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Original Research Article

Impact of educational intervention on the knowledge, attitudes, and practices of pharmacists towards drug interactions among cancer patients

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Abstract

Purpose: *To assess pharmacists' knowledge, attitude, and practice (KAP) regarding potential drug-drug interactions (PDDIs) among cancer patients.*
Methods: *A quasi-experimental design with a control group was conducted from May to September 2025. Forty-four pharmacists from two oncology wards, including Babylon Oncology Centre and Al Imam al-Sadeq Hospital in Babylon governorate, Iraq, were selected. The 44 participants were divided equally into 2 groups: intervention group and control group. A validated questionnaire was used to assess KAP regarding drug interactions in oncology wards before and 4 weeks after intervention. Only intervention group received the educational intervention, which included a scientific lecture, booklets, and brochures. While control group didn't receive any intervention.*
Results: *The pre-intervention KAP scores were 54.16, 66.47, and 69.77 % for knowledge, attitudes, and practices, respectively, in intervention group. Post-intervention scores of KAP of intervention group were 84.28, 90.11, and 80.07 %, respectively, which show a significant increase in all KAP domains ($p < 0.05$) in intervention group. No significant change ($p > 0.05$) was observed in control group across pre-post study phase (40.909 ± 27.053 vs 44.691 ± 23.611), (62.727 ± 10.261 vs 62.95 ± 9.214), and (67.575 ± 14.913 vs 66.515 ± 13.322) for KAP, respectively, but significant change was found when compared with intervention group ($p < 0.05$).*
Conclusion: *There is suboptimal KAP regarding drug interactions among the pharmacists assessed, and educational intervention significantly enhanced their KAP regarding drug interactions in oncology settings. Structured educational programs on PDDIs, especially in oncology settings, aim to ensure cancer patients' safety and minimize unwanted drug-related issues, which is therefore advocated.*

Keywords: *Drug-drug interaction, knowledge, attitudes, practices, cancer, educational intervention*

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INTRODUCTION

Globally, an estimated 19.3 million new cancer cases and nearly 10 million cancer-related deaths occurred in 2020, and the global burden is projected to reach more than 28 million new cases by 2040 [1]. According to global cancer estimates, approximately 16,000 new cancer cases were reported in Iraq in 2022 [2].

Cancer is characterized by uncontrolled development, proliferation, and spread of abnormal cells. Compared to the primary tumor, distant tumor metastases frequently have a

greater impact on the patient's quality of life, mortality, and the severity of symptoms. Patients with cancer have complex treatment regimens that include many medications, such as chemotherapy and supportive care, which raises the possibility of potential drug-drug interactions (PDDIs) [2]. Previous studies have reported that drug-drug interactions (DDIs) are highly prevalent among cancer patients [3].

Elderly patients and those on more than ten medications have higher rates of PDDIs [4], in contrast with pediatric patients, where PDDIs are less frequent [5]. Drug-drug interactions (DDIs) in cancer patients might result in increased illness, adverse drug reactions (ADRs), or treatment failure. Longer hospital stays and increased medical costs are associated with these outcomes, putting a heavy financial burden on the healthcare system. Drug–drug interactions have been estimated to account for approximately 5 – 30 % of adverse drug reactions in hospitalized patients and are associated with increased morbidity and healthcare costs [6]. The chance of drug interactions is increased by several risk factors, including age, comorbid conditions, including heart, renal, or liver issues, polypharmacy, extended hospital admissions, and genetic inheritance [6].

Healthcare professionals need to be able to recognize potential DDIs since medications are used extensively in medical treatment. Numerous strategies have been used up to this point to assist prescribers in locating PDDIs. Implementing automated warning systems, providing educational interventions, facilitating access to DDI information sources, and conducting performance reviews are the most often used strategies. Other strategies include an interprofessional approach of shared decision-making between clinical pharmacists and physicians in medication, as well as the need for healthcare professionals to inform and warn patients about the potential risks of pharmaceutical interactions [5,7].

Doctors, pharmacists, and other health professionals need to be able to recognize potential DDIs since medications are used extensively in medical treatment. Prescribers find it difficult to take DDI-relevant information into account when writing prescriptions because of the rapidly expanding and changing understanding of medications [8]. Numerous strategies have been used up to this point to assist prescribers in locating PDDIs. Implementing automated warning systems, providing educational interventions, facilitating access to DDI information sources, and conducting performance reviews are the most often used strategies [9]. Other strategies include an interprofessional approach of shared decision-making between clinical pharmacists and physicians, as well as the need for healthcare professionals to inform and warn patients about the potential risks of pharmaceutical interactions between two or more medications [10]. All these strategies help in avoiding PDDIs.

Pharmacists play a vital role in identifying and minimizing drug interactions in developing countries' healthcare systems. They are responsible for ensuring that patients are aware of any adverse effects and potential medication interactions [5]. So, it's essential to assess and optimize their knowledge, attitude, and practice to ensure patient safety and avoid medication errors. This study was established to assess and improve the knowledge, attitude, and practice (KAP) of pharmacists regarding PDDIs among cancer patients.

METHODS

Study design, setting, and population

A quasi-experimental study was conducted between May 2025 and September 2025 [9]. The study was directed at hospital pharmacists who worked in oncology centres or hospitals with an oncology department. A quasi-experimental study with a control group was conducted between May 2025 and September 2025. The study was directed by hospital pharmacists working at oncology centres or hospitals with an oncology department.

Due to the limited number of participants in the selected setting, an exhaustive recruitment strategy was employed. All pharmacists who were working in the Babylon Oncology Centre and Al Imam al-Sadeq Hospital in Babylon governorate, Iraq, in contact with cancer patients, and interested in participating were included. In contrast, pharmacists who worked in other departments, declined to participate in this study, or had incomplete questionnaires, were excluded.

A priori power analysis was performed using G Power software (version 3.1.9.7) to determine the optimal sample size. Based on Faul *et al*, which explains how to calculate sample size based on effect size, significance level, and statistical power, as assumed a medium effect size (d = 0.5), a significance level of 0.05, and a power of 0.80, indicating the need for 64

participants per group. Since the available population was limited (N = 47), the study included all pharmacists (Census), and the final number was 44 participants, which is sufficient to detect the large effect (d ≥ 0.8) observed in the results.

The total number of pharmacists in the two centers (Babylon Oncology Centre and Al Imam al-Sadeq Hospital in Babylon governorate, Iraq, where an automated system to detect PDDIs is unavailable where oncology pharmacists are responsible for patient care, consultation, reviewing, correcting drug related issue) who met the inclusion criteria is 47; two declined enrolment, and one had incomplete questionnaire fulfilment, so they were excluded from the study results. The final number was 44 pharmacists who completed the study.

The survey questionnaire

A structured and previously validated KAP questionnaire adapted from earlier studies on pharmacists' drug interaction knowledge was used [11]. The survey questionnaire consisted of four main parts. The first portion included eight demographic questions. The second set of questions focused on pharmacists' knowledge of PDDIs and was divided into three sections. Section A consisted of four questions about general knowledge of DDIs according to the British National Formulary 85 (BNF 85). Section B included four questions about order and compatibility. In both sections, possible answers were (yes, no, and not sure). The scoring system for sections A and B was that each correct answer earned one point, while incorrect or unsure answers received zero. Section C contained eight multiple-choice questions, each reviewed using UpToDate, Medscape, and Drug.com software for potential interactions. In the second part of section C, each correct answer earned one point, and incorrect answers earned zero. The total possible score for part 2 was 16 points.

Part 3 includes six questions to evaluate pharmacists' attitudes, using a (5-point Likert scale) divided into two sections. Section A has four questions with response options of (strongly agree, agree, neutral, disagree, and strongly disagree). Section B contains two questions with response options: (never, rarely, sometimes, usually, and always). The score for this part ranges from 6 to 30.

The fourth section included questions to evaluate pharmacists' practices regarding drug interactions in the oncology department. It consisted of two parts. The first part inquired about pharmacists' approaches to investigating drug interactions. The second part contained questions about pharmacists' practices when a drug interaction is detected. This part included six questions in total. In part 4, the scoring system for positive questions ranges from 1 to 5, corresponding to (never, rarely, sometimes, usually, and always), with an inverse scoring for negative questions. The total possible score for this section was 40 points. Questionnaire reliability was assessed using Cronbach's α. The Cronbach's α coefficients for the total questionnaire and the Knowledge, Attitude, and Practice dimensions were 0.719, 0.782, 0.803, and 0.795, respectively.

Intervention

The educational intervention was conducted at one oncology centre. Intervention group included 22 pharmacists employed there.

The educational intervention included a scientific lecture, booklets, and brochures. A researcher and an academic expert in clinical pharmacy reviewed and validated them. Intervention was structured as follows:

A scientific lecture was given by the researcher, lasting about half an hour; the PowerPoint slides were sent electronically to the participants immediately afterward. The lecture covered all three aspects of the knowledge: general PDDIs information, compatibility, and the order of administration, as well as examples of clinically relevant or guideline-highlighted PDDIs among cancer patients. Additionally, the researcher explained examples of software that may help facilitate their duties. The lecture also emphasized their obligation and critical role in DDI avoidance.

Booklets were delivered by hand to each participating pharmacist, containing information about drug-drug interactions and chemotherapeutic orders.

Brochures illustrated the compatibility between anticancer and fluid, and with each other. Three brochures were kept in the oncology department for long-term benefit.

Face-to-face interviews to assist them in understanding the information in the booklet and brochures. As in the pre-intervention phase, the same questionnaire was given to all participants in both control and intervention phases four weeks after intervention, and data were collected to assess the intervention's effect.

Statistical analysis

Descriptive statistics summarized the characteristics of the study participants using counts and percentages. Mean ± standard deviations, or median (Q1-Q3), are used to describe continuous data. Mann-Whitney and Wilcoxon tests were applied for nonparametric data, while paired T tests and independent T tests were used for parametric data. Statistical significance was set at $p < 0.05$. All analyses were conducted with IBM SPSS software Version 23.0.

RESULTS

The results showed that both intervention and control group pharmacists were similar in demographic characteristics, with median ages of 27.00 (25 - 30.5) and 28.50 (27 - 31.25) years, respectively. Most participants were female (17, 77 %), and numbered 12 (55 %), while males numbered 5 and 10 in intervention and control groups, respectively. Most participants had bachelor's degrees. Most had never participated in an educational program related to drug interactions. Both groups had a median of 3 years of experience, with mean numbers of patients they encountered being 40.41 ± 13.47 and 45.95 ± 17.76, respectively. The median monthly number of drug interactions was approximately 5 to 8 for both groups. A total of 44 pharmacists had demographic characteristics listed in Table 1. Table 2 showed that no statistically significant differences were observed between control and intervention groups ($p > 0.05$). After educational intervention, pharmacists who attended an educational program showed significant improvements in all knowledge areas and overall knowledge compared to control group in the post-intervention phase ($p < 0.05$).

Similarly, regarding the knowledge and attitudes parts, pharmacists' practices showed statistically significant improvements in intervention group compared to the baseline and control groups during the study phases. At the same time, there was no statistically significant change in control group from pre- to post-intervention (Table 3).

Table 1: Demographic characteristics of the participating pharmacists in both control and intervention groups

Variable		Control	Intervention	*P*-value
Age (Q1-Q3) years		28.50 (27-31.25)	27.00 (25-30.5)	0.152[b]
Sex	Male	5 (23)	10 (45)	0.112[a]
	Female	17 (77)	12 (55)	
Degree	Bachelor's degree	22 (100)	20 (91)	0.488[a]
	Other	0 (0)	2 (9)[d]	
Years of experience (Q1-Q3)		3.00 (1.75-6.75)	3.00 (1-6.25)	0.639[b]
Educational events	Yes	9 (40)	7 (31.8)	0.531[a]
	No	13 (59.09)	15 (68.18)	
Number of educational events		2.29±1.38	4.78±3.99	0.139[c]
Number of cancer patients		45.95±17.76	40.41±13.47	0.250[c]
Number of interactions (Q1-Q3)		8.00 (3-20)	5.00 (1-12)	0.216[b]

[a]Chi-square test is used to analyze categorical variables, [b]Median (Q1-Q) and the Mann-Whitney test are used for variables that do not follow a normal distribution, [c]Mean ± SD and independent t-test for normally distributed variables, [d]One participant with PGY1 and one with PGY2

Table 2: Comparison between pre-post intervention in control and intervention groups regarding the knowledge part

Item		Control	Intervention	*P*-value
Knowledge Section A	PRE	47.727±27.720	50 (25–75)	0,091 MWT
	POST	50 (25–50)	87.5 (75–100)	< 0.001 MWT
	P-value	0.317 W	< 0.001 W	
Knowledge Section B	PRE	45.454±30.507	50 (25–75)	0.591 MWT
	POST	47.737±28.773	100 (75–100)	< 0.001 MWT
	P-value	0.747 P	< 0.001 W	
Knowledge Section C	PRE	40.909±27.053	52.840±16.335	0.084 IND T
	POST	42.045±20.246	75 (50–58.33)	< 0.001 MWT
	P-value	0.724 P	< 0.001 W	
All knowledge Section	PRE	44.691±23.611	54.166 (50–58.33)	0.115 MWT
	POST	44.318±19.818	84.280 ±9.355	< 0.001 IND T
	P-value	0.916 P	< 0.001 W	

MWT: Mann–Whitney, IND T: Independent t-test, P: Paired T-test, W: Wilcoxon test. Results expressed as mean ± standard deviation for normal distribution or median (Q1 – Q3) for non-normal distribution

Table 3: Comparison between pre-post intervention in control and intervention groups regarding the attitude part

Item		Control	Intervention	*P*-value
Attitude section A	PRE	70 (65-85)	74.318±7.60	0.396 MWT
	POST	72.5 (63.75–76.25)	90 (88.75–95)	< 0.001 MWT
	P-value	0.144 W	< 0.001 W	
Attitude section B	PRE	54.09±15.32	58.636±21.886	0.426 IND T
	POST	56.818±11.29	90 (80–100)	< 0.001 MWT
	P-value	0.339 P	< 0.001 W	
Overall attitude score	PRE	62.727±10.261	66.477±10.764	0.244 IND T
	POST	62.95±9.214	90.113±6.430	< 0.001 IND T
	P-value	0.903 P	< 0.001 P	

MWT: Mann–Whitney, IND T: Independent t-test, P: Paired T-test, W: Wilcoxon test. Results expressed as mean ± standard deviation for normal distribution or median (Q1 – Q3) for non-normal distribution

Table 4: Comparison between pre-post intervention in both control and intervention groups regarding the practices part

Item		Control	Intervention	*P*-value
Practice section A	PRE	68.787±14.640	70±8.099	0.736 IND T
	POST	65 (60–80)	80 (76.66–86.66)	0.002 MWT
	P-value	0.694 W	<0.001 W	
Practice section B	PRE	66.393±21.279	69.545±21.39	0.621 IND T
	POST	63.636±22.792	80 (70–90)	0.014 MWT
	P-value	0.548 P	0.001 W	
Overall practice score	PRE	67.575±14.913	69.772±11.236	0.584 IND T
	POST	66.515±13.322	80.075±8.301	< 0.001 IND T
	P-value	0.712 P	0.001 W	

MWT: Mann–Whitney, IND T: Independent t-test, P: Paired T-test, W: Wilcoxon test. Results expressed as mean ± standard deviation for normal distribution or median (Q1 – Q3) for non-normal distribution.

Table 5: The effect size of intervention

Item	Control	Intervention	*P*-value	Effect size (r)
Δ Knowledge section A	0 (-25–6.25)	25 (25–50)	< 0.001 MWT	0.645
Δ Knowledge section B	0 (-25–31.25)	37.5 (25–50)	< 0.001 MWT	0.544
Δ Knowledge section C	0 (-12.5–12.5)	25 (25–37.5)	< 0.001 IND T	0.638
Δ Overall Knowledge Sections	-0.378±16.71	30.68±10.33	< 0.001 IND T	0.753
Δ Attitude section A	-2.5 (-10– 5)	15 (13.75–25)	< 0.001 MWT	0.812
Δ Attitude section B	5 (-10–10)	30 (20–42.5)	< 0.001 MWT	0.740
Δ Overall attitude Sections	-0.45±5.54	16.02±4.85	< 0.001 IND T	0.845
Δ Practice section A	0.606±12.99	10.61±6.87	0.003 IND T	0.441
Δ Practice section B	0 (-12.5–10)	10 (0-12.5)	0.019 MWT	0.355
Δ Overall practice Sections	-1.060±13.29	10.30±7.605	0.001 IND T	0.472

P-value for independent t-test for normal distribution and from Mann-Whitney test for non-normal distribution; r < 0.1 "negligible", 0.1 ≤ r < 0.29 "small", 0.30 ≤ r < 0.49, "medium", r ≥ 0.50 "large". Results expressed as mean ± SD for normal distribution or median (Q1 – Q3) for non-normal distribution

Table 3 and Table 4 display the pharmacists' total scores for attitude and practices, respectively, and they also demonstrate the comparisons within the group and between control and intervention groups pre- and post-intervention.

To assess the magnitude of intervention's impact, the effect size is calculated. Table 5 illustrates the effect size for all questionnaire sections.

DISCUSSION

This study evaluated and enhanced the KAP of pharmacists concerning drug interactions in cancer departments. Few studies have specifically evaluated pharmacists' KAP regarding drug interactions among cancer patients in Iraq and similar settings. PDDIs are especially critical in oncology since anticancer treatments are inherently risky and have a narrow therapeutic window. PDDIs often lead to adverse effects, such as toxicity or reduced therapeutic effectiveness [11].

Pharmacists' overall knowledge of PDDIs, drug compatibility, the proper sequence for administering chemotherapeutic drugs, and interactions involving supportive care or concomitant medications was found to be subpar. First, regarding their general knowledge of PDDIs, the total scores for this section for both

control and intervention groups were 47.72 and 50 %, respectively, during the pre-intervention phase. Similarly, in the chemotherapeutic compatibility and administration order sections, the scores were 45.45 % and 50 %, respectively. Similarly, in the identification of PDDIs, the section of pharmacist knowledge was 40.9 and 52.84 % for both groups, respectively. This all indicates that pharmacists' knowledge was below optimal levels. This study's results were slightly better than those of another study, which reported an average correct response rate of 37.3 % [12]. This difference may be due to the more specific questions related to a particular department where the participants work in this study. Regarding pharmacists' attitudes toward improving PDDI information, their response rates were 74.13 % for intervention group and 70 % for control group. This result is slightly lower than another study showing a 91 % positive attitude [13]. The difference may relate to various educational events on drug interactions attended by oncology pharmacists. Another possible explanation is their belief that they possess adequate knowledge and that physicians may refuse their intervention. About half (58.63 % and 54.09 %) exhibit a negative attitude regarding the reasons for their negative practices.

Pharmacists' practices in checking for drug interactions before dispensing medications showed a mean response of 68.787 ± 14.640 in intervention group and 70.0 ± 8.099 in control group when verifying interactions, compatibility, and order of administration. This finding aligns with a study assessing pharmacists' drug interaction practices [14]. A recent study by Anuradha *et al* also found that about two-thirds of patients had PDDIs, with 63.9 % classified as severe [3]. This is quite concerning, especially considering a previous study showing that 25.4 % of doctors do not consider the medications patients have already taken before prescribing new ones [15]. This underscores the vital role of pharmacists in identifying and managing PDDIs in oncology settings.

Pharmacists' practices regarding PDDIs identification showed that about 69.545 ± 21.39 and 66.393 ± 21.279 of participants in both intervention and control groups, respectively, observed that physicians accepted their interventions. These responses are somewhat higher than the results of Spasovska *et al*'s study, which found that nearly 50% of participants reported that physicians always or usually accept pharmaceutical interventions [13]. This may be related to the specificity of the oncology department and the common belief that the administration of high-risk chemotherapeutic medications requires greater accuracy in prescribing and dispensing.

Educational interventions can cause statistically significant improvement in pharmacists' KAP, as shown by these findings. It is comparable to previous studies, which also reported positive outcomes after implementing the educational intervention [16]. The results show significant improvements from 50 (50 - 75) to 87 (75 - 100) ($p < 0.001$) in general knowledge, from 50 (25 - 75) to 100 (75 - 100) ($p < 0.001$) in compatibility and order of administration, from 52.840 ± 16.335 to 75 (50 – 58.33) ($p < 0.001$) in PDDIs identification, and from 54.166 (50 – 58.33) to 84.280 ± 9.355 ($p < 0.001$) in overall knowledge score, while no significant change occurred in control group (p = 0.916).

The result of the effect size also strengthens these findings, since all knowledge sections' improvement shows a large effect size (r = 0.645, r = 0.544, r = 0.638, and r = 0.753) for sections 1, 2, 3, and overall knowledge part. This outcome aligns with findings from previous studies regarding baseline knowledge scores and improvements during the post-intervention phase [15]. Regarding attitudes, the most significant change was observed in interventional group. This reflects the positive impact of intervention, not only on pharmacists' knowledge but also on their attitudes regarding self-improvement and overcoming barriers that prevent them from applying their knowledge in clinical practice. The change in pharmacists' attitudes increased from 74.318 ± 7.60 in the pre-intervention phase to 90.113 ± 6.430 in the post-intervention phase in intervention group ($p < 0.001$). At the same time, there was no significant change in control group's attitudes, which were 70 (65 - 85) initially and 72.5 (63.75 – 76.25) afterward ($p = 0.144$) with effect sizes of r = 0.812, r = 0.740, and r = 0.845 for attitude sections, respectively. This result is consistent with findings from a previous study [16].

Similarly, to the knowledge and attitude sections, pharmacists' practices show significant improvement in interventional group, increasing from 69.772 ± 11.236 to 80.075 ± 8.301 (p = 0.001), while remaining roughly unchanged in control group, with 67.575 ± 14.913 in the pre-intervention phase and 66.515 ± 13.322 in the post-intervention phase, with (p = 0.712) which is statistically insignificant. Moreover, the effect size demonstrated a medium to large effect of intervention-on-intervention group (r = 0.441, r = 0.355, and r = 0.472) regarding pharmacists' practices in PDDIs identification, post-identification practices, and overall, their

practices, respectively. This finding aligns with a previous study [16]. It highlights the positive impact of intervention on multiple areas of pharmacists' practices.

Based on this study's findings, several recommendations can be made to enhance pharmacists' KAP regarding PDDIs in the oncology setting. First, continuous and structured educational programs should be integrated into pharmacists' professional development to improve their KAP. Secondly, the adoption of electronic medical record systems and drug interaction alert software to help identify PDDIs should be supported. Ultimately, future research should include larger and more diverse participants, involve other healthcare providers, and extend follow-up periods to evaluate the long-term sustainability of educational interventions. These efforts collectively aim to enhance patient safety, minimize adverse drug reactions, and alleviate the healthcare burden associated with cancer treatment.

Limitations of this study include that an exhaustive recruitment strategy was employed, comprising only pharmacists who were working in the selected oncology departments at the time. The study has a limited number of participants, so the results cannot be generalized. A small sample size may also reduce the statistical power of the findings. Furthermore, since only questions about available and commonly prescribed medications were involved, the study does not provide a comprehensive view of knowledge, attitudes, and practices (KAP) regarding PDDIs about the less commonly prescribed drugs. Finally, data collection occurred one month after the educational intervention, which is a short period to assess its long-term significance.

CONCLUSION

Pharmacists demonstrated suboptimal Knowledge, Attitude, and Practice (KAP) regarding drug interactions, and the educational intervention significantly improved pharmacists' KAP concerning drug interactions in oncology settings. These findings support the incorporation of targeted training programs into continuing professional development frameworks. Therefore, applying an educational intervention enhances pharmacists' KAP regarding drug interactions to ensure the safety of cancer patients and reduce unwanted drug-related issues.

DECLARATIONS

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None.

Ethical approval

The study was approved by the Scientific Committee of Research of Babylon Health Directorate Research (in October 2024 – no. 79) and the ethical committee for clinical studies of Al-Kufa Faculty of Medicine (in November 2024 – reference no. MEC-86). Additionally, the study adhered to the Helsinki Declaration guidelines for human research. Participant anonymity was maintained, and verbal consent was obtained.

Use of Artificial intelligence/Large language models

We also declare that we did not use Generative artificial intelligence (AI) and AI-assisted technologies in writing the manuscript.

Availability of data and materials

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

Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Amat Aljabar Faisal Abbas: Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing original draft, Visualization, Funding acquisition. Ali Mohammed Abd Alridha: Conceptualization, Methodology, Validation, Formal Analysis, Resources, Writing – review and editing, Visualization, Supervision, Project administration.

REFERENCES

1. *Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries.*

CA Cancer J Clin 2021; 71(3): 209-249. doi: 10.3322/caac.21660.

2. *International Agency for Research on Cancer. GLOBOCAN 2022: Iraq cancer profile.*
3. *Anuradha HV, Maka VV, Patil P, Anupama C. Incidence, patterns, and severity of potential drug interactions among cancer patients on chemotherapy in a tertiary care hospital. J Pharmacol Pharmacother 2023; 14(1): 35–40. doi:10.1177/0976500X231162712.*
4. *Shakeel F, Aamir M, Khan AF, Khan TN, Khan S. Epidemiology of potential drug-drug interactions in elderly population admitted to critical care units of Peshawar, Pakistan. BMC Pharmacol Toxicol 2018; 19(1): 85. doi: 10.1186/s40360-018-0276-4.*
5. *Hameed EN. Pattern of proton pump inhibitors use among patients within emergency department of Al-Hakeem General Hospital in Najaf City, Iraq. Kufa J Pharm Sci 2025; 2(2): 16–24*
6. *Ismail M, Khan S, Khan F, Noor S, Sajid H, Yar S, Rasheed I. Prevalence and significance of potential drug-drug interactions among cancer patients receiving chemotherapy. BMC Cancer 2020; 20(1): 335. doi: 10.1186/s12885-020-06855-9.*
7. *Alnaim LS, Almalki HM, Almutairi AM, Salamah HJ. The prevalence of drug-drug interactions in cancer therapy and the clinical outcomes. Life Sci 2022; 310: 121071. doi: 10.1016/j.lfs.2022.121071.*
8. *Beijnen JH, Schellens JH. Drug interactions in oncology. Lancet Oncol 2004; 5(8): 489-496. doi: 10.1016/S1470-2045(04)01528-1.*
9. *Rashid K, Khan Y, Ansar F, Waheed A, Aizaz M. Potential drug-drug interactions in hospitalized medical patients: data from low resource settings. Cureus 2021; 13(8): e17336. doi: 10.7759/cureus.17336.*
10. *Makkaoui N, Halaoui A, Atoui Z, Siblini H, Habib S, Awada H, Zgheib NK. Knowledge, attitudes, and practices regarding drug interactions among community pharmacists. J Public Health (Berl.) 2021; 29; 1357–1363. https://doi.org/10.1007/s10389-020-01252-9.*
11. *Putri AE, Ma'wa J, Habibie, Bahar MA. Knowledge, attitudes, and practices of hospital pharmacists regarding clinically relevant drug interactions: A multi-center regional survey in Indonesia. Pharmacia 2024; 71: 1–9. doi: 10.3897/pharmacia.71.130998*
12. *Spasovska O, Bardin C, Kuzmanović M, Cortés C, Assefa Tadesse T, Crul M. Clinical oncology pharmacy has become a reality: Results of a member survey of the European Society of Oncology Pharmacy Global. Eur J Oncol Pharm 2024; 7(2). doi: 10.1097/OP9.0000000000000055*
13. *Hajj A, Hallit S, Ramia E, Salameh P. Medication safety knowledge, attitudes and practices among community pharmacists in Lebanon. Curr Med Res Opin 2018; 34(1): 149–156. doi: 10.1080/03007995.2017.1361916*
14. *Alkofide H, Almalag HM, Alromaih M, Alotaibi L, Altuwaijri N, Al Aloola N, Alsabhan JF, Bawazeer GA, Al Juffali L, Alfaraj R, et al. Pharmacovigilance practices by healthcare providers in oncology: A cross-sectional study. Pharmaceuticals 2024; 17(6): 638. https://doi.org/10.3390/ph17060683*
15. *Afzal S, Khan FU, Aqeel MT, Ullah M, Bajwa M, Akhtar M, Majid M. Impact of a pharmacist-led educational intervention on knowledge, attitude, and practice toward the rational use of antibiotics among healthcare workers in a secondary care hospital in Punjab, Pakistan. Front Pharmacol 2024; 14: 1327576. doi: 10.3389/fphar.2023.1327576.*
16. *Palmer S, Chen A, Dennison T, Czech C, Auten J, Buhlinger K, Muluneh B. Impact of oncology pharmacists on the knowledge, attitude, and practices of clinicians to enhance patient engagement of self-administered oral oncolytics. Pharmacy (Basel) 2021; 9(3): 130. doi: 10.3390/pharmacy9030130.*