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Hospital Pharmacists' Knowledge, Attitudes, and Practices Toward Clinically Significant Drug Interactions: A Multi-Center Regional Survey in Indonesia

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ABSTRACT

Adverse drug interactions remain a major concern in hospital care, emphasizing the pivotal role of pharmacists in mitigating associated risks. This study explored the understanding, perspectives, and practical approaches of hospital pharmacists in South Sulawesi Province, Indonesia, toward clinically important drug interactions. A cross-sectional survey was conducted online from November 2023 to January 2024, targeting hospital pharmacists. Out of 312 participants, 38.8% showed limited knowledge, 31.4% had moderate knowledge, and 29.8% possessed a strong understanding of drug interactions. Nearly all respondents (94.5%) relied on digital tools to detect potential interactions, and 91% stressed the value of ongoing professional training. Routine practices reported included reviewing prescriptions for interaction risks (94.5%), evaluating hazards before dispensing (91.7%), recording interaction events (85.3%), offering patient counseling (89.4%), and consulting prescribers when needed (91%). Despite knowledge limitations, pharmacists demonstrated consistent adherence to standard procedures for managing drug interactions, reflecting their commitment to patient safety. The study highlights the need for focused educational initiatives and continuous learning opportunities to enhance pharmacists' expertise and improve patient care outcomes in the region.

Keywords: Drug-drug interaction, Knowledge, Attitudes, Hospital pharmacists, Practices

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Introduction

Adverse drug reactions (ADRs) represent a major public health issue and are estimated to rank as the fifth leading cause of hospital-related mortality. Alarmingly, nearly half of these reactions are potentially preventable, with a substantial number recurring (reADRs) [1]. Among preventable ADRs, drug-drug interactions (DDIs) are a critical yet frequently overlooked contributor. DDIs can elevate the risk of morbidity and mortality while adversely affecting patients' quality of life [2, 3]. These interactions arise when two or more incompatible medications are administered concurrently, leading to harmful effects [4]. The issue is particularly concerning among elderly patients, who are more vulnerable due to polypharmacy and age-related physiological changes, making the identification and prevention of DDIs essential for patient safety [5].

Comorbid conditions further complicate treatment, often resulting in poorer clinical outcomes, reduced adherence, higher mortality, and increased healthcare costs, while simultaneously raising the likelihood of DDIs [6]. Studies indicate that approximately one-third of hospital patients and two-thirds of intensive care unit (ICU) patients experience DDIs during treatment [7]. In geriatric wards, the prevalence can reach 80.5–90.5% [8].

Pharmacists play a crucial role in mitigating DDIs, using their pharmacotherapy expertise to detect interactions and propose preventive strategies [9]. Evidence shows that pharmacist-led interventions reduce DDI incidence, particularly in ICU settings [10]. In patients with heart failure, pharmacist involvement has been demonstrated to lower the occurrence of clinically relevant DDIs [11]. Such interventions include optimizing prescriptions, improving therapeutic decisions, minimizing medication errors, and preventing adverse effects. Documenting

these interventions—such as adjusting doses, modifying administration schedules, or substituting medications with safer alternatives—is vital for effective patient care [12].

In high-income countries, electronic prescription systems integrated with medical records and clinical decision support systems help prevent DDIs by alerting healthcare providers to potentially harmful drug combinations before dispensing [13]. Conversely, in developing countries like Indonesia, where manual prescription practices prevail, the detection of DDIs largely depends on the pharmacist's expertise and vigilance. However, pharmacists' capacity to manually identify DDIs is limited; for example, accuracy is about 66% for two-drug regimens and decreases as the number of interacting drugs increases [14]. Lack of updated knowledge and resources may further hinder effective DDI management, posing risks to patient safety.

Aligned with the World Health Organization's emphasis on patient safety as a core healthcare principle [15], it is crucial to assess hospital pharmacists' knowledge, attitudes, and practices regarding clinically relevant DDIs. This assessment is essential for improving patient safety and therapeutic outcomes. This study therefore, aims to evaluate the understanding, perspectives, and routine practices of hospital pharmacists regarding clinically significant DDIs in South Sulawesi, Indonesia—a region where prior research has documented frequent DDI occurrences among hospitalized patients [16–22]. The findings are expected to highlight areas for improvement, inform locally tailored strategies, and enhance pharmacists' competencies to improve hospital pharmaceutical care and patient outcomes.

Materials and Methods

Study design and setting

A cross-sectional survey design was employed, using a validated online questionnaire distributed between November 2023 and January 2024. The study targeted hospital pharmacists in South Sulawesi Province, Indonesia, who had a minimum of six months' professional experience in hospital practice, ensuring familiarity with DDI-related case management.

Pharmacy education in indonesia

Pharmacy education in Indonesia is structured to prepare graduates for professional practice. Students complete a four-year bachelor's degree in pharmacy, providing foundational knowledge in pharmaceutical sciences, followed by a one-year professional pharmacist (Apothecary) program emphasizing practical skills, clinical training, and professional ethics. Graduates must pass the national competency examination (NCE) to obtain licensure. Licensed pharmacists may work in hospitals, community pharmacies, the pharmaceutical industry, regulatory bodies, or distribution sectors. The Indonesian Pharmacists Association (IAI) oversees professional standards and offers continuous education, workshops, and certifications to ensure pharmacists remain current with advances in pharmacy practice and comply with regulatory requirements.

Questionnaire development and validation

The survey tool for this study was adapted from Abdo *et al*. (2020) [23], which assessed healthcare professionals' understanding, perceptions, and practices regarding life-threatening drug interactions in Malaysian public hospitals. This instrument was selected because it closely matched the objectives of our research and had demonstrated reliability and clarity in measuring relevant variables.

To ensure linguistic and conceptual equivalence, the questionnaire underwent a two-step translation process. Initially, two independent professional translators converted the instrument from English into Indonesian. Subsequently, two native English speakers fluent in Indonesian performed backward translation into English [24]. The translated questionnaire was then modified to reflect the Indonesian context based on prior studies on DDIs in the country [16–22]. Further refinements were made after consultation with two pharmacology experts and a practicing hospital pharmacist.

Before formal deployment, the instrument was pre-tested with 10 randomly selected hospital pharmacists to evaluate clarity and reduce potential errors in interpretation [25]. Feedback from these participants was incorporated to improve understanding of ambiguous items. Item validity was examined using Pearson bivariate correlation, with items considered valid if their scores significantly correlated ($p < 0.05$) with the total domain score [26]. Reliability was assessed through Cronbach's alpha, with a value above 0.6 deemed acceptable [27].

Questionnaire structure

The final survey consisted of four main sections. The first section captured demographic information, including age, gender, education level, years of hospital experience, hospital type and accreditation, number of pharmacists on staff, average daily prescription volume, and daily working hours. The second section assessed pharmacists' knowledge of clinically relevant DDIs, scoring responses as 10 points for correct answers and 0 points for incorrect or "don't know" answers, resulting in a total score between 0 and 100. The third section measured attitudes toward seeking information on DDIs using a Likert scale from strongly disagree to strongly agree. The fourth section evaluated pharmacists' practical behaviors in managing DDIs, also using the same Likert scale.

Sample size and sampling method

The population targeted included 578 hospital pharmacists employed across 78 hospitals in South Sulawesi in 2023, according to the regional chapter of the Indonesian Pharmacists Association (IAI). Using the Slovin formula, the minimum number of respondents required was 237. Purposive sampling was applied to recruit participants.

Data analysis

Descriptive statistics summarized demographic characteristics and the distribution of responses related to knowledge, attitudes, and practices concerning DDIs. Knowledge levels were categorized as low (≤59%), moderate (60–79%), or high (80–100%) [23]. Associations between demographic factors and knowledge levels were tested using the chi-square method, with a significance threshold of $p < 0.05$. All analyses were conducted in SPSS version 23 (IBM Corp., Armonk, NY, USA).

Use of AI tools

The authors employed ChatGPT and Gemini to enhance the manuscript's English, followed by careful manual review and editing, with the authors taking full responsibility for the final content.

Results and Discussion

Validity and reliability of the questionnaire

All items within the knowledge, attitude, and practice domains showed significant correlations with their respective total domain scores ($p < 0.05$), confirming validity. Cronbach's alpha values for each domain exceeded 0.6, indicating acceptable internal consistency and reliability. Thus, the questionnaire was considered both valid and reliable.

Respondent characteristics

A total of 312 hospital pharmacists participated, as summarized in **Table 1**. The majority were female (80.8%), and 23.4% were over 40 years of age. Only 11.9% held a master's degree, and 32.1% had less than two years of hospital experience. Most respondents (82.7%) worked in fully accredited hospitals, and more than 40% were employed in facilities handling fewer than 100 prescriptions daily across both inpatient and outpatient services.

Table 1. Demographic and professional characteristics of respondents

Variable	Frequency (n = 312)	Percentage (%)
Gender		
Male	60	19.2
Female	252	80.8
Age group (years)		
30 or younger	119	38.1
31–40	120	38.5
Over 40	73	23.4
Highest qualification		
Bachelor's in Pharmacy	274	87.8

Master's degree	37	11.9
Years of hospital experience		
2 years or less	100	32.1
3–5 years	70	22.4
6–10 years	58	18.6
More than 10 years	84	26.9
Hospital accreditation level		
Entry-level	16	5.1
Basic	11	3.5
Intermediate	9	2.9
Advanced	18	5.8
Full accreditation	258	82.7
Average daily outpatient prescriptions		
100 or fewer	130	41.7
101–200	106	34.0
200 or more	76	24.4
Average daily inpatient prescriptions		
100 or fewer	144	46.2
101–200	70	22.4
200 or more	98	31.4
Total number of pharmacists at the hospital		
Fewer than 10	141	45.2
11–20	114	36.5
More than 20	57	18.3

Pharmacists' knowledge of drug-drug interactions

Table 2 presents the assessment of hospital pharmacists' knowledge regarding clinically significant DDIs. The difficulty of the questions varied, with items two and seven being answered correctly by the majority. Specifically, 84.3% of respondents correctly identified the interaction between ciprofloxacin and insulin, while 79.2% answered correctly on the clopidogrel-omeprazole interaction. In contrast, questions one and three proved more challenging, with 65.4% and 62.5% of participants responding incorrectly or indicating uncertainty, respectively. Overall, 121 pharmacists (38.8%) were classified as having low knowledge (scores 0–59%), 98 (31.4%) had moderate knowledge (scores 60–79%), and 93 (29.8%) demonstrated a high level of knowledge (scores 80–100%) **(Figure 1)**.

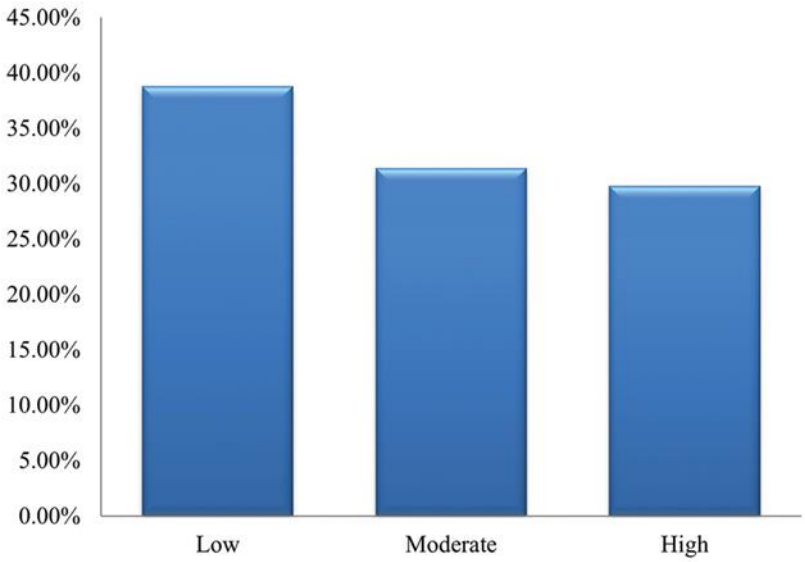

Figure 1. Level of pharmacists' knowledge of drug-drug interactions.

Table 2. Pharmacists' knowledge of drug-drug interactions.

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

Determinants of hospital pharmacists' understanding of drug-drug interactions

As shown in **Table 3**, among the variables analyzed, only sex had a significant impact on hospital pharmacists' knowledge of clinically important DDIs. Female pharmacists demonstrated a higher proportion of advanced knowledge (32.9%) compared to their male counterparts (16.7%).

Table 3. Variables impacting hospital pharmacists' understanding of potential drug-drug interactions.

Variable	Understanding Category			P-value
	Limited	Adequate	Strong	
Gender				**0.04**
Men	26 (43.3%)	24 (40.0%)	10 (16.7%)	
Women	95 (37.7%)	74 (29.4%)	83 (32.9%)	
Age group (years)				**0.65**
30 or younger	45 (37.8%)	35 (29.4%)	39 (32.8%)	
31 to 40	46 (38.3%)	43 (35.8%)	31 (25.8%)	
Over 40	30 (41.1%)	20 (27.4%)	23 (31.5%)	
Highest qualification				**0.67**

Bachelor of Pharmacy	107 (39.1%)	84 (30.7%)	83 (30.3%)	
Master's degree	13 (35.1%)	14 (38.9%)	10 (27.0%)	
Years worked in current hospital				**0.96**
2 or fewer	42 (42.0%)	31 (31.0%)	27 (27.0%)	
3 to 5	27 (38.6%)	21 (30.0%)	22 (31.4%)	
6 to 10	23 (39.7%)	17 (29.3%)	18 (31.0%)	
More than 10	29 (34.5%)	29 (34.5%)	26 (31.0%)	
Facility accreditation status				**0.80**
Entry-level / foundational	11 (77.3%)	6 (48.9%)	10 (73.9%)	
Mid-tier / progressive	12 (88.8%)	7 (55.5%)	8 (55.5%)	
Full / top-tier	98 (38.0%)	85 (32.9%)	75 (29.1%)	
Daily outpatient scripts (average)				**0.55**
100 or fewer	54 (41.5%)	35 (26.9%)	41 (31.5%)	
101 to 200	36 (34.0%)	39 (36.8%)	31 (29.2%)	
200 or more	31 (40.8%)	24 (31.6%)	21 (27.6%)	
Daily inpatient scripts (average)				**0.64**
100 or fewer	59 (41.0%)	40 (27.8%)	45 (31.3%)	
101 to 200	23 (32.9%)	26 (37.1%)	21 (30.0%)	
200 or more	39 (39.8%)	32 (32.7%)	27 (27.6%)	
Total pharmacists on staff				**0.11**
Fewer than 10	51 (36.2%)	45 (31.9%)	45 (31.9%)	
11 to 20	41 (36.0%)	34 (29.8%)	39 (34.2%)	
More than 20	29 (50.9%)	19 (33.3%)	9 (15.8%)	

Pharmacists' perspectives on accessing information about drug-drug interactions

As presented in **Table 4**, a large majority of participants (88.5%) supported the use of applications to identify drug interactions, and 91.0% were in favor of attending regular training sessions focused on monitoring such interactions. In contrast, 27.9% reported relying on traditional manual searches through books, while 42% preferred consulting a fellow pharmacist when faced with potential drug interaction cases.

Table 4. Pharmacists' Attitudes toward Seeking Information on Drug-Drug Interactions

Statement	Disagree / Strongly Disagree	Neutral	Agree / Strongly Agree
Favor using a drug interaction app	14 (9.8%)	21 (6.7%)	276 (88.5%)
Favor consulting reference books for drug interactions	53 (17%)	172 (55.1%)	87 (27.9%)
Favor seeking advice from fellow pharmacists regarding potential drug interactions	48 (15.4%)	133 (42.6%)	131 (42%)
Favor attending regular training on monitoring drug interactions	6 (2.0%)	22 (7.1%)	284 (91.0%)

Pharmacists' practices concerning drug-drug interactions

As shown in **Table 5**, the majority of pharmacists reported engaging in several key practices related to DDIs. These included reviewing each prescription for potential interactions (94.5%), notifying the prescribing physician when interactions were detected (92.9%), evaluating the clinical relevance of interactions prior to dispensing (91.7%), consistently advising patients about possible interactions (89.4%), and recording any interactions that were identified (85.3%).

Table 5. Pharmacists' Practices Concerning Drug-Drug Interactions

Statement	Disagree / Strongly Disagree	Neutral	Agree / Strongly Agree
Review every prescription for potential drug interactions	3 (1.0%)	14 (4.5%)	295 (94.5%)
Evaluate the clinical importance of drug interactions before dispensing	4 (1.3%)	22 (7.1%)	286 (91.7%)
Record identified drug interactions as part of routine practice	11 (3.6%)	35 (11.2%)	266 (85.3%)
Provide patients with regular counseling on possible drug interactions	5 (1.6%)	28 (9.0%)	279 (89.4%)
Notify the prescribing physician if a drug interaction is discovered	6 (2.0%)	16 (5.1%)	290 (92.9%)

This research represents the first assessment of hospital pharmacists' knowledge, attitudes, and practices regarding frequently encountered drug-drug interactions (DDIs) in South Sulawesi, Indonesia. Pharmacists' proficiency in identifying and managing DDIs is directly linked to patient safety and the overall quality of care. DDIs are known to contribute significantly to patient morbidity and mortality [28, 29]. In this study, only 29.8% of pharmacists demonstrated a high level of knowledge, consistent with the findings of Alorfi *et al*. (2023), who reported that community pharmacists often struggle to provide accurate responses regarding DDIs, despite their critical role in preventing harmful interactions [30].

Sex was a notable factor influencing pharmacists' knowledge of DDIs, with female pharmacists showing higher competency than males. This is in line with previous studies reporting that female pharmacists tend to have better understanding of drug and food interactions and greater awareness of drug safety considerations [31, 32]. It is important to note that the study sample consisted predominantly of females (80.8%), reflecting the general demographic of pharmacists in Indonesia. National data from 2019 indicate that 77.19% of Indonesian pharmacists are female, most of whom are employed in hospitals and primary healthcare centers, with projections suggesting this proportion could reach 86% by 2030 [33]. Other recent studies also report female representation in the pharmacist workforce at around 80% [34–36].

The level of knowledge about common DDIs has direct implications for patient safety and therapeutic effectiveness. Our results indicate that most pharmacists were familiar with interactions such as ciprofloxacin-insulin and clopidogrel-omeprazole. Nevertheless, gaps remain in understanding interactions like aspirin-warfarin and clopidogrel-enoxaparin. Enhancing pharmacists' knowledge through targeted training and education, along with implementing decision support tools and accessible resources, can improve vigilance and reduce the risk of harmful interactions, ultimately supporting safer and more effective pharmaceutical care [37].

Regarding attitudes, most pharmacists preferred modern resources, such as drug interaction applications, to obtain DDI information. A majority were also receptive to participating in regular training sessions, demonstrating awareness of the need to keep their knowledge current. A smaller proportion still relied on manual reference books or sought advice from colleagues, highlighting the importance of interprofessional collaboration to facilitate information sharing and informed decision-making [38]. Overall, pharmacists' attitudes reflect adaptation to digital tools and recognition of continuous learning as essential in contemporary pharmacy practice [39].

Pharmacists' reported practices demonstrated high adherence to recommended procedures for managing DDIs. Nearly all participants screened each prescription for interactions, contacted prescribing physicians when interactions were identified, assessed the clinical significance of interactions prior to dispensing, educated patients on potential risks, and documented observed interactions. These practices underscore the vital role of pharmacists in preventing and managing DDIs, contributing directly to patient safety and optimal therapeutic outcomes [23].

To strengthen DDI management and the role of pharmacists at a national level, several strategies are recommended. First, nationwide continuing education programs focused on DDIs should be developed and implemented. Second, clinical decision support systems (CDSS) with integrated DDI alerts should be adopted in hospital pharmacy workflows. Third, interprofessional collaboration should be enhanced through regular interdisciplinary meetings and communication channels. Additionally, pharmacists should have easy access to up-to-date drug interaction databases and literature, supported by standardized protocols and best practice guidelines. Finally, the creation and periodic updating of educational materials, including brochures, guides, and online resources, will further support pharmacists in managing DDIs effectively.

A limitation of this study is its restricted generalizability, as it was conducted solely in South Sulawesi. The findings may not fully apply to other regions or healthcare contexts. Nonetheless, the study provides valuable insights into the competencies and roles of hospital pharmacists in a suburban setting of a developing country. It fills an important gap in the literature regarding pharmacists' knowledge, attitudes, and practices in this region, and sharing these results globally can inform strategies in similar contexts. The study also emphasizes the need for CDSS implementation to aid in managing DDIs, reinforcing evidence supporting their utility.

While the study identified gaps in pharmacists' knowledge, it did not extensively explore the underlying reasons or contributing factors. Further research is needed to understand the challenges in enhancing pharmacists' knowledge and practices concerning DDIs.

Conclusion

Hospital pharmacists in South Sulawesi, Indonesia, demonstrated suboptimal knowledge regarding clinically relevant DDIs. Despite this, they consistently followed key procedures, including screening prescriptions, evaluating risk, documenting interactions, educating patients, and collaborating with colleagues. Most relied on digital applications to check interactions and showed a willingness to participate in regular training. Improving pharmacists' understanding of complex DDIs, along with promoting the use of technology and ongoing educational programs, is essential to enhance patient safety and optimize therapeutic outcomes.

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References

1. Wasylewicz A, Van De Burgt B, Weterings A, Jessurun N, Korsten E, Egberts T, et al. Identifying adverse drug reactions from free-text electronic hospital health record notes. Br J Clin Pharmacol. 2022;88(3):1235–45. doi:10.1111/bcp.15068
2. Abougalambou SSI, Alenezi TN. Knowledge and information sources of potential drug–drug interactions of healthcare professionals among Buraydah Hospitals. J Pharm Policy Pract. 2023;16(1):131. doi:10.1186/s40545-023-00642-0
3. Oguz F, Arslan M. Knowledge and behavior of community pharmacists towards detecting drug-drug interactions. Eur J Life Sci. 2023;2(1):39–44. doi:10.55971/EJLS.1266042
4. Nyamabo AK, Yu H, Liu Z, Shi JY. Drug–drug interaction prediction with learnable size-adaptive molecular substructures. Brief Bioinform. 2022;23(1). doi:10.1093/bib/bbab441
5. Liu Y, Wang J, Gong H, Li C, Chen M, Wu J, et al. Prevalence and associated factors of drug-drug interactions in elderly outpatients in a tertiary care hospital: A cross-sectional study based on three databases. Ann Transl Med. 2023;11(1):17. doi:10.21037/atm-22-5463
6. Berk M, Kohler-Forsberg O, Turner M, Penninx BWJH, Wrobel A, Firth J, et al. Comorbidity between major depressive disorder and physical diseases: A comprehensive review of epidemiology, mechanisms, and management. World Psychiatry. 2023;22(3):366–87. doi:10.1002/wps.21110
7. Zheng WY, Richardson LC, Li L, Day RO, Westbrook JI, Baysari MT. Drug-drug interactions and their harmful effects in hospitalized patients: A systematic review and meta-analysis. Eur J Clin Pharmacol. 2018;74(1):15–27. doi:10.1007/s00228-017-2357-5
8. Deoliveira LM, Diel JDAC, Nunes A, Da Silva Dal Pizzol T. Prevalence of drug interactions in hospitalized elderly patients: A systematic review. Eur J Hosp Pharm. 2021;28(1):4–9. doi:10.1136/ejhpharm-2019-002111
9. Shafiekhani M, Moosavi N, Firouzabadi D, Namazi S. Impact of clinical pharmacist's interventions on potential drug–drug interactions in the cardiac care units of two university hospitals in Shiraz, South of Iran. J Res Pharm Pract. 2019;8(3):143–8. doi:10.4103/jrpp.JRPP_18_88

10. Rivkin A, Yin H. Evaluation of the role of the critical care pharmacist in identifying and avoiding or minimizing significant drug-drug interactions in medical intensive care patients. J Crit Care. 2011;26(1):104.e1–6. doi:10.1016/j.jcrc.2010.04.014
11. Roblek T, Deticek A, Leskovar B, Suskovic S, Horvat M, Belic A, et al. Clinical-pharmacist intervention reduces clinically relevant drug-drug interactions in patients with heart failure: A randomized, double-blind, controlled trial. Int J Cardiol. 2016;203:647–52. doi:10.1016/j.ijcard.2015.10.206
12. Baptista R, Williams M, Price J. Improving the impact of pharmacy interventions in hospitals. BMJ Open Qual. 2023;12:e002276. doi:10.1136/bmjoq-2023-002276
13. Van Desijpe G, Quintens C, Walgraeve K, Van Laer E, Penny J, De Vlieger G, et al. Overall performance of a drug–drug interaction clinical decision support system: Quantitative evaluation and end-user survey. BMC Med Inform Decis Mak. 2022;22(1):48. doi:10.1186/s12911-022-01783-z
14. Weideman RA, Bernstein IH, McKinney WP. Pharmacist recognition of potential drug interactions. Am J Health Syst Pharm. 1999;56(15):1524–9. doi:10.1093/ajhp/56.15.1524
15. World Health Organization. Patient safety: making health care safer. Geneva: WHO; 2017.
16. Olii AT, Niswah H. Profil peresepan obat pada pasien rawat jalan Jamkesda dari poli kardiovaskular di apotek Rumah Sakit Labuang Baji Makassar periode Januari–Juni 2014. As-Syifaa. 2014;6(2):154–65. doi:10.33096/jifa.v6i2.45
17. EkaSafitri D, Chaliks R. Analisis faktor yang berpengaruh terhadap kejadian interaksi obat pada pasien gagal ginjal kronik rawat inap di RSUD Labuang Baji Makassar. J Farm Sains Klinik. 2015;1(1):11–26.
18. Rasyid AUM, Rante H, Djaharuddin I. Drug interactions for pulmonary tuberculosis patients in Dr. Wahidin Sudirohusodo Makassar Hospital. J Pharm Med Sci. 2016;1(2):25–9.
19. Santi I, Herman H. Evaluasi potensi interaksi obat antibiotika pada penyakit infeksi gastrointestinal pasien rawat inap periode Januari-Juni 2016 di Rumah Sakit Ibnu Sina Makassar. As-Syifaa J Farm. 2016;12(1):70–5. doi:10.33096/jifa.v12i1.623
20. Chalik R, Karim D, Dewi STR, Hidayati H. Analisis faktor yang berpengaruh terhadap kejadian interaksi obat pada pasien hipertensi di Rumah Sakit Umum X Kota Makassar. Med Chem Pharmacol. 2021;17(1):55–63. doi:10.32382/mf.v17i1.2018
21. Sukirawati S. Studi interaksi obat pada pasien tukak lambung di Rumah Sakit Umum Daerah I Lagaligo Kabupaten Luwu Timur. J Kesehatan. 2021;5(2):1–6.
22. Wahyudin E, Kasim H. Analisis kombinasi penggunaan obat pada pasien jantung koroner di Rumah Sakit Universitas Hasanuddin Makassar. Majalah Farm Farmakol. 2022;26(1):15–8.
23. Abdo MS, Hammad MA, Harun SN, Eusoff TM, Ghadzi SMS. Evaluation of knowledge, attitude and practice of health care providers towards life-threatening drug-drug interactions in Penang general hospital, Malaysia. Clin Epidemiol Glob Health. 2020;8(4):1253–8. doi:10.1016/j.cegh.2020.04.023
24. Arifin B, Perwitasari DA, Thobari JA, Cao Q, Krabbe PFM, Postma MJ. Translation, revision, and validation of the Diabetes Distress Scale for Indonesian type 2 diabetic outpatients with various types of complications. Value Health Reg Issues. 2017;12:63–73. doi:10.1016/j.vhri.2017.03.010
25. Perneger TV, Courvoisier DS, Hudelson PM, Gayet-Ageron A. Sample size for pre-tests of questionnaires. Qual Life Res. 2015;24(1):147–51. doi:10.1007/s11136-014-0752-2
26. Swank JM, Mullen PR. Evaluating evidence for conceptually related constructs using bivariate correlations. Meas Eval Couns Dev. 2017;50(4):270–4. doi:10.1080/07481756.2017.1339562
27. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. Res Sci Educ. 2018;48(6):1273–96. doi:10.1007/s11165-016-9602-2
28. Ahmad A, Parimalakrishnan S, Mohanta GP, Manna PK. Incidence of adverse drug reactions with commonly prescribed drugs in a tertiary care teaching hospital in India. Int J Res Pharm Sci. 2012;3(1):79–83.
29. Rajakannan T, Mallayasamy S, Guddattu V, Kamath A, Vilakkthala R, Rao PGM, et al. Cost of adverse drug reactions in a South Indian tertiary care teaching hospital. J Clin Pharmacol. 2012;52(4):559–65. doi:10.1177/0091270011398867
30. Alorfi NM, Alqurashi RS, Algarni AS. Assessment of community pharmacists' knowledge about drug-drug interactions in Jeddah, Saudi Arabia. Front Pharmacol. 2023;14:1209318. doi:10.3389/fphar.2023.1209318

31. Hajj A, Hallit S, Ramia E, Salameh P. Medication safety knowledge, attitudes and practices among community pharmacists in Lebanon. Int J Pharm Pract. 2017;25(2):149–56. doi:10.1080/03007995.2017.1361916
32. Abualhasan M, Tahan S, Nassar R, Damere M, Salameh H, Zyoud H. Pharmacists' knowledge of drug-food administration and their appropriate patient counseling: A cross-sectional study from Palestine. J Health Popul Nutr. 2023;42(1):99. doi:10.1186/s41043-023-00444-9
33. Meilianti S, Smith F, Kristianto F, Himawan R, Ernawati DK, Naya R, et al. A national analysis of the pharmacy workforce in Indonesia. Hum Resour Health. 2022;20:71. doi:10.1186/s12960-022-00767-4
34. Kausar MN, Fitriana E, Khairunnisa K, Faruque MO, Bahar MA, Alfian SD, et al. Development and validation of the Knowledge, Attitude, and Practice questionnaire for community pharmacy personnel in tuberculosis case detection, drug monitoring, and education: A study from Indonesia. Integr Res Dev. 2023;16:3729–41. doi:10.2147/IDR.S409107
35. Kusuma IY, Pratiwi H, Umami A, Kurniasih KI, Pitaloka DAE, Suherman S, et al. Knowledge, perceptions, and readiness of Telepharmacy (KPR-TP) questionnaire among pharmacists: Development and psychometric evaluation. J Telemed Telecare. 2023. doi:10.1177/1357633X231163354
36. Rendrayani F, Alfian SD, Wahyudin W, Puspitasari IM. Knowledge, attitude, and practice of medication therapy management: A national survey among pharmacists in Indonesia. Front Public Health. 2023;11:1213520. doi:10.3389/fpubh.2023.1213520
37. Hammar T, Hamqvist S, Zetterholm M, Jokela P, Ferati M. Current knowledge about providing drug–drug interaction services for patients – A scoping review. Pharmacy. 2021;9(2):69. Doi:10.3390/pharmacy9020069
38. Green BN, Johnson CD. Interprofessional collaboration in research, education, and clinical practice: Working together for a better future. J Chiropr Educ. 2015;29:1–10. doi:10.7899/JCE-14-36
39. Makkaoui N, Halaoui A, Atoui Z, Siblini H, Habib S, Awada H, et al. Knowledge, attitudes, and practices regarding drug interactions among community pharmacists. J Public Health. 2021;29(6):1357–63. doi:10.1007/s10389-020-01252-9