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ORIGINAL RESEARCH

Impact of Clinical Pharmacist Intervention in the Intensive Care Unit, Wad Medani, Sudan: A Cross-Sectional, Prospective Study

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Purpose: Critical care pharmacists are uniquely qualified to provide a key role within the critical care multi-disciplinary team in managing the aspect of therapy, given their contributions to improved patient outcomes, medication safety, and reduced cost of the drug. Therefore, the purpose of this study was to assess the frequency, type, and impact of clinical pharmacist interventions in the Intensive Care Unit and their physicians' acceptance.

Methods: This was a cross-sectional, prospective study. Data were gathered over six months (15th June 2023 to 15th December 2023) on a daily basis, with a minimum sample size of 384 interventions. All patients admitted to the ICU at Wad Medani Teaching Hospital, Gezira State, Sudan during the study period were included.

Results: In general, a total of 510 interventions were made for 123 patients throughout the six months course of study. Among them, 493 (96.7%) clinical pharmacist interventions were agreed by physicians. Among categories of interventions, most of the recommendations were concerned about safety 34.11% (174/510), in which drug discontinuation due to long duration was the highest one 48.27% (48/174) followed by the renal dose adjustment 30.46% (53/174). Another clinical intervention involving indication accounted for 23.33% (119/510) in second place. Regarding the cost-saving interventions the study showed that, of the total number of interventions, 124 had a costrelated component, accounting for (24.31%) of the total interventions. Among all the interventions, the addition of drug, with a frequency of 103 (20.2%) was the most recurring intervention, followed by dosing at 100 (19.6%), and renal dose adjustment at 53 (10.4%).

Conclusion: This study demonstrated how clinical pharmacists might enhance critical care patients' quality management while reducing the costs associated with medication and care. In addition, it contributes valuable insights into the integration of clinical pharmacists in ICU settings, especially in resource-limited environments.

Keywords: impact, clinical pharmacist, intensive care unit, interventions, Wad Medani, Sudan

Introduction

Intensivist-led multidisciplinary teams are currently considered to be a crucial component of the best practice model of care for critically ill patients in the intensive care unit (ICU) in order to enhance patient outcomes and minimize needless resource consumption.[1]

In general, critically ill patients have a variety of challenges posed by altered administration routes, extreme and rapidly changing pharmacodynamic and kinetic parameters, combined with extremes of physiology that necessitate close monitoring and careful pharmaceutical management;[2] critical care pharmacists provide a key role within the critical care multi-professional team in managing this aspect of therapy, given their contributions to improved patient outcomes, medication safety, and reduced cost of the drug and as an informational resource and educator about drugs.[3]

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Clinical pharmacy services were offered in both the United States and the United Kingdom by the end of the 1960s[4] and the prospect of including a clinical pharmacist in a multidisciplinary team led by an intensivist first emerged in the United States in the early 1980s.[5] Currently, there is a greater involvement of clinical pharmacists in hospital operations in order to minimize medication errors and adverse drug reactions,[6] while medical professionals approve a greater proportion of clinical pharmacist interventions in a variety of clinical conditions.[7,8]

Numerous studies have demonstrated that critical care pharmacists are part of multi-professional healthcare teams that positively influence the prognosis of critically ill patients.[5] Before-after comparison study reported 66% reduction in preventable adverse drug events (ADEs),[9] and a prospective study documented annual savings of 22,162 dollars.[10] A systematic review and meta-analysis demonstrated that critical care pharmacist participation in multidisciplinary ICU teams revealed improvements in terms of mortality, ICU length of stay, and ADEs.[11,12] Another prospective observational study conducted in Egypt showed that remote pharmacist interventions have a considerable impact on medicines use and clinical outcomes in rural locations.[13] In addition to a pre-post study conducted in Jordan showed that clinical pharmacists interventions drastically reduced prescribing errors in the emergency department by about three-quarters.[14] In Wad Medani, Sudan, there are no published data for assessing clinical pharmacist interventions and it is impact on clinical outcome. Therefore, the purpose of this study was to assess the frequency, type, and impact of clinical pharmacist interventions in the ICU and their physicians' acceptance.

Materials and Methods

Study Site

The study was conducted in the ICU at Wad Medani Teaching Hospital, Wad Medani, Gezira State, Sudan. The ICU has an eight beds capacity and was covered by two clinical pharmacists, two intensive care specialists, 18 residents, and 20 nurses.

Study Design

This was a cross-sectional, prospective study.

Sample Size

All Patients admitted to the ICU between 15th June 2023 and 15th December 2023 were included in the study with a minimum sample size required of 384 interventions, used Epi Info™, 95% confidence interval, unknown interventions, expected frequency 50%, acceptable margin of error 5%, design effect 1, cluster 1.

Data Collection

Data collection form was designed, including the type of clinical pharmacist interventions such as drug with no indications, add drug, duplication, renal dose adjustment, drug discontinuation due to long duration, drug-drug interaction, adverse drug reaction, intravenous administration, pharmacokinetic, order lab test for monitoring and safety, dosing and dose frequency. Data was gathered over six months on a daily basis by two American Board certificated critical Care Pharmacists with a master's degree in clinical pharmacy, as well as more than three years of clinical experience in ICU settings. The ICU clinical pharmacists in the Wad Medani Hospital review patient profiles, patient follow-up notes, medication charts, and all pertinent physician orders such as laboratory and culture results. During rounds, clinical pharmacists address concerns like recommending drug therapy and answering inquiries about drugs. After rounds, clinical pharmacists deal with issues such as the appropriate use of medications with nurse team members. Clinical pharmacists document these recommendations and interventions as well as their outcome (acceptance or rejection by physicians), on the data collection form.

Outcome Measure

The interventions made were categorized into four groups: (1) interventions regarding indications such as duplication; (2) interventions related to safety such as adverse drug reaction; (3) interventions with relation to dose such as Dosing, and (4) miscellaneous such as medication reconciliation shown in Figure 1.

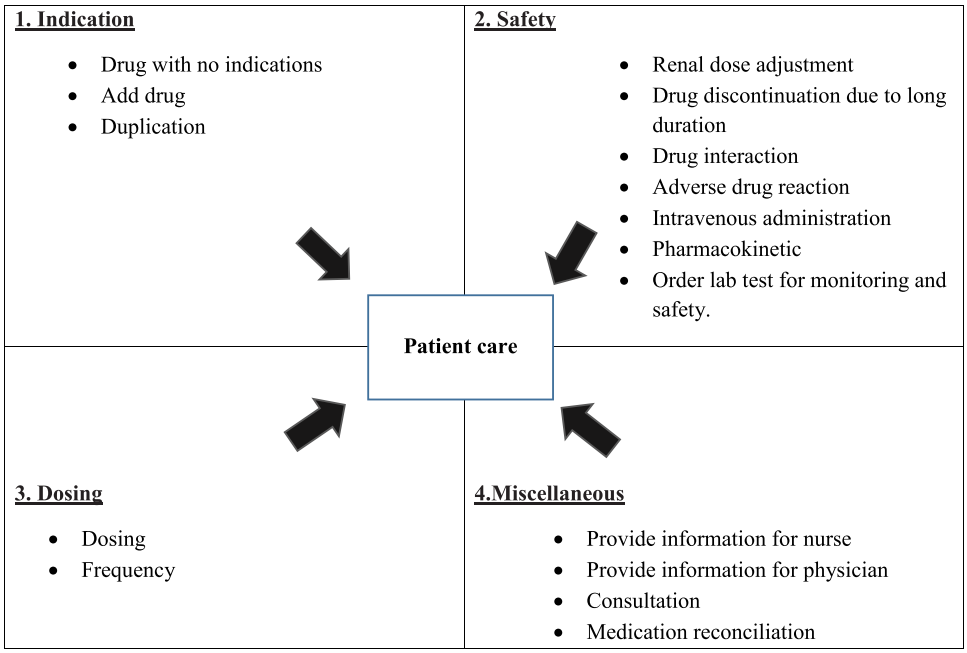

Figure 1 Theoretical Framework of Indicators.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS), version 27.0 was used to analyze the data. Descriptive and inferential statistics were used to evaluate the data. Qualitative data presented as frequencies (percentages). Fisher's exact test was used to examine the association between physicians' acceptance and the category of interventions. The confidence interval (CI) 95% and *p* value less than 0.05 was considered to indicate statistical significance.

Result

In general, a total of 510 interventions were made for 123 patients throughout the six months course of study. Among them, 493 (96.7%) interventions were agreed by physicians.

Among categories of interventions, most of the recommendations were concerned about safety 174 (34.11%), in which drug discontinuation due to long duration was the highest one 48 (48.27%) followed by the renal dose adjustment 53 (30.46%). Another clinical intervention involving indication accounted for 119 (23.33%) in second place. Regarding the cost saving interventions the study showed that, of the total number of interventions, 124 had a costrelated component, accounting for (24.31%) of the total interventions. Table 1 shows the precise information about each category intervention.

Among all the interventions, the addition of drug, with a frequency of 103 (20.2%) was the most recurring intervention, followed by dosing at 100 (19.6%), and renal dose adjustment at 53 (10.4%). Figure 2 displays the overall percentages of interventions made by a clinical pharmacists.

Regarding factors associated with physicians' acceptance, there was a statistically significant association between physicians' acceptance rate and category of interventions (95% CI, *p* value 0.002), in which the most acceptance rate was shown in the dosing category 99.1% (111/112), followed by the safety category 98.3% (171/174), and the least acceptance category was indication 90.8%(108/119), while the cost related interventions category was reported at 93.5% (116/124) acceptance rate as shown in Table 1.

Discussion

Critical care Pharmacists are uniquely qualified to offer the aspects of pharmacotherapeutic services, including clinical and operational components that are required for the treatment of patients in critical condition in addition to a multidisciplinary team approach.[15] This study evaluates the impact of clinical pharmacist interventions among ICU patients. These

Table 1 Type of Intervention Made by Clinical Pharmacists and Acceptance Rate for Each Category

Intervention	Percentages	Acceptance Rate (95% CI)
Intervention Category:		*p* value 0.002
Safety	34.11% (174/510)	98.3%
Dosing	21.96% (112/510)	99.1%
Indication	23.33% (119/510)	90.8%
Miscellaneous	20.59% (105/510)	98.1%
Total	**510**	
Interventions related to indication		
Drug with no indications	5.88%(7 /119)	57.1% (4/7)
Add drug	86.55%(103/119)	95.1% (98/103)
Duplication	7.56% (9/119)	66.7% (6/9)
Total	**119**	
Interventions related to safety		
Renal dose adjustment	30.46% (53/174)	100% (53/53)
Drug discontinuation due to long duration	48.27% (48/174)	95.8% (46/48)
Drug interaction	4.02% (7/174)	100% (7/7)
Adverse drug reaction	4.02% (7/174)	100% (7/7)
Intravenous administration	8.62% (15/174)	100% (15/15)
Pharmacokinetic	4.60% (8/174)	100% (8/8)
Order lab test for monitoring and safety 174	20.70% (36 /174)	97.2% (35/36)
Total	**174**	
Interventions related to dosing		
Dosing	89.28% (100/112)	99% (99/100)
Frequency	10.71% (12/112)	100% (12/12)
Total	**112**	
Interventions related to cost saving		93.5%
Renal dose adjustment	42.74% (53/124)	
Drug discontinuation due to long duration	38.71% (48/124)	
Drug with no indications	5.64% (7 /124)	
Duplication	7.26% (9/124)	
Drug interaction	5.64% (7/124)	
Total	**124**	
Miscellaneous		
Provide information for nurse	36.19% (38/105)	100% (38/38)
Provide information for physician	29.52% (31/105)	93.55% (29/31)
Consultation	26.67% (28/105)	100% (28/28)
Medication reconciliation	7.62%(8/105)	100% (8/8)
Total	**105**	

Abbreviation: CI, confidence interval.

interventions are classified into interventions related to indications, interventions regarding safety, interventions regarding the dosing, and miscellaneous interventions. Our study shows that most of the recommendations are concerned with safety followed by indications, dosing, and lastly, miscellaneous interventions. These interventional placements align with the findings described at the Alkhor Hospital, Qatar[16] and have a dissimilarity with Saudi Arabia's findings, where indications were the most often intervention, followed by safety, miscellaneous, and dosing.[8] In addition to differences from a study designed to analyze the impact of clinical pharmacy services in adult chemotherapy infusion clinics. In which the most frequent interventions were dose adjustments (51%), accompanied by addition (23%) and discontinuation (21%) of prescribed drugs. This disparity could be attributed to differences in study settings, patients, and medication types.[17]

From another perspective, the rate at which physicians accept clinical pharmacist interventions is one of the most important metrics for assessing the role of the clinical pharmacist. The majority of Sudanese physicians who discussed their experiences

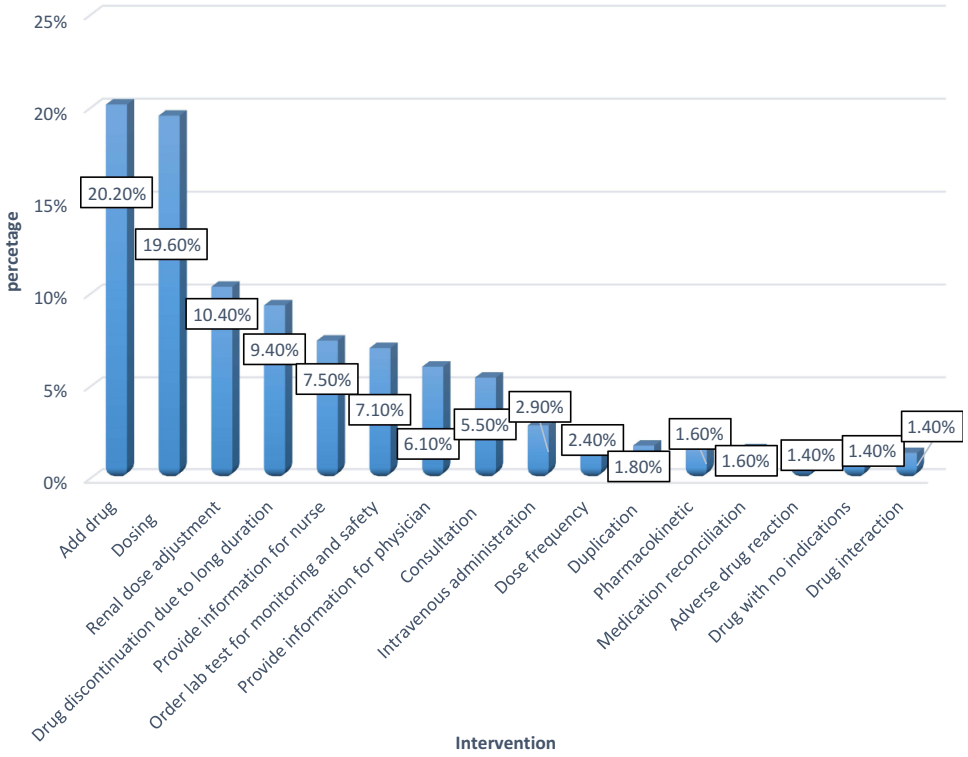

Figure 2 The overall percentages of interventions.

with clinical pharmacists agreed that these experts are a reliable source of knowledge on both general and clinical drugs, and they frequently notify physicians of any clinical concerns with the prescriptions they write.[18] In our study, almost all of the interventions were accepted by physicians in consistence with the two studies in Taif and Jeddah, Saudi Arabia, which revealed that, (98.5%) and (97%) of clinical pharmacist interventions were accepted respectively.[8,19] The findings of this study were greater than the acceptance rate in Qatar at Alkhor Hospital (87.2%),[16] India (94.8%)[5] and in United Arab Emirates (94.7%.).[20] Overall, this result was well in accordance with other published data, where the acceptance rate ranges from 85.5% to 99%.[21]

However, the most frequent safety intervention is drug discontinuation due to long duration followed by renal dose adjustment and ordering lab tests for safety and monitoring; these findings highlight the important role of clinical pharmacists in lowering medication-related problems which enhances patient safety. In particular, for patients with renal insufficiency, a relative overdose on the standard dose may result in severe impairment and/or an extended hospital stay. For this reason, these interventions are essential because they prevent overdosing, drug-related issues, and adverse drug reactions in this patient population.[16]

In regards to the costsaving interventions considering the renal dose adjustment, drug discontinuation due to long duration, the drug with no indications, duplication, and drug interaction; the analysis revealed that approximately a quarter of the total interventions had a cost-related component. These demonstrate the role of the clinical pharmacist in minimizing drug costs.[22] Similar findings have been observed in previous research regarding the impact of clinical pharmacist interventions on cost savings.[8,23] Furthermore, a study conducted in a hematology unit to assess the impact of clinical pharmacist intervention on clinical and economic outcome conclude that, clinical pharmacy service reduce cost of potential adverse drug events and medications.[24]

In terms of interventions related to indication, the most frequent intervention was the addition of drugs and also the most frequent intervention among all the interventions. This result is consistent with the fact that; a majority of critical care pharmacists work as prescribers,[25] a role that will soon be regarded as standard.[2]

Concerning interventions related to dosing, the most common type of interventions were linked to the dosing. These finding displays the crucial role of clinical pharmacists as a significant contributor during their rounds and working

closely with the medical team to optimize medication dose.[16] This finding is in line with the results of studies that evaluated the clinical pharmacists' interventions in India[5] and in Taif, Saudi Arabia.[8]

Most information given to nurses in this study are related to the preparation and administration of drugs. This emphasizes the important role of the clinical pharmacist as a medication expert, and is supported by a study conducted at Wad Medani Emergency Hospital to evaluate the preparation and administration of intravenous medications in critically ill patients in the absence of a clinical pharmacist, which revealed that the total error rate was 33.4%.[26] This finding is relatively similar to that in Saudi Arabia (45.7%).[8]

Consultation (giving a healthcare professional reactive guidance on a particular issue) is a crucial intervention carried out by pharmacists.[27] Our study demonstrated that more than half of miscellaneous interventions were associated with consultation. These were consistent with the findings in Saudi Arabia in which consultation interventions represent 65%.[8]

Strengths and Limitations

In strength of this study, the data were prospectively collected over six months. This allows better documentation of interventions and provides an accurate depiction of clinical pharmacist activity on a daily basis.

The current study has some limitations. In particular, Medication errors that affected patients while they were in the hospital were not evaluated in this study. Additionally, there was no calculation of the overall effect of clinical pharmacist interventions on healthcare costs. Furthermore, the effect of clinical pharmacist intervention on patient mortality was not included in the study.

Conclusion

This study demonstrated how clinical pharmacists might enhance critical care patients' quality management, while reducing the costs associated with medication and care by implementing medication optimization, medication error interception, and a more profound dedication to standardized therapy. Furthermore, based on the physicians' acceptance rate of the interventions, it can be deduced that clinical pharmacists' interventions are very relevant and promote interprofessional collaboration in addition to improving health care outcomes. Moreover, these findings contribute valuable insights into the integration of clinical pharmacists in ICU settings, especially in resource-limited environments, underscoring their vital role in multidisciplinary healthcare teams. Therefore, policymakers should consider implementing an active clinical pharmacist in the ICU.

Data Sharing Statement

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

Ethical Approval

The study protocol was approved by the Ethical Committee, Ministry of Health, Gezira State, Sudan. N: 22, (12/6/2023). Which waived the requirement for informed consent due to the nature of the study that evaluates the clinical pharmacy service without risk to the patient, in addition to challenging for critically ill patients consent. Permission to access patient records was obtained from the administration of the ICU, Wad Medani Teaching Hospital to ensure confidentiality.

Disclosure

The authors declare no conflicts of interest.

References

1. Kaye J, Ashline V, Erickson D, et al. Critical care bug team: a multidisciplinary team approach to reducing ventilator-associated pneumonia. *Am J Infect Control*. 2000;28(2):197–201. doi:10.1067/mic.2000.102794
2. Borthwick M. The role of the pharmacist in the intensive care unit. *Journal Intensive Care Soc*. 2019;20(2):161–164. doi:10.1177/1751143718769043
3. Horn EJJ, Jacobi J. The critical care clinical pharmacist: evolution of an essential team member. *Crit Care Med*. 2006;34(3):46–51. doi:10.1097/01.CCM.0000199990.68341.33

4. Bond CA, Pharm D, Raehl CL, Pharm D. Clinical pharmacy services, pharmacy staffing, and hospital mortality rates. *Pharmacother*. 2007;27(4):481–493. doi:10.1592/phco.27.4.481
5. Hisham M, Sivakumar MN, Veerasekar G. Impact of clinical pharmacist in an Indian Intensive Care Unit. *Indian J Crit Care Med*. 2016;(24):78–83. doi:10.4103/0972-5229.175931
6. Bean CL. Definition of clinical pharmacy. *Am J Hosp Pharm*. 1979;36(6):744. doi:10.1093/ajhp/36.6.744b
7. Khalili H, Farsaei S, Rezaee H, Dashti-Khavidaki S. Role of clinical pharmacists' interventions in detection and prevention of medication errors in a medical ward. *Int J Clin Pharm*. 2011;33:281–284. doi:10.1007/s11096-011-9494-1
8. Althomali A, Altowairqi A, Alghamdi A, et al. Impact of clinical pharmacist intervention on clinical outcomes in the critical care unit, Taif City, Saudi Arabia: a retrospective study. *MDPI Pharm*. 2022;10(5):108. doi:10.3390/pharmacy10050108
9. Leape LL, Cullen DJ, Clapp MD, et al. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA*. 1999;281(3):1.
10. Patel NP, Brandt CPYC, Yowler CJ. A prospective study of the impact of a critical care pharmacist assigned as a member of the multidisciplinary burn care team. *J Burn Care Res*. 2006;27(3):310–313. doi:10.1097/01.BCR.0000216287.98801.96
11. Lee H, Ryu K, Sohn Y, Kim J, Suh GY, Kim EY. Impact on patient outcomes of pharmacist participation in multidisciplinary critical care teams: a systematic review and meta-analysis. *Crit Care Med*. 2019;47(9):1243–1250. doi:10.1097/CCM.0000000000003830
12. Wang T, Benedict N, Olsen KM, et al. Effect of critical care pharmacist's intervention on medication errors: a systematic review and meta-analysis of observational studies. *J Crit Care*. 2015;30(5):1101–1106. doi:10.1016/j.jcrc.2015.06.018
13. Al Meslamani AZ, Kassem AB, El-Bassiouny NA, Ibrahim OM. An emergency plan for management of COVID-19 patients in rural areas. *Int J Clin Pract*. 2021;75(10):1–9. doi:10.1111/ijcp.14563
14. Abdel-Qader DH, Ismael NS, Meslamani AZ, et al. The Role of clinical pharmacy in preventing prescribing errors in the emergency department of a governmental hospital in Jordan: a pre-post study. *Hosp Pharm*. 2021;56(6):681–689. doi:10.1177/0018578720942231
15. Belcher RM, Blair A, Chauv S, et al. Implementation and impact of critical care pharmacist addition to a telecritical care network. *Crit Care Explor*. 2023;5(1):E0839. doi:10.1097/CCE.0000000000000839
16. Abuzaid HO, Corporation HM, Lalitha M, Authority S, Mahdy S, Corporation HM. Impact of clinical pharmacist interventions in the medical ward – a study at Al Khor hospital. *Am J PharmTech Res*. 2014;2014:1.
17. Mashni OK, Nazer LH, Khalil HZ, et al. Impact of clinical pharmacy services on patient management in the chemotherapy infusion clinics: a 5-year study at a comprehensive cancer center. *J Pharm Pract*. 2022;35(5):686–690. doi:10.1177/08971900211003446
18. Mahmoud MI, Maatoug MM, Jomaa AA, Yousif M. Sudanese medical doctors' perceptions, expectations, experiences and perceived barriers towards the roles of clinical pharmacists: a cross-sectional study. *Integr Pharm Res Pract*. 2022;11(July):97–106. doi:10.2147/iprp.s354717
19. AlKhanbashi RO, AlNoamy Y, Ghandorah R, Awan RM, AlButi H. Assessment of clinical pharmacist interventions using a web-based application in a Saudi Arabian Tertiary Hospital. *SAGE Open Med*. 2024;12. doi:10.1177/20503121241233217
20. Al-Quteimat O, Siddiqui M, Hussein L, Al Emleh H, Shamieh IED. Analysis of pharmacist interventions in adult COVID-19 patients admitted to a tertiary care hospital. *J Pharm Pract*. 2023;36(3):572–578. doi:10.1177/08971900211065536
21. Klopfer JD, Einarson TR. Acceptance of pharmacists' suggestions by prescribers: a literature review. *Hosp Pharm*. 1990;25(9):830–832.
22. Erstad BL, Haas CE, O'Keeffe T, Hokula CA, Parrinello K, Theodorou AA. Interdisciplinary patient care in the intensive care unit: focus on the pharmacist. *Pharmacotherapy*. 2011;31(2):128–137. doi:10.1592/phco.31.2.128
23. Schumock GT, Meek PD, Ploetz PA, Vermeulen LC. Economic evaluations of clinical pharmacy services--1988-1995. The publications committee of the American college of clinical pharmacy. *Pharmacotherapy*. 1995;16(6):1188–1208.
24. Chen P-Z, C-C W, Huang C-F. Clinical and economic impact of clinical pharmacist intervention in a hematology unit. *J Oncol Pharm Pract*. 2020;26(4):866–872. doi:10.1177/1078155219875806
25. Bourne RS, Whiting P, Brown LS, Borthwick M. Pharmacist independent prescribing in critical care: results of a national questionnaire to establish the 2014 UK position. *Int J Pharm Pract*. 2016;24(2):104–113. doi:10.1111/ijpp.12219
26. Hamadalneel YB, Maatoug MM, Yousif MA. Evaluation of errors in preparation and administration of intravenous medications in critically ill patients. *Int J Risk Saf Med*. 2023;34:1–9. doi:10.3233/jrs-220054
27. S R. PROTECTED-UK. Clinical pharmacist interventions in the UK critical care unit: exploration of relationship between intervention, service characteristics and experience level; 2015.