GMR
The Original

PHARMACISTS AND PHYSICIANS PERSPECTIVES ON DOSAGE FORM-RELATED AND MEDICATION SAFETY FACTORS IN REDUCING MEDICATION ERRORS: A CROSS-SECTIONAL STUDY

Abdulsalam Q. Almashhadani[1]*, Obaida A. Albarazanchi[2], Bilal Harieth Alrimawi[3], Mohamad Dayoob[4], Mohammad G. Al-Thiabat[5]

[1]College of Pharmacy, University of Al Maarif, Al-Ramadi 31001, Al Anbar, Iraq, salam_qahtan@yahoo.com
[2]College of Pharmacy, Pharmaceutical Department, Al-Farahidi University, Baghdad, Iraq, salamlion7@yahoo.com
[3]Michael Sayegh Faculty of Pharmacy, Aqaba University of Technology, Aqaba, Jordan, brimawi@aut.edu.jo
[4]Department of Pharmacology and Pharmacy, LKS Faculty of Medicine, The University of Hong Kong, Pok Fu Lam, Hong Kong SAR, China, mdayoob@hku.hk
[5]Department of Pharmacy, Faculty of Pharmacy, Jerash University, P.O. Box 311, Jerash 26150, Jordan, mohamaddayoob@mahsa.edu.my

ABSTRACT

Medication errors have continued to pose one of the most critical issues to global healthcare systems. To improve patient safety and to reduce the risks concerning the use of medications, it is better to be aware of the views of healthcare professionals. Hence, this study aims at investigating the perception of the pharmacists and physicians about medication errors and other pertinent issues. The survey was conducted to 200 health care practitioners in Iraq, in a cross-sectional survey. The data were analysed by employing a validated questionnaire (Cronbach's alpha = 0.86) and using SPSS software version 24 with a significance level of $p < 0.05$. Results revealed that participants showed strong agreement regarding the significance of educating patients, medication labeling, and the use of appropriate medication in minimizing medication errors. No significant differences were observed by gender or years of experience. Meanwhile, physicians were more likely than pharmacists to associate oral solid dosage forms with increased medication-error risk.

KEYWORDS: healthcare professionals; medication errors; dosage forms; patient safety

1. INTRODUCTION

Dosage form design plays a crucial role in pharmaceutical care, as it contributes to therapeutic efficacy and helps minimize medication-related errors.1 In addition to being the vehicle through which the drug will be delivered, the dosage form determines how fast, extensively, and at what site the drug is absorbed and therefore its pharmacokinetics and pharmacodynamics.2 An appropriately designed dosage form makes it possible to achieve maximum efficiency, safety, and effectiveness, making sure that patients adhere to the treatment regimen. This is viewed as one of the key factors influencing therapy outcomes.3

It is necessary to develop an overall approach to selecting the most appropriate dosage form by taking into consideration certain factors.4

Pharmacists are often the final healthcare professionals involved before medication use and therefore could be viewed as an effective measure in preventing pharmaceutical errors. Pharmacological errors still occur in any health care setting and constitute one of the leading causes of avoidable adverse outcomes among patients.5 The pharmacists and physicians play a crucial role in reducing these errors by employing various strategies. They are educating patients about correct dosing and administration, reconciling medications to address discrepancies in prescriptions, and observing patients' reactions to the treatments. In addition, the incorporation of these strategies in health care delivery helps reduce medication errors as well as improve treatment outcomes.6

Comprehensive medication review may help optimize therapy and reduce medication errors and help the patient use them appropriately, thus preventing medication errors. Medication errors should be reported to prevent their reoccurrence and ensure that the health care system becomes safe. It is equally important for the physician to communicate with the patient on drug sensitivity because it will help prevent any adverse drug reaction, especially in instances when the kidney or liver function has been impaired, and doses need to be adjusted depending on the level of dysfunction.7

As per the findings of previous studies, dosing-related prescribing errors are quite common. For instance, according to the meta-analysis carried out by Alhomoud et al., inappropriate doses are one of the most common prescription mistakes committed by healthcare professionals.8 Moreover, from the study of error patterns in pharmacological interventions, it can be observed that inappropriate dosage strength and duration often result in unfavorable consequences. In addition, the advent of modern techniques in pharmacy has emphasized the significance of formulation design in enhancing therapeutic outcomes and decreasing adverse events.9

Statistical data demonstrates the extensive frequency of drug errors in healthcare settings. In acute care hospitals, around 6.5 medication errors occur per 100 patients.9 Medication-related errors occur in 5% to 41.3% of all

hospital admissions and 22% of readmissions after discharge. Patients who take five or more drugs are 30% more likely to make such errors, as are those aged 75 and up (38%).10 Medication errors are a major cause of preventable healthcare harm worldwide. Drug absorption, patient adherence, and administration accuracy depend on pharmaceutical dosage forms, affecting medication safety.11 Physicochemical pharmacological properties, mode of administration, and patients' factors influence the choice of dosage forms. Pharmacists and physicians ensure proper use of drugs by means of prescribing, dispensing, counseling, and monitoring.

Medication errors are a multidimensional and ubiquitous problem of modern healthcare delivery systems with important consequences to patient morbidity, mortality and the socioeconomic health services burden at large. Medication errors have been estimated to harm millions of patients annually all around the globe as millions of dollars of unnecessary healthcare costs are added to the burden of healthcare expenses.21,22 These issues are amplified in resource-constrained environments such as in Iraq through issues such as shortages of workforce, ineffective infrastructure to support medication management systems, poor access to further professional education, and a relative lack of local research evidence on which to base policy and practice.

Pharmaceutical dosage form selection and design is a cornerstone of clinical pharmacotherapy which is often not given due attention to in terms of discussing medication safety. The characteristics of dosage forms such as, but not limited to, physical state, route of administration, release profile, organoleptic properties, and unit dose container directly affect the risk of administration mistakes, patient compliance and effect of therapy. For instance, the difficulties of dividing pills, dosing liquids or the delivery of parenteral drugs under less-than-optimal circumstances creates particular risk of error that vary considerably across dosage groups. Although strong oral dosage forms are the most common type of medications prescribed globally, they have specific issues regarding difficulty in swallowing, confusion between prescribed medications by lookalike and incorrect frequency of dosing.23 In contrast injections are increased in danger of contamination, inaccurate calculation when preparing the dosage and wrong route of administration.

As the last point of contact before a drug is given to a patient, pharmacists are in a uniquely-placed position in the healthcare continuum. The scope of their professional duties goes beyond the proper dispensing of prescribed drugs to also verifying the suitability of the dosages, any possible drug interactions, counselling the patients and taking an active role in the interprofessional drug review procedures.24 Physicians are on the other hand the ones who are first responsible in the prescribing decision which is the choice of the most suitable therapeutic agent, dose form, dose, route and frequency of administration. The two professional groups thus have a complementary set of competencies in preventing medication errors and it is pertinent to understand where the views of the two are similar or different so that specific educational and systemic interventions can be developed.

The pharmacist-physician interface of preventing medication errors in the Iraqi healthcare setting has been properly investigated with several studies showing limited systematic investigation. Before this research, the evidence that existed on the rates and types of medication errors in Iraq was mostly anecdotal or based on reported incidences, and few utilised standardised, validated tools. Additionally, the comparative studies of perception in the professional categories, among the demographic groups or among the levels of experiences had not been done appropriately. This gap stimulated the current study that aimed to give structured evidence-based understanding on the attitudes and beliefs of the pharmacists and physicians on the dosage form factors and the medication safety factors in relation to the protection of medication errors.

In this way, by finding areas where there is common ground between two scientists, researchers and policymakers can strengthen shared best practice and use professional consensus as a foundation towards clinical guidelines. In comparison, diversification areas can indicate an unmet education need or gaps in the system, which need specific efforts to address. The information about the differences (or similarity) in perceptions by gender and the years of professional experience is also helpful in terms of inclusiveness and sustainability of professional training.

There have only been a few attempts at comparing opinions held by pharmacists and physicians about dosage form importance regarding reducing medication errors, particularly in less developed nations such as Iraq.

This study aimed to: (i) investigate strategies for reducing medication errors related to dosage forms, (ii) compare pharmacists' and physicians' perspectives, (iii) assess differences according to gender, and (iv) assess differences according to years of experience. The study tested the following hypotheses:

- There are no statistically significant differences between the opinions of pharmacists and physicians regarding the effect of pharmaceutical dosage forms in reducing medication errors.
- There are no statistically significant differences between sample members according to the gender variable.
- There are no statistically significant differences between sample members according to the years of experience variable.

2. MATERIALS AND METHODS

2.1 Study Area and Study Design

Iraqi licensed pharmacists and physicians participated in this descriptive cross-sectional study. Staff members in public and private hospitals, community pharmacies, and outpatient clinics in Baghdad and Al-Anbar governorates provided data. The study was conducted between June and August 2025. All registered pharmacists and physicians in Iraq under the Ministry of Health and the professional regulatory authority oversight were studied. Accessible institutional staff lists and professional networks in chosen healthcare facilities formed the sampling frame.

The minimum sample size was estimated using a two-proportion formula to detect a 20% difference in agreement between pharmacists and physicians, resulting in a sample size of 97 participants per group (total N = 194). However, due to differences in professional workforce distribution and voluntary participation rates, the group numbers were unequal (152 pharmacists and 48 physicians). The total sample size (N = 200) exceeded the minimum required overall sample size, and statistical analyses were carried out using methods that can handle unequal group sizes.

To ensure accessibility, convenience sampling was used to select participants. The STROBE standards for cross-sectional research were followed in this study.12

The research was conducted by the best practice standards of conducting a cross-sectional research on health services. The selection of healthcare facilities to take part in the study was done by geographic representation and diversity of professionals including both urban and semi-urban locations in Baghdad and Al-Anbar governorates. The reasons why these areas have been chosen have to do with the fact that these regions are contrasting in terms of healthcare settings such as Baghdad, a capital area, is characterised by highly developed tertiary hospitals and specialised outpatient services, whereas Al-Anbar is a province with rather limited resources. This strategic geographical difference enhances the extrapolability of the results on practice settings in different settings in Iraq. The convenience sampling was used to recruit subjects. The participants were contacted during work hours in their respective healthcare facilities face-to-face, ensuring that they were eligible participants. Questionnaire was administered by research assistants, who clarified the purposes of the study and gave it to the participants who agreed to participate in the study. The survey was self-administered which means that the participants could have some time to fill out the survey. To minimise the biasness of the responses, researchers explained that there were no correct and incorrect answers and that their answers would remain strictly confidential. Sealed envelopes were used to send questionnaires.

A comprehensive search of the published literature on the types of medication errors, risks related to dosages forms and pharmaceutical care practice would inform the development of the study instrument. The initial items were created by reviewing validated questionnaires of similar studies, and then the research team conceptualised to narrow down to final items. After the preliminary development, the instrument was discussed with a team of five experts consisting of the academic pharmacists and clinical physicians that have knowledge of the medication safety and pharmaceutical sciences. Reviewing their feedback led to content validity revision and every item was put in a clear wording, contextually appropriate and aligned with conceptual framework of the study.

A pilot study was then done on 20 non-participants in the main sample amongst healthcare professionals. The aim of the pilot was to determine the level of clarity and understanding of items, approximate average time to complete the questionnaire and to identify any technical problems with the questionnaire administration. Some small changes were conducted on the wording of the items, depending on the pilot feedback, before the main data collection phase. The average time taken to complete was around 8-10 minutes.

The questionnaire was conducted in English as it is apparent that all licensed pharmacists and physicians in Iraq are professionally educated in English (and have to prove their proficiency in English, as part of their licensing terms and conditions). The study had a bilingual research assistant to elucidate any terminological question which was necessary.

To reduce the issue of error when entering data, data entry was done through a double entry confirmation method. Listwise deletion was used to handle any missing data where the item has a greater non-response at the item level (>10%). The entire dataset was subjected to the reliability analysis in terms of Cronbachs alpha and sensitivity analysis revealed that the estimates of internal consistency did not change whether the cases with any missing values were used or not.

2.2 Inclusion/Exclusion Criteria

The inclusion criteria were licensed pharmacists and physicians in Iraq with at least one year of hospital, community pharmacy, or outpatient clinical experience. Participants who consented and were actively practicing professionally during the study were eligible, regardless of gender, age, or occupational sector. Healthcare students and interns, and practitioners under one year were excluded. The final analysis removed incomplete questionnaires or replies with significant missing data. Based on these criteria, 200 healthcare workers were studied.

2.3 Study Population

The study population consists of 200 healthcare providers, including 152 pharmacists and 48 physicians from Iraq. Gender distribution: 102 females and 98 males. Years of experience: <5 years (142), 5–10 years (25), >10 years (33).

2.4 Study Instrument and Variable Measurement

The study instrument was developed after a complete literature evaluation on dosage form–related medication error and medication safety risk factors. The English questionnaire assessed healthcare professionals' views on how pharmaceutical dosage forms reduce prescription errors. The instrument had two parts. The first part collected respondents' socio-demographic and professional data, including profession (pharmacist or physician), gender, and years of experience. The second part had 20 constructed statements to assess participants' agreement with

dosage form–related medication errors prevention variables. The items covered dosage form selection, labeling clarity, dose determination, route of administration, convenience of use, patient education, safety, and interprofessional collaboration. These perception items served as the study's dependent variables, whereas socio-demographic and professional traits were independent. All perception items were measured on a five-point Likert scale (5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly disagree). Higher scores indicated stronger agreement. The total perception score was derived by adding the responses across the 20 items, producing a possible score range of 20–100.

2.5 Construction Validity and Reliability

The construct validity of the 20-item perception scale was examined using exploratory factor analysis. A Kaiser–Meyer–Olkin (KMO) value of 0.799 indicated adequate sampling adequacy for factor analysis. A significant Bartlett's test of sphericity ($\chi^2 = 893.09$, $p < 0.001$) indicates that item correlations are sufficient for factor extraction. Principal component analysis with varimax rotation was used, and factors with eigenvalues >1.0 were retained. A four-factor structure explained 33.9% of the variance. Factor loadings ≥ 0.40 classified items as relevant and retained within their scopes. Patient education and safety, dosage form selection and design clarity, administration characteristics, and dose determination were recognised as critical dosage form and pharmaceutical safety aspects. Internal consistency reliability was assessed using Cronbach's alpha. Overall, the scale showed high dependability ($\alpha = 0.86$), above the minimum criteria of 0.70.

2.6 Ethical Approval

This study was approved by the College of Pharmacy Ethical Approval Committee, University of Almaarif, Iraq (Ref. No. 55; 4 April 2025). Participation was voluntary and anonymous, and informed consent was obtained before application of the questionnaire.

2.7 Data Analysis

Statistical analysis was conducted with IBM SPSS Statistics, Version 24. Descriptive statistics, including means and standard deviations, were computed for each of the 20 survey items. Independent-samples *t*-tests were performed to examine variations in participants' perceptions about binary variables (gender and professional title: pharmacist versus physician). A one-way analysis of variance (ANOVA) was employed for multi-category variables, such as years of experience. The significance threshold was established at p-value < 0.05 for all statistical analyses.

3. RESULTS

In terms of sociodemographic and professional profile of the sample, 200 healthcare professionals (including 152 pharmacists (76%), 48 physicians (24%)) were enrolled in the study. The sex distribution was equal as 102 female participants (51%) were involved and 98 male participants (49%). Regarding years of work experience, most of the participants were less than five years (n = 142, 71%) and this is aligned with the age of younger workforce, as is the common case in healthcare institutions in the regions of the study. A lower percentage (n = 25, 12.5%) had a between five and ten years of experience and 33 participants (16.5%) had more than ten years of professional experience.

The mean perception score of all the 20 items was 4.18 (SD = 0.48) which means that the agreement of all factors related to the dosage form and pharmaceutical care were generally high towards the minimisation of medication error. The highest mean scores were obtained by teaching patients about the correct dosage and how to take medicine (Item 13, mean = 4.36), reducing medicine errors, informing patients and caregivers to do so (Item 15, mean = 4.34), focusing on the five rights of medication administration (Item 17, mean = 4.31), tailoring dosing to patients with organ dysfunction (Item 18, mean = 4.31), finding it difficult to determine the correct dosage (Item 3, mean = 4.31), and the instructions being unclear (Item 4, mean = 4.32). The overall results highlight a general trend in professional opinion of patient education, counselling and personalised management of dosage as the most valued policies to prevent errors.

Simultaneously, the lowest mean score suggested that Item 5 was the most likely item to have the highest mean score (mean = 3.07, SD = 0.98) with respect to whether oral solid dosage forms are most likely to be connected with an increase in medication errors. This observation implies that participants as a group did not highly recommend oral solid dosages forms as the main high-risk group though this trend was highly tempered with professional category, as is discussed in the section below.

In all four explored factors found by the principal component analysis, patient education and patient safety-related items were always the highest followed by the dose form selection, and design clarity-related items. Questions related to administration route traits, and dose decisions were rated slightly lower, but with a very high mean score, which confirms the multifactorial approach in the perceptions of the participants with medication errors prevention.

Regarding the study's first objective, participants were asked to evaluate various assertions about formulation qualities and pharmaceutical care procedures that prevent medication errors. Table 1 shows the statistical data for these questions, including mean scores, standard deviations, and study item rankings. It is worth noting that most items had mean values greater than 4.00, indicating that the participants agreed very strongly on the importance

of these criteria in reducing drug errors. One of the lowest mean scores was reported for the item about the risk of oral solid dose forms contributing to drug errors (mean = 3.07). The top-ranked factors included patient education, carer education, and clear directions. In conclusion, the preceding findings indicate that pharmacists and physicians agree on the importance of these factors.

Table 2 shows the comparison of responses between pharmacists and physicians. There was no statistically significant difference between the two groups on the majority of items used in the study except for one item, i.e., oral solid dosage form, where a statistically significant difference ($p = 0.03$) was found as physicians scored it significantly higher in relation to increased risks of medication errors compared to pharmacists. In other words, the similarity between pharmacists and physicians responses indicates that both groups agreed on the impact of dosage form and medication safety strategies to minimize medication errors.

Table 3 presents the comparison according to gender. No statistically significant differences were found between male and female participants across the study items. The mean scores were highly comparable between the two groups, indicating a strong degree of consistency in perceptions regarding the strategies assessed for reducing medication errors.

Moreover, Table 4 presents the comparison according to years of professional experience. No statistically significant differences were observed among the three experience groups. Nevertheless, the average value of all scores tended to be slightly higher with respect to longer duration of experience as follows: participants with experience lower than five years had an average score of 4.14, those with 5 to 10 years of experience scored 4.18 on average, and those with more than 10 years – 4.28.

Table 1 Mean scores, standard deviations, and significance ranking of factors influencing medication errors due to drug dosage forms and medication management

Rank	SD	Mean	Item	Item Number
15	0.82	4.13	Drug dosage forms (oral solid dosage (tablets, capsules and syrup), injection, suppositories, and topical dosage forms) reduce medication errors	1
10	0.76	4.20	Similar names or appearances between medications lead to medication errors.	2
5	0.74	4.31	Difficulty determining the appropriate dose leads to medication errors.	3
3	0.73	4.32	Lack of clarity in instructions leads to medication errors.	4
19	0.98	3.07	Oral solid dosage forms (tablets and capsules) are most likely to be associated with increased medication errors.	5
12	0.81	4.14	Ease of use medication dosage reduces medication errors.	6
17	0.77	4.10	Positive previous drug dosage experiences reduce medication errors.	7
18	0.87	3.77	The injections are fast acting and avoid gastrointestinal disturbances, thus reducing medication errors.	8
14	0.77	4.13	The dosage form desired by the patient leads to adherence to it, which reduces medication errors.	9
13	0.74	4.13	Improving the design and clarification of dosage forms can reduce medication errors.	10
11	0.74	4.16	Choosing the appropriate dosage form affects reducing medication errors?	11
9	0.74	4.27	Medication errors can be reduced by collaborating with other healthcare professionals to develop patient-centered medication management plans.	12
1	0.71	4.36	Teaching patients the proper dosage and how to take their medication reduces medication errors.	13
7	0.72	4.28	Patients can be engaged to identify barriers to medication adherence and develop strategies to overcome them.	14
2	0.72	4.34	Reducing medication errors by educating patients and caregivers about the safe and effective use of medications.	15

Rank	SD	Mean	Item	Item Number
8	0.71	4.27	Medication errors can be reduced by providing guidance on medication therapy.	16
4	0.71	4.31	To reduce medication errors, the pharmacist emphasizes the five rights, (medication, dose, time, route, and patient).	17
5	0.74	4.31	Adjusting the drug dosage for patients with liver and kidney dysfunction to avoid toxicity, which reduces medication errors.	18
6	0.75	4.31	Encouraging reporting of medication errors is crucial to reducing them.	19
16	0.80	4.12	Lack of training for medical staff causes medication errors.	20

Table 2 Differences between pharmacists and physicians in item scores

Item Number	Pharmacists		Physicians		p-value (t-test)
	Mean	SD	Mean	SD	
1	4.09	0.72	4.29	0.80	0.18
2	4.16	0.81	4.38	0.65	0.13
3	4.29	0.74	4.43	0.68	0.32
4	4.34	0.73	4.26	0.71	0.71
5	3.01	0.97	3.48	0.96	**0.03***
6	4.13	0.80	4.19	0.77	0.67
7	4.11	0.78	4.10	0.73	0.95
8	3.79	0.85	3.67	0.77	0.50
9	4.13	0.78	4.10	0.73	0.85
10	4.13	0.75	4.19	0.68	0.67
11	4.18	0.75	4.10	0.73	0.57
12	4.27	0.75	4.29	0.71	0.90
13	4.36	0.71	4.38	0.70	0.92
14	4.28	0.72	4.29	0.71	0.97
15	4.34	0.73	4.33	0.73	0.96
16	4.27	0.71	4.29	0.71	0.91
17	4.34	0.72	4.38	0.70	0.84
18	4.32	0.74	4.29	0.71	0.97
19	4.32	0.75	4.29	0.71	0.86
20	4.13	0.80	4.19	0.77	0.75

* Indicates significant difference ($p \leq 0.05$)

Table 3 Differences in item scores by gender (102 female, 98 male)

Item Number	Mean Male	SD Male	Mean Female	SD Female	p-value (t-test)
1	4.13	0.76	4.16	0.82	0.80
2	4.12	0.86	4.26	0.73	0.32
3	4.30	0.75	4.31	0.74	0.97
4	4.24	0.74	4.36	0.73	0.36

Item Number	Mean Male	SD Male	Mean Female	SD Female	p-value (t-test)
5	3.08	1.01	3.10	0.98	0.95
6	4.12	0.81	4.17	0.82	0.73
7	4.12	0.78	4.11	0.77	0.96
8	3.78	0.88	3.77	0.88	0.98
9	4.09	0.77	4.17	0.77	0.57
10	4.13	0.76	4.13	0.73	0.99
11	4.17	0.73	4.16	0.75	0.97
12	4.23	0.75	4.30	0.73	0.71
13	4.31	0.74	4.36	0.71	0.73
14	4.27	0.72	4.29	0.72	0.92
15	4.32	0.72	4.34	0.72	0.88
16	4.24	0.73	4.29	0.73	0.76
17	4.36	0.72	4.34	0.71	0.91
18	4.29	0.73	4.33	0.74	0.82
19	4.30	0.74	4.32	0.75	0.91
20	4.13	0.80	4.13	0.80	1.00

* Indicates significant difference ($p \leq 0.05$)

Table 4 Differences in item scores by years of professional experience

Item Number	< 5 yrs Mean	< 5 yrs SD	5–10 yrs Mean	5–10 yrs SD	> 10 yrs Mean	> 10 yrs SD	p-value (ANOVA)
1	4.06	0.79	4.22	0.72	4.30	0.76	0.37
2	4.13	0.81	4.29	0.72	4.30	0.67	0.52
3	4.27	0.76	4.36	0.69	4.43	0.68	0.46
4	4.27	0.75	4.36	0.71	4.39	0.68	0.67
5	3.10	0.97	3.00	0.97	3.30	0.95	0.64
6	4.13	0.79	4.14	0.82	4.26	0.74	0.78
7	4.10	0.77	4.14	0.74	4.22	0.67	0.76
8	3.76	0.87	3.70	0.81	3.87	0.82	0.91
9	4.11	0.77	4.14	0.75	4.26	0.74	0.80
10	4.11	0.75	4.21	0.70	4.26	0.74	0.68
11	4.15	0.75	4.21	0.73	4.26	0.74	0.81
12	4.25	0.75	4.29	0.71	4.39	0.68	0.77
13	4.34	0.72	4.36	0.71	4.48	0.67	0.81
14	4.27	0.72	4.29	0.71	4.39	0.68	0.85
15	4.33	0.72	4.36	0.71	4.48	0.67	0.81
16	4.25	0.74	4.29	0.71	4.39	0.68	0.77
17	4.33	0.72	4.36	0.71	4.48	0.67	0.81
18	4.39	0.73	4.36	0.71	4.48	0.67	0.73
19	4.30	0.74	4.36	0.71	4.48	0.67	0.75

Item Number	< 5 yrs Mean	< 5 yrs SD	5–10 yrs Mean	5–10 yrs SD	> 10 yrs Mean	> 10 yrs SD	p-value (ANOVA)
20	4.13	0.80	4.14	0.77	4.30	0.74	0.74

* Indicates significant difference ($p \leq 0.05$)

4. DISCUSSION

The present study explored pharmacists' and physicians' perspectives on the role of dosage form-related factors and pharmaceutical care practices in reducing medication errors. The findings showed strong agreement across most study items, particularly those related to patient education, safe medication use, and clarity of instructions. These findings highlight the importance of communication and counselling as central strategies in medication-error prevention. In support of these results, a review of 28 studies conducted in Saudi hospitals reported that improper and incorrect dosing was among the most frequently identified medication errors. Likewise, the high scores observed for patient- and caregiver-education items in the present study suggest that participants consider these interventions essential for safer medication use.13 Effective counselling by pharmacists and physicians can improve adherence, increase patient understanding of therapy, and ultimately reduce medication-related problems.14–16 Furthermore, using multiple therapies may negatively affect patient compliance and burden of treatment.17 Medication errors can be extremely dangerous to children, thus making it important to focus more on pediatric health care services. Such risks may be reduced by training healthcare professionals to use computerized prescribing systems, consulting clinical pharmacists regarding dosage, and adjusting doses according to patient age, body weight, and organ function.18

With regard to professional differences, the findings showed substantial similarity between pharmacists and physicians for nearly all study items. The only significant difference concerned oral solid dosage forms, which physicians were more likely than pharmacists to associate with increased medication-error risk. This may reflect differences in professional responsibilities. Physicians may consider the importance of solid oral forms more strongly than pharmacists, possibly because the physicians are more directly involved in prescribing drug doses for particular areas of treatment, while the latter has an occupation spanning a wider array of medicinal products and forms. Nonetheless, it can be noted that there is an underlying similarity in their answers. Previous studies have focused mainly on pharmacists' roles in reducing medication errors, whereas fewer studies have examined the perspectives of both pharmacists and physicians together. This makes the current comparison valuable in identifying areas of agreement between the two professional groups. Collaboration between pharmacists and physicians may also contribute to improved outcomes. For example, a previous study reported in a review of 37 studies that pharmacist-led interventions coordinated with physicians reduced hospital readmissions by up to 13% overall and by 22% within the first 30 days after discharge.6

The results did not show any significant difference among gender groups. This implies that perceptions of medication safety practices depend on professional training, clinical experience, and familiarity with the subject rather than demographic factors. Similarity in answers between male and female respondents further validates the strategies and shows that these findings suggest broad agreement on their importance in minimizing medication errors. Any slight numerical differences noted do not carry any clinical significance but may be attributed to contextual differences and personal practices.18,19

In addition, no significant differences were also found based on the number of years of professional experience, despite some indication of higher average scores based on increased years of professional experience. This may point to the fact that professional experience is related to improved accuracy in diagnosis and understanding of medication safety concepts. Both pharmacists and physicians who have been practicing for longer periods of time may be better equipped at distinguishing between look-alike and sound-alike drugs and managing prescriptions. They may also be more likely to follow safety procedures and learn from previous errors. This interpretation is consistent with the findings of those who reported an inverse relationship between clinical experience and the frequency of medication errors.

Overall, the findings of the present study indicate broad agreement among healthcare professionals on the importance of patient education, labeling clarity, dosage form optimization, and interprofessional collaboration in reducing medication errors. The highest-ranked items emphasized counselling and adherence support, reinforcing the importance of education in promoting medication safety. The findings also showed that pharmacists and physicians shared largely similar perceptions, while gender and years of experience did not significantly influence responses. Together, these results support the need to integrate pharmaceutical formulation considerations with routine clinical practice in order to improve patient safety and reduce medication errors.

This trend of high consent scored in most of the items in this study is identical to an emerging world of evidence on the primary role of communication, education and systematic medication management in error prevention. Studies done in different healthcare systems have always found a shortage of patient knowledge, poor labelling and insufficient counselling are repeat factors in causing preventable harm due to medication.25 These conclusions are supported by the findings of this study in the context of the Iraqi healthcare, presenting a regionally specific evidence to back the argument about the need to enhance the pharmaceutical education and interprofessional clinical communication.

Interestingly enough, objects connected with the focus on highlighting the five rights of medication administration and promoting the occurrence of medication errors reports were the ones with the highest scores in the study. The five rights model of the right medication, right dose, right time, right route and right patient is a cornerstone of safety measures that are imparted universally to pharmacy and medical students.27 Its top position is a testament of the long-term importance practitioners accorded to this systematic method, throughout their career. Similarly, the firm support of the error-reporting as a prevention strategy should be associated with the principles of patient safety that contend with the promotion of non-punitive culture of reporting and the learning system of adverse events and near-misses. Practically, in most of the low and middle-income country environments, such as by Iraq, error reporting has not been put into practice yet, and the rationales of fear of professional retribution and systemic obstacles might deter disclosure. The high level of attitudinal support which is evident here is thus a good platform in which policies and reporting systems in the institutes can be made.

The fact that the pharmacists and the physicians had a significant similarity in their perspective in all the domains has significant implications on interprofessional collaboration. The demonstration of convergent attitudes to medication safety by two professional groups, which are different in terms of clinical preparation and responsibilities, and the work with patients is an indication that universal professional values, which are formed during the education process and licensure are functioning as intended.24 The practical implication of this consensus into the design of joint continuing professional development activity and interdisciplinary medication review activities can also be made. Workplaces where pharmacists and physicians have similar safety models would be most capable of generating more aligned, and effective error-preventive approaches as opposed to works that are typified by professional silos.

The only point of high difference, which is the increased propensity of physicians to identify oral solid form of dosages with increased risk of medication errors deserves keen attention. Oral solid dosage forms (such as tablets and capsules), are the most common type of medication that is prescribed, and are also the most frequently misinvolved in dispensing, administration, and errors in adherence. This ranking of this risk as higher by physicians than by pharmacists could be indicative of awareness of patient-reported challenges to swallowing a tablet especially in the elderly or pediatric population where this could be problematic.23 It can also be based on direct clinical experiences of prescribers with patients who have had adverse experiences in regard to getting the wrong dose of solids. The relative hazard of oral solids, as compared to the other, high-risk categories, may weigh differently with pharmacists, whose training focuses more on a wider range of dosage form categories, such as injectables, topical preparations, and controlled-release systems. The interpretation needs to be put to the test in the future in a qualitative study that tries to elaborate on reasoning of these professional differences deeply.

The lack of strong gender differences is part of a literature indicating that pharmaceutical and medical training, in the form of standardisation and competency-based training, was more likely to generate uniform attitudes of professionals in terms of their demographic traits. Although some studies have linked gender to the variation in communication style and empathy, it has minimal effect on the attitude towards technical safety, when professional training is kept as constant. The positive implications of this finding are that the existing training paradigm of pharmacy and medicine in Iraq is a good indicator that, despite the differences between the genders in medicine, the competencies of medication safety are similar in the case of the two genders.

The median tendency to increased mean scores in the samples that included over ten years of professional experience, although not statistically significant deserves extended research on bigger samples. The trend is that over time clinical experience can be expected to enhance practitioners in understanding the factors contributing to medication errors. The experienced practitioners might have developed a broader spectrum of error type, be involved in more complex medication management situations and acquired more pattern recognition on high-risk situations.26 The changes in medication safety attitudes in relation to career stage would be better evidenced by longitudinal studies that monitor changes in medication safety attitudes over a career.

Politically, the study results underpin the argument of incorporating the dosage form considerations in undergraduate pharmacy and medicine programmes, postgraduate education and training programmes, and the continuing professional development models in Iraq. On an institutional level, the level of professional consensus could be exploited by leading hospitals and community pharmacies to put in place collaborative medication review systems, formal patient counselling system, and standard labelling system. It can also be of value to the national regulatory bodies to come up with evidenced based guidelines that deal with the error risks presented by different dosage form categories with special consideration of oral solid formulations since there is a strong divergence in their use as witnessed by the various workers.

This research has several limitations other than those mentioned above. The cross-sectional design does not allow causality to be drawn between the attitudes, and real medication error prevention practices. The objective measures of medication safety performance (dispensing errors rate or prescription review results) and self-reported perceptions should be included in future research. The sample size of the participants was a small population (Baghdad and Al-Anbar) and, thus, could not be generalised to other Iraqi governorates with different healthcare infrastructure or culture. Additionally, voluntary character of the participation also leads to the issue of self-selection bias in that practitioners might have been more inclined to join the study with better interest in medication safety.

There are several limitations that should be considered when interpreting the results of this study. The unequal distribution of participants between the two professional groups, particularly the smaller number of physicians,

may have reduced the statistical power of group comparisons. In addition, the study assessed self-reported perceptions rather than actual medication-error practices, which may have introduced response bias or social desirability bias. This conclusion is supported by the studies that found a negative correlation between the level of clinical experience and the occurrence of medication errors.20

In summary, the results obtained in this study suggest that healthcare workers have common grounds regarding the significance of patient education, clear labelling, improved dosing formulations, and cooperation across professions for the reduction of medication errors. The highest-ranking factors focused on counseling and compliance improvement, highlighting the relevance of education in ensuring medication safety. The results further indicated that pharmacists and physicians hold similar viewpoints, while gender and years of professional experience did not significantly influence responses. In conclusion, this study supports the necessity of combining pharmaceutical formulations into everyday clinical practice.

5. CONCLUSION

The results of this study highlighted the significance of pharmaceutical dosage form as a factor minimizing medication errors in Iraq, according to pharmacists and physicians. Indeed, there was high-level agreement concerning the effectiveness of certain measures in treating errors like educating patients, choosing proper dosage form, and working cooperatively among health care providers.

It should be mentioned that, despite high-level agreement, physicians showed greater concerns regarding oral solid dosage forms. This can be explained by the fact that it is associated with physicians' roles related to prescribing medications.

Also, it was found that there were no significant differences depending on the gender and work experience. As such, professional training appears to play a central role in improving pharmaceutical safety competencies among health care providers. Nonetheless, the slight trend shows that work experience may be associated with greater awareness of medication errors.

These findings highlight the need for more collaboration between pharmacists and physicians, as well as continued education and support for healthcare policy, to improve pharmaceutical safety outcomes.

The implications of this study on the pharmaceutical practice, medical education and healthcare policy in Iraq and similar resource-restrained environments are enormous. The fact that the participants are in high agreement with each other on the importance of patient education, use of clear labels on medications, their selection of the proper dosage form, and organised counselling strategies might indicate that not only pharmacists in Iraq but also physicians are subject to a consistent theory on how to comprehend and respond to medication errors. This practitioner agreement is a significant resource to use in putting up aligned, system-wide measures to safety of medication.

The future studies could aim to build on the current results because, using longitudinal designs, the effect of the professional attitude on the change over time and its connections to the observed rates of medication errors in clinical practices will be measured. To further elaborate on the interprofessional relationships involved in the dosage form-related errors, expanding the study to other healthcare workers (such as nurses) that are important participants in the delivery of medication would be quite insightful. Moreover, qualitative approaches, such as focus groups and in depth interviews might help to get more insight into the contextual factors and lived-in information, which these quantitative trends are beginning to be based on.

On an applied level, constructing formal structures of pharmacist-physician collaboration in Iraqi healthcare facilities such as joint medication review committees, clinical pharmacist-on-ward programmes, formal interprofessional communication protocols, would make a pragmatic, evidence-based attempt at converting the common professional attitudes into tangible patient safety results. Another alternative that policymakers need to think about is the encouragement of medication errors reporting by non-punitive, anonymous reporting systems which could leverage the attitudinal support by practitioners towards error reporting as a prevention measure.

Thus in summary, this paper offers a comparative validation of pharmacists and physicians attitudes towards factors of dosage forms and medication safety in Iraq, which would be the first systematic study. The results confirm that there is a high level of professional consensus in the primary areas of medication error prevention but also reveal areas of significant variation that can be used in the targeted responses to education and institutional. These attitudes must be translated into better patient safety outcomes throughout the Iraqi healthcare system by sustained investment in the pharmaceutical care infrastructure, interprofessional education and development of evidence-based policies explicitly in the long term.

Declaration of Competing Interest

The authors declare no conflict of interest.

Declaration Statement for Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Funding

This research received no external funding.

Acknowledgments
The authors would like to thank all pharmacists and physicians who participated in this study for their time and valuable responses.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process
During the preparation of this work, the authors used Claude (Anthropic) to improve the language, readability, and expansion of manuscript sections. The authors reviewed and edited the output as necessary and accept full responsibility for the content of the final manuscript.

List of Abbreviations
ANOVA, Analysis of Variance; KMO, Kaiser–Meyer–Olkin; SPSS, Statistical Package for the Social Sciences; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology

REFERENCES
1. Sharma L, Prakash A, Medhi B. Ensuring medication and patient safety for better quality healthcare. Medknow; 2024. p. 375-8.
2. Ranmal SR, O'Brien F, Lopez F, Ruiz F, Orlu M, Tuleu C, et al. Methodologies for assessing the acceptability of oral formulations among children and older adults: a systematic review. Drug Discovery Today. 2018;23(4):830-47.
3. Hauber B, Hand MV, Hancock BC, Zarrella J, Harding L, Ogden-Barker M, et al. Patient acceptability and preferences for solid oral dosage form drug product attributes: a scoping review. Patient Preference and Adherence. 2024:1281-97.
4. Allen L, Ansel HC. Ansel's pharmaceutical dosage forms and drug delivery systems. Lippincott Williams & Wilkins; 2013.
5. Wittich CM, Burkle CM, Lanier WL, editors. Medication errors: an overview for clinicians. Mayo Clin Proc. 2014; Elsevier.
6. Foot H, Scott I, Sturman N, Whitty JA, Rixon K, Connelly L, et al. Impact of pharmacist and physician collaborations in primary care on reducing readmission to hospital: a systematic review and meta-analysis. Res Social Adm Pharm. 2022;18(6):2922-43.
7. Borgert C, Fuentes C, Burgoon L. Principles of dose-setting in toxicology studies: the importance of kinetics for ensuring human safety. Arch Toxicol. 2021;95(12):3651-64.
8. Alhomoud FK, Alnemari W, Alfahmi H, Alhomoud F, Cheema E. Incidence and prevalence of prescribing errors in Saudi Arabia: a systematic study. Int J Pharm Pharm Sci. 2016;8(12):194-8.
9. Oyebode F. Clinical errors and medical negligence. Med Princ Pract. 2013;22(4):323-33.
10. Tariq RA, Vashisht R, Sinha A, Scherbak Y. Medication dispensing errors and prevention. 2018.
11. Unnissa Z, Unnissa M, Khan S. A comprehensive review of medication errors in modern healthcare. J Drug Deliv Therapeut. 2024;14(5):220-8.
12. Von Elm E. STROBE initiative. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Ann Intern Med. 2007;147:573-7.
13. Tobaiqy M, MacLure K. Medication errors in Saudi Arabian hospital settings: a systematic review. Medicina. 2024;60(9):1411.
14. Patel K, Jay R, Shahzad MW, Green W, Patel R. A systematic review of approaches for calculating the cost of medication errors. Eur J Hosp Pharm. 2016;23(5):294-301.
15. 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):481-97.
16. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. QJM. 2009;102(8):513-21.
17. Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. Expert Opin Drug Saf. 2014;13(1):57-65.
18. Svensberg K, Brandlistuen RE, Björnsdottir I, Sporrong SK. Factors associated with pharmacy students' attitudes towards learning communication skills–A study among Nordic pharmacy students. Res Social Adm Pharm. 2018;14(3):279-89.
19. Kloss B. Cluster B Personality Disorders Separated by Gender Expectations. J Undergraduate Res Minnesota State Univ Mankato. 2009;9(1):7.
20. Singh S, Vahora S, Chokshi K, Solanki A, Chaudhary D, Patel S. Medication errors in relation to education and medication errors in relation to years of nursing experience. IJPRS. 2012;1:323-6.
21. Panagioti M, Hodkinson A, Planner C, Dhingra N, Gupta N. Global burden of preventable medication-related harm in health care: a systematic review. Geneva: World Health Organization; 2024.
22. World Health Organization. WHO calls for urgent action by countries for achieving medication without harm. Geneva: WHO; 2022. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9994493/
23. Harnett A, Byrne S, O'Connor J, Lyons D, Sahm LJ. Adult patients with difficulty swallowing oral dosage forms: a systematic review of the quantitative literature. Pharmacy. 2023;11(5):167.

24. Zaij S, Pereira Maia K, Leguelinel-Blache G, et al. Intervention of pharmacist included in multidisciplinary team to reduce adverse drug event: a qualitative systematic review. BMC Health Serv Res. 2023;23:927.
25. Naseralallah L, Stewart D, Price M, et al. Prevalence, contributing factors, and interventions to reduce medication errors in outpatient and ambulatory settings: a systematic review. Int J Clin Pharm. 2023;45(6):1359–77.
26. Martínez-Domínguez J, Sierra-Martínez O, Galindo-Fraga A, et al. Antibiotic prescription errors: the relationship with clinical competence in junior medical residents. BMC Med Educ. 2022;22:451.
27. Hanson A, Haddad LM. Nursing rights of medication administration. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026. Updated 2023 Sep 4.