	1.4%
Pharmacist	115	76.2%	140	74.1%	125	88.0%	157	100%	145	98.6%
Physician	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Dentist	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Patient/Caregiver	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
RAD/ RT/ LAB	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Medication Error Reported by:	Feb-22		Mar-22		Apr-22		May-22		Jun-22	
Nurse	26	23.8%	3	2.9%	17	12.0%	0	0%	12	4.4%
Pharmacist	116	76.2%	140	97.1%	169	88.0%	155	100%	145	95.6%
Physician	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Dentist	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Patient/Caregiver	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
RAD/ RT/ LAB	0	0.0%	0	0.0%	0	0.0%	0	0%	0	0.0%
Reported by:	Jul									
Nurse	2	1.4%								
Pharmacist	141	98.6%								
Physician	0	0.0%								
Dentist	0	0.0%								
Patient/Caregiver	0	0.0%								
RAD/ RT/ LAB	0	0.0%								

The data collected during the study period revealed various causes for the occurrence of medication errors **Fig. 7**. It is evident that the miscommunication of drug orders (due to illegibility, ambiguity, or incompleteness) was the primary cause of medication errors in all the months under investigation. The potential causes of medical errors and contributing factors that led to these errors included the following: Lack of staff experience, accounting for 40% of the cases; staffing or workflow-related factors, such as staff

shortages and high workloads, contributing to 30% of the errors; incorrect labeling of medications, which accounted for 10% of the errors; environmental factors, comprising 20% of the contributing factors and distributed equally among various environmental aspects, including lighting, noise, interruptions, and small or crowded working areas; and attitude-related elements from staff, patients, and caregivers also played a role in medication errors.

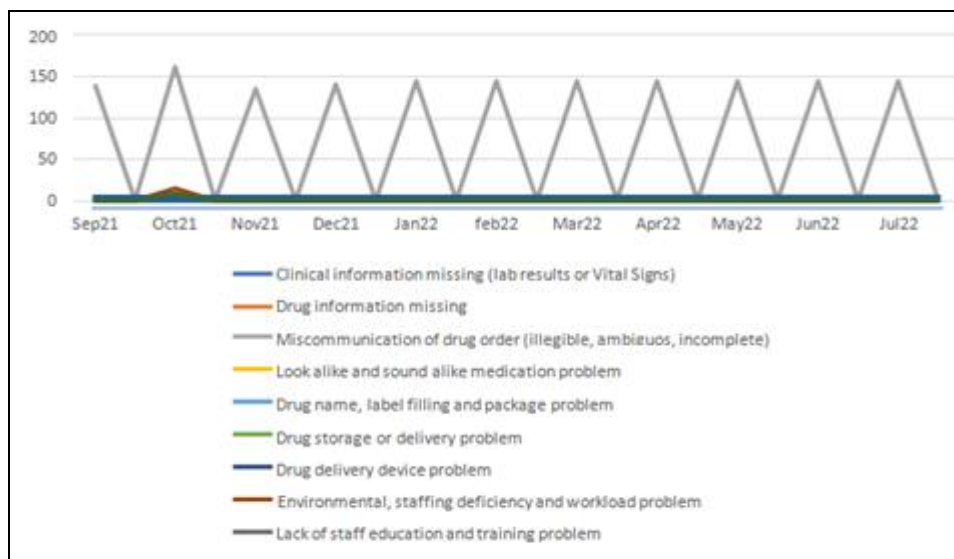


FIG. 7: CAUSES OF MEDICATION ERRORS

Pharmacists' interventions aimed at reducing medical errors are illustrated in **Fig. 8**. The most common interventions included contacting the physician to verify emergency orders, followed by refraining from dispensing drugs to the patient and correcting the dose to the appropriate one. Upon detecting errors, pharmacists took a series of actions, starting with reporting the error to the area

supervisor or in-charge. Subsequently, they would contact the physician to complete any missing information and notify the individual responsible for the mistake to correct it and prevent its recurrence. Additionally, efforts were made to arrange for further training programs to prevent the recurrence of reported errors.

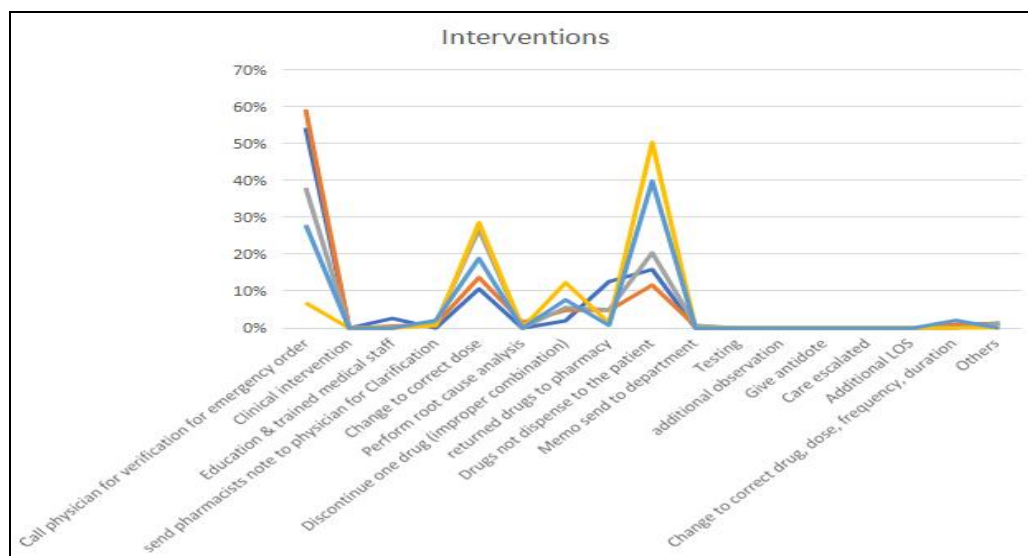


FIG. 8: INTERVENTIONS FOR MEDICAL ERRORS

DISCUSSION: Medication errors are a significant contributor to patient morbidity and mortality. According to a report from the Institute of Medicine, medication errors are responsible for one out of every 131 outpatient deaths and one out of every 854 inpatient deaths¹⁸.

The purpose of the current study was to assess the efforts of pharmacists in reporting and preventing medication errors at King Faisal Hospital in Makkah, Saudi Arabia. A total of 45 pharmacists participated in this study, and our findings indicated that the most common cause of medication errors detected in our hospital was attributed to various defects in the prescribing process.

In a separate study conducted in Tehran, Iran, clinical pharmacists reported 112 medication errors, which were primarily linked to errors in drug dosing, drug selection, drug administration, or drug interactions⁹. Our study revealed that the majority of the participating pharmacists strongly agreed on the crucial role of pharmacists in checking for medication interactions between the prescribed medication and the patient's existing

medications listed in their medical history. They also unanimously acknowledged that a lack of knowledge about the prescribed medication, its accurate dosage, and the patient's medical condition contributed significantly to medication errors.

A prospective study conducted in the United Kingdom over a span of 4 weeks supported our findings, indicating that one of the factors contributing to prescribing errors was the prescriber's knowledge of the medication. In this study, it was observed that 5% of errors were related to prescribing, with 58% of these errors stemming from prescribing decisions and 42% resulting from issues with medication order writing¹⁷.

The participating pharmacists identified several common barriers that could impede their efforts. The inadequate number of clinical pharmacists in their hospital and the lack of support from other clinical pharmacists or certain physicians were frequently cited as hindrances. Analysis of the questionnaire data revealed that our pharmacists are cognizant of their responsibilities and roles in

detecting, reporting, and preventing drug-related problems (DRPs). A Saudi study also affirmed the vital role of pharmacists in reducing the incidence of DRPs, underscoring the significance of an optimized pharmaceutical care plan within clinical care settings⁴.

Throughout the study period, the primary culprits behind medication errors at our hospital were omission errors during the prescribing phase and miscommunication of drug orders, often due to illegibility, ambiguity, or incompleteness. In line with our findings, a study conducted at King Khalid University Hospital, Kingdom of Saudi Arabia, identified incorrect drug strength and improper administration routes as the most prevalent types of prescribing errors, accounting for 35% and 23% of cases, respectively. These errors were primarily attributed to a lack of proficiency in prescribing skills¹.

In alignment with our study's emphasis on the pivotal role of pharmacists in preventing DRPs,¹⁴ highlighted the significant benefits of clinical pharmacist interventions, particularly in correcting prescribing errors related to dosing inaccuracies, units of measurement, route of administration, and dosing frequency¹⁴.

Furthermore, the inclusion of pharmacists in critical care units has been shown to contribute to a reduction in medication error rates. The presence of an on-site pharmacist can help mitigate the occurrence of adverse drug reactions, particularly when drug dosages are meticulously adjusted to align with the functioning of the body's elimination organs⁶.

CONCLUSION: Most medication errors were committed by physicians. However, it's worth noting that the majority of medication errors were reported by pharmacists. The most prevalent causes of these errors included prescribing, dispensing, dosing, omission errors, improper doses, and incorrect frequencies. Additionally, miscommunication of drug orders, often due to illegibility, ambiguity, or incompleteness, was identified as a critical factor contributing to medication errors in hospitals. Pharmacists took various interventions to reduce these medical errors. These interventions included actions such as

calling physicians for verification in cases of emergency orders, discontinuing medications, dispensing medications to patients, and correcting incorrect dosages to the appropriate ones. Finally, the entire healthcare team should collectively shoulder the responsibility of ensuring optimal medication administration for patients to uphold best practices. Future studies should delve deeper into the various factors that contribute to a higher likelihood of encountering medication administration errors within hospital settings.

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