J Current Biomed Report
ISSN: 2717-1906
2025, Volume 6, Number 3
Letters to Editor

From empirical to precision therapy in ICUs: Rethinking antibiotic use after COVID-19

Hossein Azarmina[1], Niloofar Keikhaei[2,*], Kamyar Kharazmi[1]

1. *Critical Care Quality Improvement Research Center, Shahid Modarres Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
2. *Sayad Shirazi Hospital, Department of Internal Medicine, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran*

To the Editor

Article info:
Received: 23 Aug 2025
Accepted: 10 Sep 2025

Keywords:
Post-COVID
Critical care
Antibiotic resistance

The coronavirus disease 2019 (COVID-19) pandemic caused a unique surge in empiric broad-spectrum antibiotic use in intensive care units (ICUs), even when bacterial coinfection was unlikely [1-3]. Such widespread empirical prescribing, while understandable under crisis conditions, has likely accelerated antimicrobial resistance (AMR) in critical care settings, exacerbating challenges for post-pandemic infection management. In this regard, we believe the time is suitable to advocate a transition from empirical toward precision-based antimicrobial therapy in ICUs, integrating diagnostics, stewardship, and clinical decision support to better shape antibiotic use. During the early waves of COVID-19, studies documented that antibiotic prescribing rates were high, reaching nearly 70 % in ICU and hospitalized patients, despite bacterial coinfection rates typically being low [1,4,5]. For example, an observational analysis revealed that empirical antibiotic overuse in a COVID-19 ICU correlated with increased spread of carbapenem-resistant Gram-negative (CR-GNB) pathogens [6]. These observations underscore a critical gap between prevailing clinical practices and the true microbiological risk profile in critically ill patients, a gap largely driven by diagnostic uncertainty and the fear of overlooking bacterial superinfection. Transitioning to precision therapy requires several integrated strategies. First, rapid diagnostics (e.g. multiplex polymerase chain reaction [PCR] panels, molecular pathogen detection, antimicrobial resistance gene assays) used within an antimicrobial stewardship framework have already demonstrated reduced time to optimal therapy, shorter hospital stays, and mortality benefits in bloodstream infections [7,8]. A network meta-analysis of 88 studies found that combining rapid diagnostic tests (RDTs) with stewardship programs reduced mortality compared to standard blood culture alone (odds ratio [OR] 0.72; 95 % CI 0.59–0.87) [9]. However, RDTs alone offered no benefit, underlining the importance of the stewardship component. Second, diagnostic stewardship ordering the right test for the right patient at the right time is essential to avoid overinterpretation or misapplication of molecular results [10]. Third, artificial intelligence-driven decision support, local antibiogram integration, risk stratification tools, and biomarker-guided algorithms (e.g., procalcitonin, CRP kinetics) can help clinicians calibrate antibiotic initiation and adjustment more precisely [11,12].

Realizing this paradigm shift requires investment in infrastructure, 24/7 molecular testing capacity, and integration of infectious diseases, pharmacy, and microbiology teams into ICU workflows.

Corresponding Author(s):
Niloofar Keikhaei, MD
Address: *Sayad Shirazi Hospital, Department of Internal Medicine, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran*
Tel: +98 17 3220 2154
E-mail: Keikhaei.n@gmail.com

Institutional protocols should adopt rapid diagnostic–guided pathways with continuous monitoring, while clinical and observational studies are needed to validate precision algorithms, particularly in post-COVID populations. Building acceptance among intensivists depends on outcome evidence confirming the safety of de-escalation in high-risk patients, consistent with the stewardship principle of delivering the right drug at the right time and for the right duration [13].

In conclusion, the empirical antibiotic paradigm that dominated ICU practice during COVID-19 was a necessary short-term response to uncertainty, but it is unsustainable in a post-pandemic era faced with accelerating AMR. ICUs must evolve toward precision antimicrobial prescribing, leveraging diagnostics, stewardship, and smart decision support to preserve therapeutic options, reduce collateral harm, and optimize patient outcomes. We call upon critical-care leaders, journal editors, and funding agencies to prioritize and support research, infrastructure, and guideline updates that embed precision therapy into standard ICU practice.

Acknowledgement

The authors acknowledge that artificial intelligence (AI)-based tools were used to assist in language editing and improving the clarity of the manuscript. No AI tool was employed for interpretation of results, or generation of scientific conclusions. The authors take full responsibility for the content and integrity of the work.

Authors' contributions

HA, NK, KK: conceived the idea and drafted the initial version of the manuscript. NK, KK: contributed to the literature review and critical discussion. HA, NK: provided revisions for intellectual content and supervised the overall development of the work. All authors approved the final version of the manuscript.

Conflict of interest

No potential conflict of interest was reported by the authors.

Ethical declarations

Not applicable.

Financial support

Self-funded.

References

1. Abu-Rub LI, Abdelrahman HA, Johar AA, Alhussain HA, Hadi HA, Eltai NO. Antibiotics Prescribing in Intensive Care Settings during the COVID-19 Era: A Systematic Review. Antibiotics (Basel). 2021;10(8):935. DOI: 10.3390/antibiotics10080935 PMID: 34438985
2. Langford BJ, So M, Raybardhan S, Leung V, Westwood D, MacFadden DR, et al. Bacterial co-infection and secondary infection in patients with COVID-19: a living rapid review and meta-analysis. Clin Microbiol Infect. 2020;26(12):1622-1629. DOI: 10.1016/j.cmi.2020.07.016 PMID: 32711058
3. Rawson TM, Moore LSP, Zhu N, Ranganathan N, Skolimowska K, Gilchrist M, et al. Bacterial and Fungal Coinfection in Individuals With Coronavirus: A Rapid Review To Support COVID-19 Antimicrobial Prescribing. Clin Infect Dis. 2020;71(9):2459-2468. DOI: 10.1093/cid/ciaa530 PMID: 32358954
4. Karakoc HN, Aydin M, Ozcan SN, Olcar Y, Sumlu E, Dindar EK, et al. To prescribe or not: a two-center retrospective observational study of antibiotics usage and outcomes of COVID-19 in Turkey. Sci Rep. 2024;14(1):21031. DOI: 10.1038/s41598-024-72086-8 PMID: 39251674
5. O'Kelly B, Cronin C, Connellan D, Griffin S, Connolly SP, McGrath J, et al. Antibiotic prescribing patterns in patients hospitalized with COVID-19: lessons from the first wave. JAC Antimicrob Resist. 2021;3(2):dlab085. DOI: 10.1093/jacamr/dlab085 PMID: 34223144
6. Dambroso-Altafini D, Dos Santos Saalfeld SM, de Souza Ferreira de Mattos M, Martinez HV, Shinohara DR, Zarpellon MN, et al. Overuse of empirical antibiotics in a COVID-19 intensive care unit led to the spread of carbapenem-resistant Gram-negative bacteria in a teaching hospital. J Glob Antimicrob Resist. 2022;30:100-102. DOI: 10.1016/j.jgar.2022.06.006 PMID: 35710060
7. Timbrook TT, Morton JB, McConeghy KW, Caffrey AR, Mylonakis E, LaPlante KL. The Effect of Molecular Rapid Diagnostic Testing on Clinical Outcomes in Bloodstream Infections: A Systematic Review and Meta-analysis. Clin Infect Dis. 2017;64(1):15-23. DOI: 10.1093/cid/ciw649 PMID: 27678085
8. Mojebi A, Wu P, Keeping S, Hale B, Chase JG, Beaubrun A. Clinical impact of rapid molecular diagnostic tests in patients presenting with viral respiratory symptoms: A systematic literature review. PLoS One. 2024;19(6):e0303560. DOI: 10.1371/journal.pone.0303560 PMID: 38870136
9. Peri AM, Chatfield MD, Ling W, Furuya-Kanamori L, Harris PNA, Paterson DL. Rapid Diagnostic Tests and Antimicrobial Stewardship Programs for the Management of Bloodstream Infection: What Is Their Relative Contribution to Improving Clinical Outcomes? A Systematic Review and Network Meta-analysis. Clin Infect Dis. 2024;79(2):502-515. DOI: 10.1093/cid/ciae234 PMID: 38676943
10. Messacar K, Parker SK, Todd JK, Dominguez SR. Implementation of Rapid Molecular Infectious Disease Diagnostics: the Role of Diagnostic and Antimicrobial Stewardship. J Clin Microbiol. 2017;55(3):715-723. DOI: 10.1128/JCM.02264-16 PMID: 28031432
11. Ackermann K, Baker J, Green M, Fullick M, Varinli H, Westbrook J, et al. Computerized Clinical Decision Support Systems for the Early Detection of Sepsis Among Adult Inpatients: Scoping Review. J Med Internet Res. 2022;24(2):e31083. DOI: 10.2196/31083 PMID: 35195528
12. Duijkers R, Prins HJ, Kross M, Snijders D, van den Berg JWK, Werkman GM, et al. Biomarker guided antibiotic stewardship in community acquired pneumonia: A randomized controlled trial. PLoS One. 2024;19(8):e0307193. DOI: 10.1371/journal.pone.0307193 PMID: 39163362
13. Wunderink RG, Srinivasan A, Barie PS, Chastre J, Dela Cruz CS, Douglas IS, et al. Antibiotic Stewardship in the Intensive Care Unit. An Official American Thoracic Society Workshop Report in Collaboration with the AACN, CHEST, CDC, and SCCM. Ann Am Thorac Soc. 2020;17(5):531-540. DOI: 10.1513/AnnalsATS.202003-188ST PMID: 32356696