

EDITORIAL VIEW

INTENSIVE CARE

Highlighting the critical care innovations against severe dengue: mortality insights charting the next frontier

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ABSTRACT

Severe dengue has become one of the largest health issues globally, recording more than 6 million cases and more than 20,000 deaths in 2024 alone. Although there is an improvement in vaccines, critical care interventions, timely, correct and resource sensitive remain pivotal towards ensuring a reduced death toll at the acute stage. The current trend of point of care Endothelial biomarkers, ultrasound guided resuscitation and AI-based shock prediction systems have reshaped the already in place model of the dengue management system into a precision guided system. The technologies help clinicians detect plasma leakage earlier, predict hemodynamic failure and tailor fluid treatment more precisely and eventually preventing cases of preventable organ failure and death. This editorial suggests that there is an emerging paradigm of precision critical care in dengue and the subsequent steps to convert innovation into survival.

Keywords: Severe Dengue, Critical Care, Plasma Leakage, Hemodynamic Monitoring, Endothelial Biomarkers, Ultrasound-Guided Resuscitation, Predictive Analytics, AI-Assisted Triage

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Clinicians are now-a-days confronted with managing catastrophic plasma leakage without triggering any iatrogenic injury caused by the use of inappropriate fluid management, among severe dengue patients. Conventional clinical manifestations, such as hemoconcentration, narrow pulse pressure and warning symptoms are although essential, they only manifest after the significant volume loss due to endothelial dysfunction has occurred.¹ Conversely, new technologies in critical healthcare systems change care to a proactive approach, in which pre-shock, occult bleeding, and fluid responsiveness can be identified at the onset, prior to clinical degradation. This is especially important in high-risk populations, such as the population of children and pregnant women and elderly patients, where a slight delay in the correction of instability can be fatal.²

Recent findings revealed that activation of endothelium and glycocalyx damages commence hours prior to the development of clinical plasma leakage in dengue patients.³ New biomarkers including Angiopoietin-2, soluble VCAM-1, IL-10, VEGF and NS1 antigen

kinetics are early molecular markers of capillary leakage that is superior to traditional trends of hematocrit.⁴ It is now possible to incorporate host immune activation profiles with viral dynamics into machine-learning-enhanced biomarker panels to predict the risk of developing shock or severe leakage.⁵ This development minimizes mortality rate as compared with conventional patient care system.

The unforeseen dengue fluid dynamics makes the disease particularly vulnerable to both under-resuscitation and fluid overload. Sophisticated programs, developed on thousands of ICU dengue cases are able to spot minute changes in the waveform, disturbances in perfusion, and a lactate pattern long before clinical shock occurs.⁶ These systems have a self-improving platform which utilizes the accumulated data to refine its threshold. In pilot studies, AI-assisted triage devices have been shown to predict the development of serious dengue up to 12 to 24 hours beforehand.⁷ This predictive ability is revolutionary to resource constrained environments and minimize death rates.

Recent systems combine thromboelastography, fibrinolysis indicators and endothelial stress biomarkers with platelet counts to develop a multidimensional bleeding risk index.⁸ Moreover, closed-loop systems, already successful in ARDS (acute respiratory distress syndrome) ventilation and perioperative anesthesia, are now being tested in dengue shock management.⁹ These platforms use predictive algorithms to titrate fluids or vasopressors automatically within clinician-defined safety boundaries. Early data indicate more stable hemodynamics, fewer fluid-related complications, and shorter recovery time compared to manual titration.¹⁰ Although ethical and regulatory considerations remain, semi-autonomous dengue management may soon complement human expertise and help overcome workforce shortages during outbreaks.

These innovations have a significant role in transforming the reorganization of the pre-ICU triage.¹¹ Predictive analytics will help identify patients at risk, whereas biomarker panels can help figure out who must be placed under high-dependency watch. This advances dengue care to a “wait and rescue model” into a “predict and prevent model”.¹² These tools make it not a fluid and organ support in serious disease management, but a concerted strategy of anticipation, prevention and personalization.

Better alternatives in critical care are not innovations, but a change in the knowledge of severe dengue and its treatment. Severe dengue treatment will also be taken over by precision monitoring and intelligent technologies but the human judgement will still be vital. The next decade would be dedicated to the proliferation of these innovations to the places where the dengue is the most lethal. The personalized, predictive, and prevention-based treatment of dengue in the future would be focused on data and move towards anticipatory critical care.

Conflict of Interest

Nil declared by the author.

Author's contribution

Sitara Nasar is the sole author of this editorial.

REFERENCES

1. McBride A, Chanh HQ, Fraser JF, Yacoub S, Obonyo NG. Microvascular dysfunction in septic and dengue shock: Pathophysiology and implications for clinical management. *Global Cardiology Science & Practice*. 2020 Nov 30;2020(2):e202029. doi: 10.21542/gcsp.2020.29.
2. Jeng MJ, Lee NY, Lee K, Chen YC, Huang WC, Hsu JC, et al. Prognosis and mortality risk in elderly patients with dengue virus infection: Excess fatality and the urgent need for revising current WHO criteria for elderly patients. *Travel Medicine and Infectious Disease*. 2025 May 1;65:102855. doi: 10.1016/j.tmaid.2025.102855.
3. Buijssers B, Garishah FM, Riswari SF, van Ast RM, Pramudo SG, Tunjungputri RN, et al. Increased plasma heparanase activity and endothelial glycocalyx degradation in dengue patients is associated with plasma leakage. *Frontiers in Immunology*. 2021 Dec 20;12:759570. doi: 10.3389/fimmu.2021.759570.
4. Chia PY. Endothelial damage and cardiac dysfunction in the pathophysiology of severe dengue in adults. doi: 10.32657/10356/166502.
5. Tana C, Soloperto M, Giuliano G, Erroi G, Di Maggio A, Tortorella C, et al. Artificial Intelligence for Predicting Lung Immune Responses to Viral Infections: From Mechanistic Insights to Clinical Applications. *Viruses*. 2025 Nov 7;17(11):1482. doi: 10.3390/v17111482.
6. Lyle NN, Chanh HQ, Nguyen Van H, Anibal J, Karolcik S, Ming D, et al. An artificial intelligence-based approach to identify volume status in patients with severe dengue using wearable PPG data. *PLOS Digital Health*. 2025 Jul 18;4(7):e0000924. doi: 10.1371/journal.pdig.0000924.
7. Nivasheni B, Fernando VG, Srihari M, Sarah MI. AI Assisted Diagnosis of Dengue Amid Arboviral Diseases, Severity Prediction, and Post Effects. In: 2024 9th International Conference on Information Technology Research (ICITR). 2024 Dec 5;1–6. doi: 10.1109/ICITR64794.2024.10857778.
8. Yoon I, Han JH, Jeon HJ. Advances in platelet-dysfunction diagnostic technologies. *Biomolecules*. 2024 Jun;14(6):714. doi: 10.3390/biom14060714.
9. Buiteman-Kruizinga LA, van Meenen DM, Bos LD, van der Heiden PL, Paulus F, Schultz MJ. A closed-loop ventilation mode that targets the lowest work and force of breathing reduces the transpulmonary driving pressure in patients with moderate-to-severe ARDS. *Intensive Care Medicine Experimental*. 2023 Jul 14;11(1):42. doi: 10.1186/s40635-023-00527-1.
10. Vidyashree J, Nayak NS, Swamy S. Impact of fluid management strategies on clinical outcomes of dengue. *European Journal of Cardiovascular Medicine*. 2025 Jan 19;15:254–60. doi: 10.5083/ejcm/25-01-42.
11. Garrido NJ, González-Martínez F, Losada S, Plaza A, Del Olmo E, Mateo J. Innovation through

artificial intelligence in triage systems for resource optimization in future pandemics. *Biomimetics*. 2024 Jul 18;9(7):440. doi: 10.3390/biomimetics9070440.

12. Gupta G, Khan S, Guleria V, Almjally A, Alabdullah BI, Siddiqui T, et al. DDPM: A dengue disease prediction and diagnosis model using sentiment analysis and machine learning algorithms. *Diagnostics*. 2023 Mar 14;13(6):1093. doi: 10.3390/diagnostics13061093.