Volume 7, January/June 2026, Issue 1, pp. 79-81
Interdisciplinary Journal of Acute Care
Journal homepage: ijac.lums.ac.ir
Online ISSN: 3060-7159

Pharmacology in Acute Care: Scientific Foundations and Clinical Challenges

Amin Hasanvand[1*]

[1.] Department of Pharmacology and Toxicology, School of Pharmacy, Lorestan University of Medical Sciences, Khorramabad, Iran

ARTICLE INFO

Article Type:
Comment

Article History:
Received
11 February 2025

Received in revised form
18 December 2025

Accepted
24 March 2025

Available online
28 June 2026

ABSTRACT

Acute care environments, including emergency departments, intensive care units, and postoperative settings, require rapid, precise, and evidence-based pharmacological decision-making. Patients in these settings often experience hemodynamic instability, multi-organ dysfunction, and complex polypharmacy, which can significantly alter drug pharmacokinetics and pharmacodynamics. Understanding these alterations is essential for optimizing therapeutic efficacy and minimizing adverse effects. Drugs with high hepatic metabolism, such as phenytoin and propofol, may accumulate in patients with liver impairment, whereas renally excreted agents, including aminoglycosides, require careful dose adjustment in patients with acute kidney injury. Polypharmacy further complicates the management of these patients, increasing the risk of drug–drug interactions and iatrogenic complications. Critical interventions, such as vasopressor administration in septic shock or antiarrhythmic therapy for acute arrhythmias, require the integration of pharmacological knowledge with real-time clinical assessment to achieve safe and effective outcomes. Tables summarizing pharmacokinetic considerations and high-risk drug interactions provide concise reference tools for clinicians in acute care settings. Emerging fields, including pharmacogenetics and precision medicine, offer the potential to individualize therapy based on genetic profiles and dynamic patient status, thereby enhancing safety and therapeutic accuracy. This commentary emphasizes that success in acute care pharmacology depends not only on understanding drug mechanisms but also on rapid and informed clinical decision-making. Integrating pharmacological expertise with acute care practice represents a vital convergence of science and clinical art that directly influences patient survival and recovery outcomes.

Keywords: Acute Care; Pharmacology; Drug Interactions; Precision Medicine

Publisher:
Lorestan University of Medical Sciences

Cite this article: Hasanvand A. Pharmacology in acute care: scientific Foundations and clinical challenges. *Interdisciplinary Journal of Acute Care.*2026;7(1):79-81. https://doi.org/10.22087/ijac.2026.575293.1098

Introduction

Acute care environments, including emergency departments, intensive care units (ICUs), and postoperative care settings, require rapid and precise medication-related decision-making [1]. Critically ill patients often require complex drug therapies, making careful medication management crucial for ensuring both safety and effective treatment [2]. In such contexts, pharmacology extends beyond understanding drug mechanisms to include the ability

* Corresponding Author: Amin Hasanvand, Department of Pharmacology and Toxicology, School of Pharmacy, Lorestan University of Medical Sciences, Khorramabad, Iran. E-mails: dr.hasanvand@yahoo.com, dr.hasanvand@lums.ac.ir

DOI: 10.22087/ijac.2026.575293.1098

to predict individual responses, manage drug interactions, and promptly identify adverse effects [3].

Pharmacokinetics and Pharmacodynamics in Acute Patients

In ICU patients, rapid changes in hemodynamic status, liver and kidney function, and blood volume can alter drug distribution and metabolism unpredictably [4]. For example, drugs extensively metabolized by the liver, including phenytoin, propofol, and fospropofol, may have reduced clearance and increased toxicity in patients with hepatic impairment [5, 6]. Similarly, renally excreted drugs, such as aminoglycosides, require careful monitoring in patients with acute kidney injury [7]. A precise understanding of pharmacokinetic parameters, such as the volume of distribution, half-life, and metabolic pathways, combined with clinical data, forms the foundation for therapeutic decision-making in critically ill patients (Table 1).

Management of Polypharmacy and Drug Interactions

Critically ill patients are often administered multiple concurrent therapies, increasing the risk of drug interactions and adverse effects [8]. For example, concurrent administration of vasopressors and antiarrhythmic drugs may have additive effects on blood pressure and cardiac rhythm. Regular medication review, along with the use of updated pharmacologic databases and clinical guidelines, is essential for reducing medication errors and improving patient safety (Table 2).

Clinical Examples and Practical Applications

I n septic shock, the appropriate selection of vasopressors and dosing of broad-spectrum antibiotics requires rapid assessment of hemodynamic status, renal and hepatic function, and drug pharmacokinetics. In the management of acute arrhythmias, careful drug selection is essential to maintain therapeutic efficacy while minimizing the risk of QT prolongation and secondary arrhythmias. These examples underscore the need to integrate pharmacological knowledge with clinical expertise to deliver safe and effective care in acute settings. Clinical monitoring of the QT interval is essential in patients receiving QT-prolonging agents, such as amiodarone. Baseline and serial ECG assessments are recommended, particularly in critically ill patients with fluctuating metabolic and hemodynamic statuses.

Table 1. Pharmacokinetic and pharmacodynamic changes of drugs in acute care patients

Drug	Metabolism Pathway	Effect of Renal Impairment	Effect of Hepatic Impairment	Key Clinical Considerations
Phenytoin	Hepatic (CYP2C9/19)	Generally stable, but serum levels may fluctuate	Reduced metabolism → drug accumulation	Monitor serum levels; adjust dose in severe liver impairment
Propofol	Hepatic and biliary excretion*	Generally unchanged	Reduced metabolism → prolonged effect	Requires close monitoring of sedation depth and blood pressure
Aminoglycosides (Gentamicin)	Renal	Rapid accumulation → nephro- and ototoxicity	Minimal effect	Requires precise dosing and serum level monitoring
Vasopressors	Variable	Hemodynamic effect may increase	Drug-dependent	Continuous monitoring of blood pressure and heart rate

* Note: Pulmonary uptake, redistribution, and extrahepatic clearance (including lung metabolism and tissue sequestration) contribute to propofol elimination, particularly during prolonged infusion in critically ill patients.

Table 2. Common Acute Care Drugs and Risk of Drug Interactions

Drug	Drug Class	High-Risk Interactions	Clinical Risk	Management Considerations
Norepinephrine	Vasopressor	Antiarrhythmics, diuretics	Hypertension/hypotension, arrhythmia	Continuous hemodynamic monitoring
Broad-Spectrum Antibiotics	Antibiotic	Anticoagulants, NSAIDs	Increased risk of bleeding or nephrotoxicity	Assess interactions; adjust dose
Amiodarone	Antiarrhythmic	Vasopressors, digitalis	QT prolongation (dose-dependent; torsades de pointes is rare, <1%), arrhythmia	Monitor ECG and electrolytes
Morphine	Opioid	Benzodiazepines, CNS depressants	Respiratory depression, sedation	Monitor respiration and consciousness

Therapy should be re-evaluated or discontinued when QTc exceeds 500–550 ms or when there is an increase of more than 60 ms from baseline. The risk of malignant arrhythmias is further increased in the presence of electrolyte disturbances, including hypokalemia, hypomagnesemia, and bradycardia. Continuous ECG monitoring in intensive care settings enables the early detection of arrhythmic risk and timely pharmacological intervention.

Future Directions: Pharmacogenetics and Precision Medicine

Recent advances in pharmacogenetics, predictive modeling of drug responses, and targeted drug delivery suggest a future in which medications can be selected and dosed based on individual genetic profiles and real-time clinical statuses [9]. These innovations have the potential to significantly enhance the precision and safety of therapy in acute care settings [10].

Conclusion

Success in acute care pharmacology requires not only mastery of drug mechanisms but also the ability to rapidly analyze clinical data and make evidence-based decisions in real-time. Pharmacology in acute care represents the integration of pharmacological principles with real-time clinical decision-making, which directly impacts patient survival and recovery. The tables provide a concise, practical overview of pharmacokinetic changes and drug interaction risks and serve as reference tools for clinical decision-making.

Ethical Consideration

Not appliable

Declaration of Competing Interest

The author declares no conflicts of interest related to the development, analysis, or presentation of the concepts described in this manuscript.

Acknowledgments

Not appliable

Funding

This study did not receive any external funding.

Data Availability

Not appliable

Declaration of Generative AI

The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of tables, or their corresponding captions.

References

1. Vasilevskis EE, Chui MA, Mai S, Kripalani S. Medication Safety in Acute Care Settings. Medical Clinics of North America. 2025 Sep;109(5):1029-1045. https://doi.org/10.1016/j.mcna.2025.02.010

2. Zhao B, Shen Y, Devlin JW, Murphy DJ, Smith SE, Murray B, Rowe S, Sikora A. Prediction of pharmacist medication interventions using medication regimen complexity. JAMIA Open. 2025 Nov 3;8(6):ooaf138. https://doi.org/10.1093/jamiaopen/ooaf138

3. Alhaj HA, Samara J, Alnamous A, Karima R, Saber-Ayad M. Advancing drug safety in psychiatry: insights from pharmacogenomics of hypersensitivity reactions. Front Pharmacology. 2025 Sep 19;16:1651898. https://doi.org/10.3389/fphar.2025.1651898

4 Tanaka R. Pharmacokinetic variability and significance of therapeutic drug monitoring for broad-spectrum antimicrobials in critically ill patients. Journal of Pharmaceutical Health Care and Sciences. 2025 Mar 17;11(1):21. https://doi.org/10.1186/s40780-025-00425-6

5. Wang R, Jiang X, Cao Q, Zhang W. Pharmacokinetics and Safety of Fospropofol Disodium for Injection in Subjects with Hepatic Impairment Compared with Healthy Matched Controls: A Prospective Cohort Study. Drug Design, Development and Therapy. 2025 Oct 17;19:9355-9366. https://doi.org/10.2147/DDDT.S545798

6. Godinho M, Marques L, Vale N. Comprehensive PBPK Evaluation of Phenytoin and Indomethacin: Dose, Age, Pregnancy and Drug–Drug Interaction Insights. International Journal of Translational Medicine. 2025 Dec 18;5(4):58.

7. Dupont V, Mourvillier B, Barbe C, Legros V, Jozwiak M, Merdji H, Dupuis C, Winiszewski H, Marchalot A, Lacave G, Neuville M, Sagnier A, Barbier F, Thivilier C, Ruiz S, Smonig R, Rosman J, Argaud L, Grangé S, Sarton B, Chillet P, Voiriot G, Kanagaratnam L, Djerada Z. Amikacin use in critically ill patients requiring renal replacement therapy: the AMIDIAL-ICU study. Annals of Intensive Care. 2025 Mar 26;15(1):42. https://doi.org/10.1186/s13613-025-01461-z

8. Abhishek T, Mukunda N, Rooparani K. Evaluation of Potential Drug-Drug Interactions with Antimicrobials among Critically Ill Patients in Intensive Care Units of a Tertiary Care Hospital: A Cross-Sectional Study. J Pharm Bioallied Sci. 2025 May;17(Suppl 1):S311-S313. https://doi.org/10.4103/jpbs.jpbs_1870_24

9. Westergaard N, Lund TM, Vermehren C. Predictive Biomarkers and Personalized Therapy: Use of Pharmacogenetic Testing in a Scandinavian Perspective. Basic Clin Pharmacol Toxicol. 2025 Mar;136(3):e70009. https://doi.org/10.1111/bcpt.70009

10. Mosch R, van der Lee M, Guchelaar HJ, Swen JJ. Pharmacogenetic Panel Testing: A Review of Current Practice and Potential for Clinical Implementation. Annual Review of Pharmacology and Toxicology. 2025 Jan;65(1):91-109.