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Clinical Pharmacists' Attitudes and Practices Regarding Drug-Drug Interaction in Hospital

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Abstract
Background: Drug-drug interactions (DDIs) are a significant cause of adverse drug reactions (ADIs) and treatment failures. Clinical pharmacists play a critical role in identifying and preventing DDIs, which is crucial in hospital settings where poly pharmacy is common. In Saudi Arabia, clinical pharmacy services have been expanding, but little is known about the attitudes and practices of clinical pharmacists regarding DDIs. ADIs remain a widespread problem in hospital settings, emphasizing the critical role of pharmacists in their prevention and management. **This study aims** to assess the knowledge, attitudes, and practices of clinical pharmacists in hospital, KSA, concerning clinically relevant drug interactions. **Method:** A cross-sectional design was utilized; a questionnaire was distributed to hospital pharmacists from February 2024 to April 2024. **Results:** Among the 312 participants, found that 38.8% had low, 31.4% had moderate, and 29.8% had high knowledge of drug interactions. Most of the pharmacists (94.5%) used software to evaluate drug interactions, and a significant proportion (91%) emphasized the necessity for regular training. Additionally, pharmacists routinely screened prescriptions for potential interactions (94.5%), assessed risks before dispensing (91.7%), documented drug interactions (85.3%), provided patient counseling (89.4%), and contacted prescribing physicians when necessary (91%). Despite the identified gaps in knowledge, the alignment of pharmacists' practices with standard procedures for managing drug interactions highlights their proactive approach to patient safety. This research underscores the need for targeted educational initiatives and continuous professional development to enhance pharmacists' understanding of drug interactions, ultimately improving patient outcomes in hospital, KSA.
Keywords: knowledge, attitudes, practices, clinical pharmacists, drug-drug interaction

Introduction:

Adverse drug reactions (ADRs) are estimated to be the fifth most common cause of hospital mortality, making them a serious public health concern. Unfortunately a significant percentage of these ADRs are recurrent (reADRs), and up to 50% of them may be avoided [(1)]. Drug-drug interactions (DDIs) are a significant and frequently disregarded contributing

element to the avoidable causes of adverse drug reactions (ADRs). DDIs significantly lower patients' quality of life in addition to raising the risk of morbidity and mortality [2, 3]. These interactions occur when two or more mismatched drugs are taken together, leading to adverse effects [4]. Due to age-related physiological changes and poly pharmacy, older people are especially vulnerable to adverse drug reactions (ADRs). Therefore, it is essential to recognize and stop possible DDIs in order to protect patient health [5].

Comorbidities result in inadequate outcomes, reduced treatment adherence, higher mortality, and more expensive healthcare, further complicating the therapeutic landscape. Comorbidities complicate therapeutic management by increasing the risk of DDIs and posing clinical problems [6]. According to earlier studies, DDIs are common; over 33% of hospital patients and 67% of patients in intensive care units experience them while undergoing therapy [7]. In geriatric care units, where the prevalence of DDI varies between 80.5% and 90.5%, the situation is even more concerning [8].

Pharmacists are essential in preventing DDIs because they use their knowledge of pharmacotherapy to spot possible interactions and suggest practical precautions [9]. It has been demonstrated that involving pharmacists greatly lowers the occurrence of DDIs, especially in critical care settings [10]. Additionally, a randomized controlled research with patients who had heart failure showed that pharmacist interventions successfully reduced the frequency of DDIs that were clinically meaningful [11]. These results demonstrate how important clinical and pharmacological interventions are to providing the best possible care for patients. These interventions include reducing medication errors and side effects, improving therapeutic options, and rationalizing prescriptions. To guarantee the best possible health outcomes, pharmaceutical interventions pertaining to the detection, avoidance, and resolution of DDIs must be documented [12]. In order to maintain therapeutic efficacy, these interventions may involve changing the timing of drug administration (spacing out the administration of two drugs that interfere with each other), modifying medication dosages (lowering or raising the dose of one or both interacting drugs), or replacing one or more of the interacting drugs with substitutes that do not have the same interaction potential.

In wealthy nations, clinical decision support systems have made it easier to prevent DDIs by integrating computerized prescriptions with patient medical information. Before medication is given, these systems provide actionable advice to reduce the risk of interactions by generating alerts when potentially interacting drug combinations are discovered [13].

Assessment of hospital pharmacists' knowledge, attitudes, and practices addressing clinically relevant DDIs is essential, especially in light of the World Health Organization's emphasis on patient safety as a core value of healthcare (WHO 2017) [14]. Improving therapy results and patient safety requires this kind of assessment. In Saudi Arabia, the role of clinical pharmacists in hospitals has expanded significantly in recent years, with a focus on direct patient care, medication therapy management, and clinical decision support. However, despite the growth of clinical pharmacy services, little research has been conducted on pharmacists' attitudes, practices, and knowledge related to DDIs in the country. This study aims to investigate the knowledge, attitudes, and practices of hospital pharmacists regarding clinically relevant DDIs in hospitals in hospitals, Saudi Arabia.

Materials and methods

A cross-sectional design was utilized; a validated questionnaire was distributed to hospital pharmacists from February 2024 to April 2024. The questionnaire targeted hospital pharmacists in Makkah, KSA, and involved those with at least six months of professional experience in hospital settings. This duration was chosen to ensure that the pharmacists had experience managing cases related to DDIs.

The curriculum for pharmacy education is organized to guarantee that graduates are ready for the demands of the industry. A four-year bachelor's degree in pharmacy serves as the starting point for the educational process and offers a solid foundation in pharmaceutical sciences. A one-year professional pharmacist education curriculum that emphasizes clinical training, professional ethics, and practical skills must thereafter be completed by the students. The national competency examination (NCE), a demanding test that gauges graduates' knowledge, abilities, and preparedness for the field, must be passed before they may be licensed to practice pharmacy.

The survey instrument was adapted from the questionnaire used by Abdo et al. (2020) [(15)] to evaluate the knowledge, attitudes, and practices of healthcare providers regarding life-threatening drug interactions in public hospitals. We used the instrument from Abdo et al. (2020) [(15)] due to its alignment with our research aims. Additionally, this survey instrument has proven effective in measuring the intended variables within the context of our study and was easily understood by the respondents to this research.

The instrument translation process involved two stages: forward translation from English to Arabic by two independent professional translators and backward translation by two native English-speaking translators fluent in KSA. This ensured conceptual equivalence between English and Arabic items.

Expert consultation, including two pharmacology experts and one hospital pharmacist, refined the instrument. Following the revision, the instrument underwent pretesting with 10 randomly selected participants from the target population [(16)] (Perneger et al. 2015). This ensured clarity and reduced measurement errors. The participants provided feedback on unclear items to enhance understanding.

The validity of the questionnaire items was tested using the Pearson bivariate correlation (Pearson product moment correlation) [(17)] An item is considered valid if there is a significant relationship ($p < 0.05$) between the item score and the total score, indicating that the item measures the same concept as the concept measured by the domain in the questionnaire. The reliability of the questionnaire was evaluated using the Cronbach's alpha value, with a minimum acceptable value of 0.6 [(18)].

The survey instrument was divided into four sections. The first section collected data on participant socio-demographics, including gender, highest education level, and age, length of employment, hospital type and accreditation, number of pharmacists in the hospital, average daily prescriptions, and participants' daily working hours. The second section evaluated the pharmacists' knowledge of clinically relevant DDIs. The responses were rated as correct, incorrect, or 'don't know,' with a score of 10 for correct answers and 0 for incorrect or don't know responses. The total score ranged from 0 to 100. In the third section, the pharmacists' attitudes towards seeking information about drug interactions were assessed using a Likert scales ranging from strongly disagree to strongly agree. The fourth section examined the pharmacists' practices related to clinically relevant DDIs using the same Likert scale.

The minimum sample size required, calculated using the Slovin formula, and was 237 participants and reach to 312 to overwhelmed missing data. We used purposive sampling as the sampling method. Descriptive statistics were used to describe the demographic data and the frequency of responses regarding the knowledge, attitudes, and practices of hospital pharmacists towards DDIs. The level of pharmacists' knowledge about DDIs was categorized into three levels: low (score ≤ 59%), moderate (score 60–79%), and high (score 80–100%). To assess the relationship between demographics and levels of knowledge, a chi-square test was used. The significance level was set at a p-value of less than 0.05. Statistical analyses were performed using the SPSS software, version 28.0.

Results

All the questionnaire items in the knowledge, attitude, and practice domains demonstrated significance levels below 0.05, indicating a significant correlation with the total score in each domain. The reliability evaluation for each domain yielded Cronbach's alpha values exceeding 0.60, indicating reliability. Therefore, the questionnaire used in this study was deemed valid and reliable.

Table (1) shows that Characteristics of the respondents. The data were collected from 312 hospital pharmacists. The majority of the respondents were female (80.8%), with 23.4% aged over 40 years. Only 11.9% held a master's degree, and 32.1% had less than 2 years of work experience in hospitals. The majority (82.7%) worked in fully accredited hospitals, with over 40% being employed in facilities to handle fewer than 100 prescriptions for both inpatient and outpatient services.

Table (1): Characteristics of the respondents

Characteristics	Number (n = 312)	Percentage (%)
Sex		
Male	60	19.2
Female	252	80.8
Age (years)		
<=30	119	38.1
31–40	120	38.5
>40	73	23.4
Education		
Pharmacist	274	87.8
Master's degree	37	11.9
Length of service in the hospital (years)		
<=2	100	32.1
3–5	70	22.4
6–10	58	18.6
>10	84	26.9
Hospital accreditation		
Initial	16	5.1
Basic	11	3.5
Intermediate	9	2.9
Advanced	18	5.8
Comprehensive	258	82.7
Average number of prescriptions per day		
Outpatient		
<=100	130	41.7
101–200	106	34.0
>=200	76	24.4
Inpatient		
<=100	144	46.2
101–200	70	22.4
>=200	98	31.4
Number of pharmacists		
<10 pharmacists	141	45.2

Characteristics	Number (n = 312)	Percentage (%)
11–20 pharmacists	114	36.5
>20 pharmacists	57	18.3

Table (2) displays the pharmacists' knowledge evaluation concerning clinically relevant DDIs. The questions varied in difficulty, with questions two and seven being comparatively easier for pharmacists. Question two, concerning the ciprofloxacin-insulin interaction, resulted in 84.3% correct responses, while question seven, on the clopidogrel-omeprazole interaction, had 79.2% correct responses. Conversely, questions one and three posed greater difficulty, with 65.4% and 62.5% of incorrect or uncertain responses, respectively. Overall, 121 (38.8%) pharmacists demonstrated a low level of knowledge (score 0–59%), 98 (31.4%) showed moderate knowledge (score 60–79%), and only 93 (29.8%) individuals exhibited a high level of knowledge (score 80–100%).

Table (2): Pharmacists' knowledge of drug-drug interactions

Drug-drug interactions	Correct (n, %)	Incorrect and don't know (n, %)
Aspirin + Warfarin	108 (34.6)	204 (65.4)
Ciprofloxacin + Insulin	263 (84.3)	49 (15.7)
Clopidogrel + Enoxaparin	117 (37.5)	195 (62.5)
Ramipril + Spironolactone	156 (50.0)	156 (50.0)
Ibuprofen + Aspirin	185 (59.3)	127 (40.7)
Methylprednisolone + Ciprofloxacin	235 (75.3)	77 (24.7)
Clopidogrel + Omeprazole	247 (79.2)	65 (20.8)
Candesartan + Spironolactone	235 (75.3)	77 (24.7)
Allopurinol + Captopril	224 (71.8)	88 (28.2)
Amlodipine+ Simvastatin	189 (60.6)	123 (39.4)

Table (3): it is evident that only the sex variable significantly affected the hospital pharmacists' knowledge regarding clinically relevant DDIs. Female pharmacists (32.9%) exhibited a higher percentage of high levels of knowledge compared to male pharmacists (16.7%).

Table (3): Factors influencing the level of hospital pharmacists' knowledge regarding drug-drug interactions

Characteristics	Low	Moderate	High	P-value
Sex				
Male	26 (43.3%)	24 (40.0%)	10 (16.7%)	0.04
Female	95 (37.7%)	74 (29.4%)	83 (32.9%)	
Age (Years)				
<=30	45 (37.8%)	35 (29.4%)	39 (32.8%)	0.65
31–40	46 (38.3%)	43 (35.8%)	31 (25.8%)	
>40	30 (41.1%)	20 (27.4%)	23 (31.5%)	
Education				
Pharmacist	107	84 (30.7%)	83	0.67

Characteristics	Low	Moderate	High	P-value
	(39.1%)		(30.3%)	
Magister	13 (35.1%)	14 (38.9%)	10 (27.0%)	
Length of service in the hospital (years)				
<=2	42 (42.0%)	31 (31.0%)	27 (27.0%)	0.96
3–5	27 (38.6%)	21 (30.0%)	22 (31.4%)	
6–10	23 (39.7%)	17 (29.3%)	18 (31.0%)	
>10	29 (34.5%)	29 (34.5%)	26 (31.0%)	
Hospital accreditation				
Initial and basic	11 (77.3%)	6 (48.9%)	10 (73.9%)	0.80
Intermediate and advanced	12 (88.8%)	7 (55.5%)	8 (55.5%)	
Comprehensive	98 (38.0%)	85 (32.9%)	75 (29.1%)	
Average number of prescriptions per day				
Outpatient:				
<=100	54 (41.5%)	35 (26.9%)	41 (31.5%)	0.55
101–200	36 (34.0%)	39 (36.8%)	31 (29.2%)	
>=200	31 (40.8%)	24 (31.6%)	21 (27.6%)	
Inpatient :				
<=100	59 (41.0%)	40 (27.8%)	45 (31.3%)	0.64
101–200	23 (32.9%)	26 (37.1%)	21 (30.0%)	
>=200	39 (39.8%)	32 (32.7%)	27 (27.6%)	
Number of pharmacist				
<10 pharmacists	51 (36.2%)	45 (31.9%)	45 (31.9%)	0.11
11–20 pharmacists	41 (36.0%)	34 (29.8%)	39 (34.2%)	
>20 pharmacists	29 (50.9%)	19 (33.3%)	9 (15.8%)	

Table (4) it is observed that 88.5% of the participants' expressed agreement with using an application to search for drug interactions, and 91.0% agreed with receiving regular training on monitoring drug interactions. Furthermore, 27.9% of the respondents indicated agreement with manually searching for drug interactions using books, while 42% agreed with consulting a colleague pharmacist when encountering cases of drug interactions.

Table (4): Pharmacists' attitudes toward seeking information about drug-drug interactions

Statements	Disagree/ Strongly Disagree	Neutral	Agree/Strongly Agree
Prefer using a drug interaction application	14 (9.8%)	21 (6.7%)	276 (88.5%)
Prefer using reference books for drug interactions	53 (17%)	172 (55.1%)	87 (27.9%)
Prefer asking colleague pharmacists about potential drug Interactions	48 (15.4%)	133 (42.6%)	131 (42%)
Prefer receiving regular training on drug interaction Monitoring	6 (2.0%)	22 (7.1 %)	284 (91.0%)

Table (5) shows that a high percentage of pharmacists agreed to various practices related to DDIs, including screening for interactions with every prescription (94.5%), contacting prescribing doc- tors upon identifying interactions (92.9%), assessing clinical significance before dispensing medication (91.7%), routinely counseling patients about potential interactions (89.4%), and documenting encountered interactions (85.3%).

Table (5): Pharmacists' practices regarding drug-drug interactions

Statements	Disagree/ Strongly Disagree	Neutral	Agree/Strongly Agree
Screen for drug interactions with every prescription	3 (1.0%)	14 (4.5%)	295 (94.5%)
Assess the clinical significance of drug interactions before dispensing	4 (1.3%)	22 (7.1%)	286 (91.7%)
Document observed drug interactions routinely	11 (3.6%)	35 (11.2%)	266 (85.3%)
Counsel patients regularly about potential drug interactions	5 (1.6%)	28 (9.0%)	279 (89.4%)
Contact the prescribing doctor if a drug interaction is detected	6 (2.0%)	16 (5.1%)	290 (92.9%)

Discussion

The aim of this study is to assess hospital pharmacists' knowledge, attitudes, and practices regarding frequently encountered DDIs in Makkah, Saudi Arabia. Because it improves patient safety in the hospital context, pharmacists' knowledge of drug interactions has a direct impact on the standard of patient care. DDIs are commonly linked to higher patient morbidity and mortality rates [19, 20]. This study found that only 29.8% of pharmacists exhibited a high level of knowledge. Our findings are consistent with those of Alorfi et al. (2023) [21], who reported that most community pharmacists cannot provide accurate answers regarding DDIs, despite the crucial role that pharmacists play in identifying and managing such interactions.

Among other factors, sex influences hospital pharmacists' understanding of DDIs. When it came to drug interactions, we discovered that female pharmacists knew more than their male counterparts. This is consistent with earlier studies showing that female pharmacists are more aware of drug safety issues and possess superior understanding of drug and food interactions [22, 23].

Pharmacists' knowledge of DDIs in hospitals has significant implications for patient

safety and treatment efficacy. Our study found that most of the pharmacists possessed a good understanding of common DDIs, such as those between ciprofloxacin and insulin as well as clopidogrel and omeprazole. However, challenges persisted in comprehending other drug interactions, such as those between aspirin and warfarin and between clopidogrel and enoxaparin. Efforts are needed to improve pharmacists' understanding of DDIs through training and education. Additionally, the implementation of decision support systems and easily accessible information resources can increase awareness and vigilance towards potentially harmful DDIs, thereby enhancing the quality of pharmaceutical services and overall patient safety [(24)].

According to the pharmacists' attitudes, most of them prefer to use contemporary information sources, including medication interaction apps, while looking for information concerning DDIs. The majority of pharmacists also expressed a willingness to participate in ongoing training on medication interaction monitoring, demonstrating an understanding of the value of keeping up with the most recent advancements in pharmacy. Some pharmacists, however, preferred to physically look up information in books and speak with other pharmacists. This emphasizes how crucial inter-professional cooperation is in the pharmaceutical workplace since it can promote the efficient sharing of knowledge and information [(25)]. Overall, pharmacists' attitudes towards seeking information about drug interactions reflect an adaptation to technological advancements and the need for regular knowledge updates [(26)]. It is crucial to utilize various information sources optimally according to the needs and context of pharmacy practice.

The pharmacists' DDI practices show a high degree of understanding and adherence to important protocols in drug interaction management. Almost all of the pharmacists were willing to check each prescription for drug interactions, get in touch with the prescribing physician if one was discovered, assess the risk of an interaction before giving medication, educate patients, and regularly record their activities. These procedures emphasize how important pharmacists are to detecting, controlling, and averting potentially dangerous drug interactions, highlighting their vital role in healthcare to provide patients with the greatest results [(15)].

We recommend a number of important measures to enhance DDI management and strengthen the position of pharmacists nationally. First, we suggest creating and implementing national continuing education initiatives for hospital pharmacists that are especially targeted at DDIs. Second, we help hospital pharmacy practices to incorporate clinical decision support systems (CDSS) with DDI alerts. Third, in order to promote efficient discussion and management of DDIs, we recommend enhancing inter-professional collaboration through frequent multidisciplinary meetings and communication channels. Additionally, it is essential to make current and thorough drug interaction databases and literature easily accessible to pharmacists. For the management of DDIs, we also suggest developing best practices and established processes. Finally, the development and regular updating of brochures, guides, and online resources containing practical information on DDI management will further empower pharmacists in their critical roles.

Conclusion

The hospital pharmacists in Makahh, KSA, had suboptimal knowledge of relevant drug-drug interactions. While they demonstrate strong adherence to standard procedures such as screening, risk evaluation, documentation, education, and collaboration, most of the pharmacists relied on software applications for interaction checks and sought regular training. To enhance patient safety and treatment outcomes, it is crucial to improve pharmacists' understanding of complex interactions and to advance the use of technology and ongoing educational programs.

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