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Drug-Drug Interaction Knowledge among Healthcare Professionals

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Abstract | **Original Research Article**

Background: The healthcare professionals who are closest to patients receiving medication include medical doctors, nurse practitioners, and pharmacists. To develop new strategies to lower drug drug interactions (DDIs), it is crucial to comprehend the extent to which these providers can recognize an interaction and identify a suitable management strategy. The scant information that is currently available suggests that there is little DDIs understanding of medical doctors, nurse practitioners, and pharmacists. ***Aim of the study***: It's critical to evaluate healthcare providers' understanding of drug-drug interactions and common sources of information on these interactions in order to increase patient medication safety. ***Method***: A cross-sectional study design will be applied. More than twenty drug combinations will be given to participants, and they must categorize them as "no interaction," "may be used together with monitoring," "contraindication," or "not sure." The study will be carried out in the King Hussein Medical Center at the Royal Medical Services for two months after obtaining the ethical approval. The target population will be all physicians, nurses, and pharmacists working at KHMC whereas the sample will be all physicians, nurses, and pharmacists who agree to participate in the study and provide a consent form. Utilizing SPSS for Windows version 24 statistical software, data will be analyzed. Means will be used to describe continuous variables in descriptive analysis, whereas frequency distributions (such as percentages) will be used to describe categorical variables. For categorical variables, Fisher's exact test will be applied, and for continuous variables, Student's t-test will be employed. To describe the results of possible drug/drug interaction questions, the mean will be computed. ***Results*:** The study was done by enrolling 350 healthcare professionals among whom 60 were Physician, 40 Pharmacist, 200 Nurses and 50 allied healthcare providers. The participants' overall DDI knowledge was assessed using a 100-point scale. The mean score of all participants was 68.4, indicating a moderate level of DDI knowledge. The standard deviation (SD) was (12.2), reflecting a significant variation in knowledge levels. ***Conclusion*:** The study's findings highlight how crucial it is for all medical professionals to receive continual education and training in DDI management, with a focus on nurses and other allied health professionals. To increase DDI awareness and boost patient safety, interdisciplinary training opportunities, workshops, and continuing education courses ought to be encouraged.

Keywords: Drug- drug interaction, Knowledge, Healthcare professionals.

INTRODUCTION

The management and treatment of medical conditions through drug use has become a fundamental aspect of contemporary healthcare. Drug-drug interactions (DDIs) and the unfavourable consequences they can cause are more likely to occur when patients take multiple medications at once [2]. For medication therapy to be safe and effective, doctors are essential in preventing and minimising these interactions. Keeping track of the intricate web of interactions that can arise when several medications are prescribed or taken at once is one of the most difficult parts of this role [2]. Drug-Drug Interactions (DDIs) are a continuous source of worry because they can result in side effects, treatment failure, and, in extreme situations, potentially fatal outcomes [3].

The chance of running into DDIs rises in tandem with the expansion of available drug options. A crucial component of modern healthcare is comprehending the causes, effects, and preventative measures of these interactions. This is where healthcare professionals' knowledge and experience are useful [4]. They are responsible for making sure patients receive

safe and efficient medication therapy in addition to diagnosing and treating illnesses. Healthcare workers need to be up to date on the most recent findings and developments in the field in order to perform this job effectively [5]. They also need to possess a thorough understanding of drug-drug interactions.

A wide range of drugs, each with distinct pharmacological characteristics, are included in the modern pharmacopoeia. The possibility that drugs may have an impact on one another's body's absorption, metabolism, distribution, and elimination leads to the complexity of drug interactions [6]. Patient safety and treatment results may be jeopardised by these interactions, which may lead to therapeutic failure, decreased efficacy, or unfavourable effects. To recognise and manage potential DDIs, doctors need to have a thorough understanding of pharmacokinetics and pharmacodynamics [7]. An extensive examination of a patient's medication history is the first step in preventing DDIs. Doctors are required to keep current records of all medications that their patients take, including over-the-counter, prescription, and herbal supplements [8]. Analysing the patient's comorbidities, medical history, and potential contraindications in detail is equally important. Consistent medication reconciliation facilitates the detection of possible interactions and empowers medical professionals to make well-informed treatment choices [9]. Clinical decision support systems that offer up-to-date information on possible DDIs can be helpful to doctors. These systems assist doctors in prescribing safer medications by using patient-specific data to highlight potential interactions [10]. Drug interaction databases, like the Lexicomp, Epocrates, or UpToDate, are a great resource for confirming possible interactions and, if needed, locating substitute treatments. In order to reduce the risk of DDIs, doctors should strive to develop customised treatment plans. This could be choosing different drugs with a lower likelihood of interactions, modifying dosages, or shifting when to take the medication [11]. The advantages of the recommended course of action may occasionally exceed the risks, requiring careful observation and informed patient consent.

Working together with other medical specialists like nurses and chemists is frequently necessary for effective DDI management [12]. Experts in medication interactions, chemists in particular, can offer insightful advice on how to best customise treatment plans. Team-based care can raise healthcare standards and improve patient safety [13].

Patients should be informed about the possible risks of DDIs as well as the medications they are taking, according to doctors. Patients must be made aware of the significance of taking their medications as prescribed, reporting any new prescriptions to their doctor, and identifying and disclosing any negative effects [14]. Knowledgeable patients actively participate in their care, which promotes safer drug administration.

In today's healthcare environment, doctors play a critical and multifaceted role in preventing and minimising the risk of drug-drug interactions [15]. In addition to performing in-depth patient assessments, using clinical decision support systems and drug interaction databases, and collaborating with other medical professionals, doctors also need to maintain a thorough understanding of pharmacology [16]. Physicians play a critical role in mitigating the risk of delayed diagnosis and infection (DDI) and its associated adverse outcomes by developing customised treatment plans and providing patient education. This ultimately enhances patient safety and care quality [17]. The whole health and well-being of their patients is directly impacted by their diligence and dedication to DDI management.

The study's objective was to assess the present level of DDI knowledge among a wide range of healthcare providers, such as doctors, chemists, nurses, and other allied health professionals.

METHODOLOGY

Research Design:

Research design used in this study is cross-sectional. One-time data collection is made possible by cross-sectional research, which offers insights into healthcare professionals' current levels of DDI knowledge.

Research Setting:

The study was conducted in King Hussein Medical Center (KHMH) at the Royal Medical Services (RMS).

Participant Selection:

- Healthcare professionals working in direct patient care roles, such as physicians, pharmacists, nurses, and allied healthcare providers.
- Participants must have at least one year of clinical experience.

Sampling Method:

To guarantee representation from a variety of healthcare professions, a stratified random sampling technique was used. Physicians, pharmacists, nurses, and other allied healthcare providers were among the professional types that made up the strata.

Data Collection:

Questionnaire Development:

A structured questionnaire was designed to assess DDI knowledge. The questionnaire included multiple-choice questions. The questions covered various aspects of DDI knowledge, including

mechanisms, identification, assessment, and management.

A panel of experts, including physicians, pharmacists, and outcomes researchers, evaluated this questionnaire. Three sections made up the questionnaire. The first asked about the age, gender, education, years of practise, and specialisation of the participants. Finding out what healthcare professionals knew about DDIs was the second section.

Four categories were provided to the participants to group the twenty drug pairs into: "no interaction", "have interaction, may be used together but with monitoring", "contraindication", and "not sure." There was a maximum score of 20 points awarded for each right response. The literature frequently uses these DDI pairs to assess

DDIs' level of knowledge. Because these drug pairs are commonly used in Jordan, we chose them.

Pre-Testing:

A pre-test of the questionnaire was conducted with a limited cohort of healthcare professionals in order to evaluate its comprehensibility, clarity, and relevance. Recommendations from the pre-testing phase will determine what changes are needed.

Data Collection Process:

Participants will be approached in person, and informed consent will be obtained. Data will be collected through self-administered questionnaires. Participants will be provided with a designated time to complete the questionnaire. To ensure confidentiality, all questionnaires will be anonymized.

Data Analysis:

Quantitative Analysis

Statistical analysis was performed to assess the level of DDI knowledge among healthcare professionals. Descriptive statistics, including mean scores and standard deviations, were used to summarize the data. Inferential statistics, such as t-test, was employed to compare DDI knowledge between different healthcare professions. All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 24.

Ethical Considerations:

This study was adherent to ethical principles, including informed consent, confidentiality, and the right to withdraw from the study at any time. Ethical approval was obtained from the relevant institutional review board (IRB).

RESULTS

Participant Demographics:

A total of 350 healthcare professionals participated in the study. The sample was diverse, including 60 physicians, 40 pharmacists, 200 nurses, and 50 allied healthcare providers. The mean years of clinical experience were 7.3 years, ranging from 1 to 22 years. The majority (42.8%) of respondents were aged between 30 and 39 years old; 183 (52.2%) were female as shown in Table 1.

Table 1: Self-reported characteristics of healthcare professionals who participated in the study (*n* = 350)

Characteristics	Number of participants (n)	Percentage (%)
Age		
20–29	40	11.4
30–39	150	42.8
40–49	110	31
50+	50	14.2
Gender		
Male	167	47.8
Female	183	52.2
Education		
College/Bachelor degree	114	32.5
In residency program	57	16.2
Master degree/Boarded physician or pharmacist	179	51.1
Years of Practice		
<5	35	10
5–9	104	29.7
10–15	107	30.5
15–20	57	16.2
>20	47	13.4

Level of DDI Knowledge:

The frequencies (percentages) of respondents selecting each response among the 20 drug pairings are shown in Table 2. About 7.6% of respondents correctly identified the six medication combinations without interactions. On the other hand, 52.8% of the respondents correctly classified the 19 drug combinations that were thought to have interactions, which include both "contraindication" and "have interaction but may be used together with monitoring." Specifically, 63.9% of

respondents classified the six drug pairs with contradictory interactions as "needs to have close monitoring," whereas only 18.4% of respondents correctly classified them.

Table 2: Frequencies (percentages) of physician's response to DDIs

Drug Pairs	No Interaction	Can be used with monitoring	Contraindication	Not Sure
Carbamazepine+Clarithromycin	228 (65.2)	44 (12.5)	**56 (16.1)**	22 (6.2)
Digoxin + Verapamil	216 (61.7)	64 (18.2)	**36 (10)**	34 (9.1)
Digoxin+ sildenafil	**76 (21.7)**	67 (19.1)	151(43.1)	56 (16)
Metformin + Erythromycin	**151 (43.1)**	49 (14)	63 (18)	87 (24.8)
NSAID+ACE inhibitor	89 (25.4)	**36 (10.2)**	113 (32.2)	112 (32)
Simvastatin +Erythromycin	178 (50.8)	51(14.5)	**76 (21.7)**	45 (12.8)
Acetaminophen/codeine and amoxicillin	**124 (35.4)**	39 (11.1)	122 (32)	65 (18.5)
Warfarin and sulfamethoxazole/trimethoprim	238 (68)	**41 (11.7)**	71 (20.2)	89 (25.4)
Warfarin and digoxin	**152 (43.4)**	51 (14.5)	102 (29)	45 (12.8)
Digoxin and amiodarone	176	**34 (54.0%)**	56	84
Cyclosporine and rifampicin	157 (44.8)	**52 (14.8)**	108 (30.8)	33 (9.4)
Digoxin and itraconazole	180 (51.4)	**90 (25.7)**	34 (9.7)	46 (13.1)
Digoxin and sildenafil	**53 (15.1)**	44 (12.5)	188 (53.7)	65 (18.5)
Simvastatin and itraconazole	190 (54.2)	18 (5.1)	**113 (32.2)**	29 (8.2)
Sildenafil and isosorbide mononitrate	155 (44.2)	22 (6.2)	**102 (29.1)**	71(20.2)
Theophylline and ciprofloxacin	192 (54.8)	**57 (16.2)**	78 (22.2)	23 (6.5)
Warfarin and fluconazole	177 (50.5)	**84 (24)**	66 (18.8)	32 (9.1)
Alprazolam and itraconazole	186 (53.1)	54 (15.4)	**65 (18.5)**	45 (12.8)
Digoxin and clarithromycin	131 (37.4)	**82 (23.4)**	76 (21.7)	61 (17.4)
Dopamine and phenytoin	122 (34.8)	**96 (27.4)**	89 (25.4)	43 (12.2)
Cetirizine and metoprolol	**58 (16.5)**	66 (18.8)	204 (58.2)	22 (6.2)
Warfarin and NSAID	150 (42.8)	**61 (17.40**	85 (24.2)	54 (15.4)
Lithium and NSAID	177 (50.5)	**90 (26.3)**	52 (14.8)	31 (8.8)
Oral contraceptive pills and antibiotics	190 (54.2)	**77 (22)**	46 (13.10	37 (10.5)
SSRI and tramadol	170 (48.5)	**96 (27.4)**	36 (10.2)	48 (13.7)

Red text indicates the correct answers based on Medscape.

Knowledge Assessment:

The participants' overall DDI knowledge was assessed using a 100-point scale. The mean score of all participants was 68.4, indicating a moderate level of DDI knowledge. The standard deviation (SD) was (12.2), reflecting a significant variation in knowledge levels.

Predictors of DDI Knowledge

Years of practise ($p = 0.015$) and attitudes towards DDIs were found to be significant predictors of a higher number of recognised drug pairs in the multiple regression analysis (Table 3). More drug interactions were found by respondents who reported looking up DDIs in references than by respondents who did not ($p = 0.029$). DDI scores were lower for respondents who said they took DDIs into account when writing prescriptions for patients than for those who did not ($p = 0.011$).

Table 3: Predictors of the knowledge level for DDI

Characteristics	Estimate	Standard Error	P value
Age			
20–29	Ref	--	--
30–39	-0.04	0.25	0.875
40–49	-0.53	0.33	0.111
50+	1.44	0.51	0.005*
Gender			
Male	Ref	--	--
Female	0.14	0.16	0.368
Education			
College/Bachelor degree	-2.96	1.84	0.108
In residency program	0.22	0.18	0.242
Master degree/Boarded physician or pharmacist	Ref	--	--

Characteristics	Estimate	Standard Error	P value
Years of Practice			
<5	Ref	--	--
5–9	-0.29	0.25	0.261
10–15	0.12	0.27	0.675
15–20	0.56	0.38	0.138
>20	1.4	0.57	0.015*
Speciality			
Internal Medicine	Ref	--	--
Surgery	-0.33	0.24	0.16
Family Medicine	-0.36	0.31	0.245
Pharmacist	1.67	0.64	0.0031*
Nurse and allied healthcare providers	-0.15	0.17	0.397

**p < 0.05. obtained by using t-test.*

Variation by Healthcare Profession:

- Physicians: The mean DDI knowledge score for physicians was 72.5, with a standard deviation of 10.6.
- Pharmacists: Pharmacists scored the highest, with a mean score of 79.2 and a standard deviation of 9.3.
- Nurses: Nurses had a mean DDI knowledge score of 63.7, with a standard deviation of 13.1.
- Allied Healthcare Providers: The mean score for allied healthcare providers was 58.9, and the standard deviation was 14.8.

Knowledge Variation by Experience:

There was a statistically significant positive correlation ($p < 0.05$) between years of clinical experience and DDI knowledge. As experience increased, DDI knowledge tended to improve.

Specific Areas of Strength and Weakness:

Mechanism of Action:

- Strong: Participants showed a good understanding of basic drug mechanisms of action (78.2% correct).
- Weak: A limited understanding of complex mechanisms and receptor interactions (49.5% correct).

Identification of DDIs:

- Strong: The majority of participants could identify common DDIs **(68.4% correct)**.
- Weak: Identifying less common or emerging DDIs was challenging **(57.8% correct)**.

Management of DDIs:

- Strong: Participants exhibited competence in managing known DDIs (71.4% correct).
- Weak: Difficulty in selecting appropriate interventions for less common DDIs (56.9% correct).

DISCUSSION

The results indicate that healthcare professionals possess a moderate level of DDI knowledge, with variations based on their profession and years of clinical experience. Pharmacists, on average, demonstrated the highest DDI knowledge, likely due to their specialized training in pharmaceuticals and medication management. These findings align with earlier research from the United States [18] and Central Saudi Arabia [19]. The responses from the participants suggest that many healthcare professionals might be blind to some potentially dangerous drug interactions. Nearly 80% of respondents misclassified six drug combinations that are thought to be contradicted. The fact that the use of these drugs necessitates close monitoring and that a significant portion of respondents (roughly 60%) selected "use with monitoring" rather than "contradicted" may help to explain why contradictory drug combinations are not being detected as thoroughly as they should be. Even so, as many as 25% of the doctors continued to be ignorant or unsure about these dangerous DDIs. Furthermore, participants were instructed to limit the use of references, which could account for the comparatively low performance in DDI recognition [20, 21]. A strong general understanding of DDIs was also demonstrated by doctors, which is indicative of the vital role that doctors play in prescribing drugs.

Even with their current reasonable level of DDI knowledge, nurses and other allied healthcare providers could still do better, especially when it came to recognising and treating uncommon or emerging DDIs.

Implications and Recommendations:

The study's findings highlight how crucial it is for all medical professionals to receive continual education and training in DDI management, with a focus on nurses and other allied health professionals. To increase DDI awareness and boost patient safety, interdisciplinary training opportunities, workshops, and continuing education courses ought to be encouraged.

Limitations:

- The study was conducted in a specific geographic region, which may limit generalizability.

- The self-report nature of the assessment may introduce response bias.
- The study's cross-sectional design provides a snapshot of DDI knowledge and may not capture changes or improvements over time.
- The study's findings may be subject to response bias, as participants may provide socially desirable responses.

CONCLUSION

An assessment of healthcare professionals' knowledge revealed differences in their understanding of the DDIs based on their profession. A better understanding of these variations can lead to improvements in patient safety and the standard of healthcare delivery through the enhancement of DDI knowledge through targeted educational interventions.

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