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Bioimpedance-Guided De-resuscitation in Septic Shock: Bridging Fluid Distribution, Microcirculation, and Precision Fluid Stewardship – A Narrative Review

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ABSTRACT:
Fluid management in septic shock remains challenging, particularly during the transition from resuscitation to de-resuscitation, where fluid overload is associated with adverse clinical outcomes. Conventional methods for assessing fluid status have important limitations and often fail to accurately reflect fluid distribution, especially interstitial accumulation. Bioimpedance Analysis (BIA) has emerged as a non-invasive bedside tool capable of quantifying total body water, extracellular water, and the extracellular-to-total body water (ECW/TBW) ratio, providing insight into fluid compartmentalization. This narrative review summarizes current evidence on the physiological basis and clinical utility of BIA in critically ill and septic patients. Available studies consistently demonstrate that elevated ECW and ECW/TBW ratio are associated with increased mortality, prolonged mechanical ventilation, and longer intensive care unit stay. BIA also shows potential for real-time monitoring of fluid shifts and may help guide individualized de-resuscitation strategies by identifying fluid overload and evaluating response to therapy. However, its clinical application is limited by heterogeneity in study populations, lack of standardized protocols, and insufficient high-quality randomized controlled trials specifically in septic shock. Overall, BIA represents a promising adjunctive tool for fluid assessment and management, but further research is required to establish its role in guiding de-resuscitation and improving patient outcomes.

1. Introduction

Sepsis and septic shock remain major causes of morbidity and mortality in intensive care units (ICUs) worldwide (La Via et al., 2025). Early fluid resuscitation is essential to restore tissue perfusion; however, excessive fluid administration frequently leads to fluid overload, which is associated with worse clinical outcomes (Ramesh & Adams, 2023; Ziaka et al., 2025). Recent approaches emphasize a more balanced fluid strategy, including de-resuscitation during the later phase of care (Malbrain et al., 2020; Naorungroj et al., 2025). Within the ROSE concept (resuscitation, optimization, stabilization, evacuation), de-resuscitation focuses on removing excess fluid to reduce tissue edema and improve organ function (Pantet et al., 2025). Fluid overload has been linked to prolonged mechanical ventilation, increased ICU length of stay, and higher mortality, largely due to capillary leak, endothelial dysfunction, and interstitial fluid accumulation (Sbaraini Zernini et al., 2025; Ziaka & Exadaktylos, 2025).

Accurate assessment of fluid status is therefore crucial but remains challenging (Patel et al., 2023). Conventional methods such as central venous pressure, urine output, body weight, and imaging techniques have important limitations in accuracy, invasiveness, or feasibility for repeated bedside use (Giangregorio et al.,

2025). Currently, no single gold standard exists for fluid assessment in critically ill patients. Bioimpedance Analysis (BIA) has emerged as a promising non-invasive bedside tool for evaluating fluid status (Madsen et al., 2021). By measuring tissue resistance and reactance, BIA provides estimates of total body water (TBW), extracellular water (ECW), and the ECW/TBW ratio, enabling assessment of fluid distribution and detection of overhydration. Its ease of use and ability for serial monitoring make it particularly attractive in critical care settings (Chung et al., 2024).

Septic shock–associated fluid overload is increasingly recognized not merely as a consequence of excessive fluid administration, but as a manifestation of maladaptive fluid distribution driven by endothelial dysfunction and capillary leak. In this context, the transition from resuscitation to de-resuscitation requires not only assessment of intravascular volume but also quantification of interstitial fluid accumulation. We propose a conceptual integration of BIA into precision fluid stewardship, linking macrocirculation (blood pressure, cardiac output, vasopressor requirement), microcirculation and endothelial integrity (glycocalyx disruption, capillary leak, tissue edema), and fluid distribution (ECW, TBW, and ECW/TBW ratio). Within this framework, BIA serves as a bridge between pathophysiology and clinical decision-making, enabling early detection of interstitial fluid accumulation, identification of the transition from fluid responsiveness to fluid intolerance, and guidance of individualized de-resuscitation strategies. This approach aligns with the ROSE concept while extending it toward distribution-guided fluid management rather than purely volume-based strategies.

Several studies have demonstrated associations between BIA-derived parameters, especially increased ECW and ECW/TBW ratio, and adverse clinical outcomes. However, the role of BIA in guiding de-resuscitation specifically in septic shock remains unclear, with existing evidence still limited and fragmented. This literature review aims to evaluate the role of Bioimpedance Analysis as a bedside tool for guiding de-resuscitation in septic shock, focusing on its physiological basis, relevant parameters, and clinical implications based on current evidence.

2. Methods

This study was conducted as a narrative literature review to summarize current evidence regarding the role of BIA in guiding de-resuscitation in septic shock. A comprehensive literature search was performed using electronic databases, including PubMed, Scopus, and Google Scholar, to identify relevant studies published up to 2020. The search strategy incorporated combinations of the following keywords: “bioimpedance analysis,” “septic shock,” “fluid overload,” “fluid management,” and “de-resuscitation,” using appropriate Boolean operators to refine the results.

Studies were considered eligible if they involved adult or pediatric critically ill patients, particularly those with sepsis or septic shock, and evaluated the use of BIA or bioimpedance-derived parameters in assessing fluid status. Articles were also required to report clinical outcomes related to fluid balance, such as mortality, length of stay, or duration of mechanical ventilation, and to be original research studies, including randomized controlled trials, cohort studies, or observational studies. Studies were excluded if they were conducted in non-human subjects, published in languages other than English, or presented as conference abstracts, editorials, or commentaries without sufficient data. Articles not directly related to BIA or fluid assessment were also excluded.

The study selection process was conducted by screening titles and abstracts to identify potentially relevant articles, followed by full-text review to determine final eligibility based on predefined criteria. In addition, manual searches of reference lists from selected articles were performed to identify further relevant studies.

Data were extracted from the included studies focusing on study design, patient characteristics, BIA-derived parameters such as total body water, extracellular water, and ECW/TBW ratio, as well as reported clinical outcomes. The findings were then synthesized narratively, with emphasis on the physiological basis, clinical relevance, and potential role of BIA as a bedside tool to guide de-resuscitation strategies in patients with septic shock.

3. Results and Discussion

3.1 Pathophysiological Basis of Fluid Overload and the Need for Advanced Monitoring

Fluid overload in septic shock is not merely a consequence of excessive fluid administration but reflects a complex pathophysiological process involving systemic inflammation, endothelial injury, and profound alterations in vascular permeability (Martin-Loeches et al., 2025; Pfortmueller et al., 2024). The inflammatory response characteristic of sepsis leads to disruption of the endothelial glycocalyx, resulting in increased capillary permeability and leakage of plasma components into the interstitial space (Iba et al., 2024). This process promotes extracellular fluid accumulation, commonly referred to as third spacing, which contributes to tissue edema, impaired oxygen diffusion, and ultimately organ dysfunction.

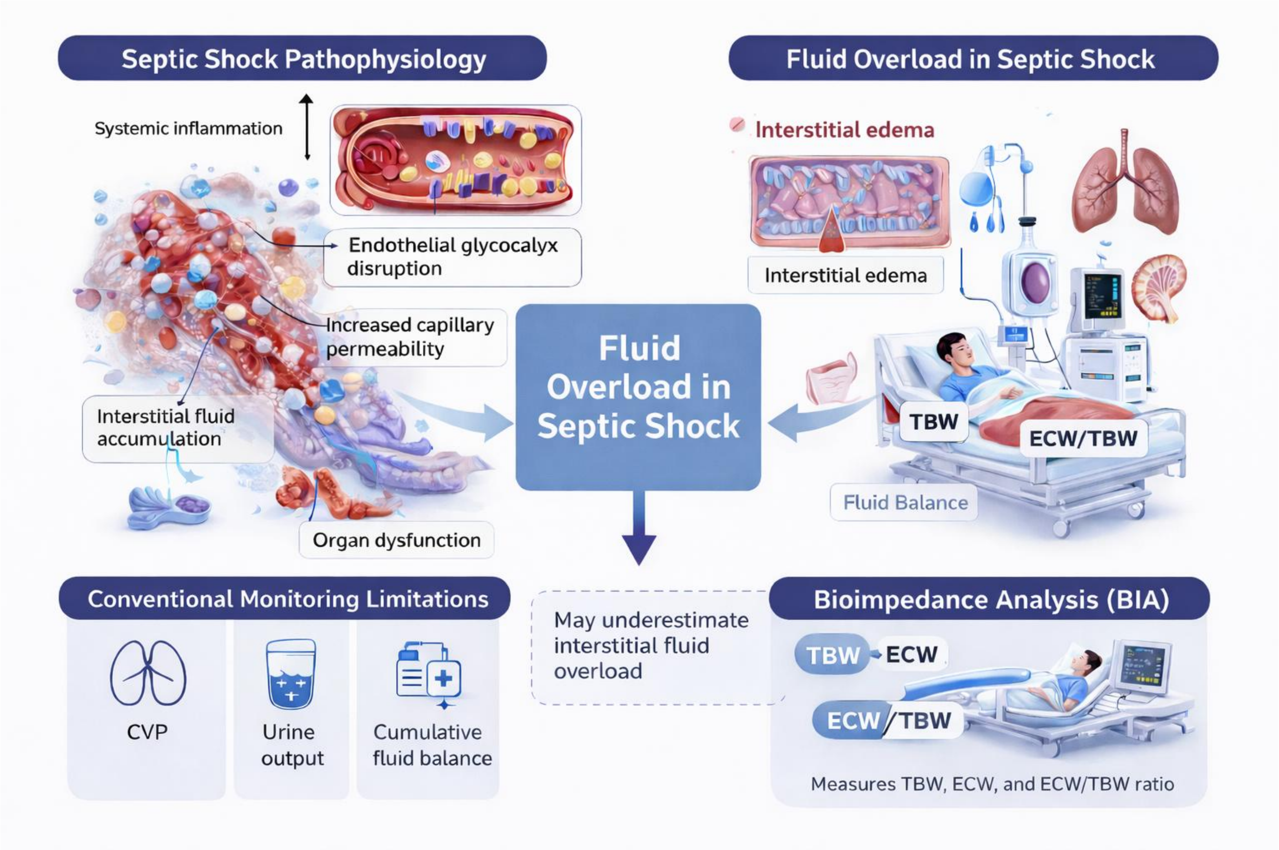

Figure 1. Pathophysiological basis of fluid overload in septic shock and the role of BIA in fluid assessment.

Importantly, these alterations in fluid distribution are often not adequately captured by conventional monitoring tools (Graziani et al., 2025; Weigl et al., 2022). Parameters such as central venous pressure, urine output, and cumulative fluid balance primarily reflect intravascular status and may fail to detect early or subclinical interstitial fluid accumulation (Semedi & Soediono, 2024). As a result, clinicians may underestimate the degree of fluid overload, particularly in the later phases of septic shock when hemodynamic parameters appear stable despite ongoing tissue edema.

This limitation underscores the need for monitoring tools that provide insight into fluid compartmentalization rather than absolute volume alone. BIA addresses this gap by enabling quantitative assessment of TBW and ECW, as well as their ratio (ECW/TBW). From a physiological standpoint, the ECW/TBW ratio is particularly relevant, as it reflects the redistribution of fluid toward the extracellular space, which is the hallmark of capillary leak and interstitial edema in septic shock. Therefore, the pathophysiological basis of septic shock strongly supports the integration of tools such as BIA into clinical practice, particularly during the

transition from resuscitation to de-resuscitation, where accurate assessment of fluid overload becomes critical.

3.2 Clinical Evidence of BIA in Critically Ill and Septic Populations

The evidence summarized in Table 1 consistently demonstrates that BIA-derived parameters, particularly ECW and ECW/TBW ratio, are closely associated with clinically relevant outcomes across both septic and general ICU populations.

Table 1. Summary of Key Studies on Bioimpedance Analysis in Critical Illness and Septic Shock

No	Author (Year)	Title	Study Design	Population	Key Findings
1	Chae et al. (2021)	Extracellular Water to Total Body Water Ratio in Septic Shock Patients Receiving Protocol-Driven Resuscitation Bundle Therapy	Prospective	Septic shock	ECW/TBW ≥0.41 ↑ mortality
2	Kyosebekirov et al. (2024)	Bioimpedance analysis for fluid status assessment in critically ill septic patients	Observational	ICU sepsis	BIA useful for fluid assessment
3	Dahlan et al. (2025)	The relationship of bioimpedance analysis to central venous pressure, degree of edema, and cumulative fluid balance in septic shock patients in the intensive care unit	Observational	Septic ICU	ECW ↑ associated with mortality
4	Shin et al. (2021)	Comparison of body water status and its distribution in patients with non-septic infection, patients with sepsis, and healthy controls	Observational	Sepsis	ECW/TBW ↑ vs healthy controls
5	Myatchin et al. (2020)	Bio-electrical impedance analysis in critically ill patients: are we ready for prime time?	Review	ICU patients	BIA predicts LOS & outcomes
6	Karpavičiūtė et al. (2021)	Assessment of Fluid Status by Bioimpedance Analysis and Central Venous Pressure Measurement and Their Association with the Outcomes of Severe Acute Kidney Injury	Prospective	AKI ICU	Hyperhydration linked to outcomes
7	Cleymaet et al. (2023)	Comparison of Bioelectrical Impedance Analysis (BIA)-Derived Parameters in Healthy Volunteers and Critically Ill Patients	Review	ICU	Mixed evidence ECW/TBW vs mortality
8	Pérez-Morales et al (2021)	Extracellular water/total body water ratio as predictor of mortality in hemodialysis patients	Clinical Study	Hemodialysis patients	ECW/TBW ↑ predicts mortality
9	Chung et al (2024)	Effect of rigorous fluid management using monitoring of ECW ratio by bioelectrical impedance analysis in critically ill postoperative patients: A	Randomized Control Trials	Critically ill postoperative ICU patients	ECW/TBW-guided fluid management ↓ 28-day mortality; ECW/TBW >0.406 ↑

		prospective, single-blind, randomized controlled study			complications & mortality risk
10	Vaara et al (2021)	Restrictive fluid management versus usual care in acute kidney injury (REVERSE-AKI): a pilot randomized controlled feasibility trial	Research Article	ICU patients with AKI post-initial resuscitation	Restrictive fluid strategy ↓ fluid balance, ↓ RRT need, ↓ adverse events

In septic shock, Chae et al. (2021) provided one of the most robust prospective datasets, showing that an ECW/TBW ratio ≥0.41 independently predicted mortality. This finding is clinically significant, as it suggests the existence of a measurable threshold beyond which extracellular fluid accumulation becomes detrimental. Supporting this, Shin et al. (2021) demonstrated that patients with sepsis exhibit significantly higher ECW/TBW ratios compared to non-septic individuals, indicating that fluid redistribution is a defining feature of the septic state rather than merely a consequence of fluid therapy. Similarly, Dahlan et al. (2025) showed that increased ECW correlates with edema severity and cumulative fluid balance, reinforcing the ability of BIA to reflect real-time fluid dynamics in critically ill patients.

Beyond septic shock, broader ICU studies further validate the prognostic relevance of BIA. Karpaviči et al. (2021) reported that hyperhydration assessed by BIA was associated with worse outcomes in patients with acute kidney injury, including increased mortality. Meanwhile, Myatchin et al. (2019) and Cleymaet et al. (2024) highlighted the broader applicability of BIA in predicting ICU length of stay and overall prognosis, suggesting that its utility extends beyond a single disease entity.

Collectively, these findings indicate that BIA-derived parameters are not only markers of fluid status but also reflect underlying disease severity and physiological derangement. Elevated ECW and ECW/TBW ratios appear to be consistently associated with adverse outcomes, including prolonged mechanical ventilation, organ dysfunction, and mortality. Importantly, these associations support the concept that fluid overload is not simply a passive marker but an active contributor to poor outcomes, likely mediated through tissue edema and impaired organ perfusion.

In addition to the previously discussed studies, several other investigations further strengthen the clinical relevance of BIA in fluid assessment. A prospective observational study by Kyosebekirov et al. (2024) demonstrated that serial BIA measurements in septic ICU patients showed a significant correlation between cumulative fluid balance and increases in total body water, extracellular water, and overhydration indices. Importantly, dynamic changes in impedance parameters over the first 72 hours were closely aligned with fluid accumulation trends, suggesting that BIA is capable of capturing real-time fluid shifts in critically ill septic patients. Furthermore, the study highlighted the practicality of BIA as a non-invasive, rapid, and repeatable bedside tool, supporting its feasibility for routine clinical use in fluid monitoring.

Additional evidence from non-ICU populations also reinforces the prognostic value of BIA-derived parameters. Pérez-Morales et al. (2021) reported that an elevated ECW/TBW ratio was a significant predictor of mortality in hemodialysis patients, indicating that extracellular fluid expansion is consistently associated with adverse outcomes across different clinical settings. Although this population differs from septic shock patients, the findings provide important external validation of ECW/TBW as a robust marker of fluid overload and systemic physiological stress.

Taken together, these studies complement existing evidence by demonstrating that BIA is not only capable of reflecting static fluid status but also sensitive to dynamic changes over time. This reinforces its potential role in early detection of fluid accumulation and continuous monitoring during critical illness. Importantly, the consistency of findings across heterogeneous populations suggests that extracellular fluid expansion, as quantified by BIA, represents a fundamental pathophysiological marker rather than a disease-specific phenomenon.

However, it is important to note that variability exists across studies, particularly regarding optimal cut-off values and measurement timing. Differences in patient populations, clinical settings, and BIA methodologies may contribute to these inconsistencies. Nevertheless, the overall trend remains clear: extracellular fluid

expansion, as quantified by BIA, is strongly associated with worse clinical outcomes.

3.3 Comparison of BIA with Other Fluid Assessment Modalities

While BIA offers unique advantages in assessing fluid compartmentalization, it should be interpreted within the broader context of other monitoring modalities. Unlike ultrasound-based techniques that primarily detect venous congestion through parameters such as inferior vena cava variability or venous Doppler patterns, BIA uniquely quantifies global extracellular fluid expansion (Li et al., 2026). This distinction is clinically important, as BIA captures systemic fluid redistribution rather than localized congestion, making it particularly valuable in identifying early interstitial edema before overt organ dysfunction develops. Consequently, BIA enables detection of subclinical fluid accumulation that may not yet be apparent through conventional imaging or standard hemodynamic parameters (Zheng et al., 2024).

In contrast, traditional methods such as central venous pressure, fluid balance charts, and urine output predominantly reflect intravascular volume status and are often insensitive to early interstitial fluid shifts. Advanced hemodynamic monitoring techniques, including transpulmonary thermodilution, provide detailed information on cardiac output, preload indices, and extravascular lung water (Lloyd-Donald et al., 2025). While these methods offer superior insights into cardiopulmonary interactions and organ-specific fluid status, they are invasive, resource-intensive, and not always feasible for repeated bedside use. Similarly, ultrasound-based approaches, including lung ultrasound and venous excess ultrasound (VExUS), are increasingly used to assess organ congestion; however, their interpretation is operator-dependent and primarily reflects regional rather than global fluid distribution (Beltrame et al., 2025).

Within this landscape, BIA occupies a distinct niche by providing a rapid, non-invasive, and reproducible assessment of whole-body fluid distribution. Its ability to quantify total body water and extracellular water, as well as their ratio, offers a surrogate measure of capillary leak and interstitial fluid accumulation, which are central features of septic pathophysiology (Beltrame et al., 2025). This makes BIA particularly relevant during the transition from resuscitation to de-resuscitation, when the clinical challenge shifts from restoring perfusion to preventing or reversing fluid overload.

However, BIA has several important limitations that must be acknowledged. It does not provide direct information regarding cardiac function, vascular tone, or real-time hemodynamic responsiveness. As such, it cannot differentiate between preload dependence and cardiac dysfunction, nor can it guide acute resuscitation decisions in hemodynamically unstable patients (La Porta et al., 2024). Furthermore, its measurements may be influenced by clinical factors such as body positioning, presence of significant edema, mechanical ventilation, and variability between devices, potentially affecting accuracy in critically ill populations. Given these considerations, BIA should not be viewed as a standalone tool but rather as a complementary modality within an integrated monitoring strategy. Its greatest value lies in augmenting, rather than replacing, existing approaches by adding a layer of information on fluid distribution that is otherwise difficult to obtain. When combined with clinical assessment, hemodynamic monitoring, and imaging techniques, BIA contributes to a more comprehensive understanding of a patient's fluid status. This multimodal approach supports a shift toward hybrid precision monitoring, in which therapeutic decisions are guided not only by intravascular parameters but also by the distribution and compartmentalization of body fluids, ultimately enabling more individualized and physiologically informed fluid management in septic shock.

3.4 BIA-Guided De-resuscitation: Clinical Implications and Future Directions

While the diagnostic and prognostic value of BIA is increasingly well established, its role in guiding de-resuscitation strategies represents an evolving and highly relevant area of research. As highlighted by Malbrain et al. (2020) and further emphasized by Pantet et al. (2025), the transition from fluid resuscitation to fluid removal remains one of the most challenging aspects of septic shock management, as traditional parameters often fail to provide clear guidance on when and how to initiate de-resuscitation.

The findings of this review highlight a paradigm shift in fluid management in septic shock, from a volume-centered approach to a distribution-centered strategy. While conventional monitoring focuses on intravascular parameters, the pathophysiology of sepsis, as described

by Pfortmueller et al. (2024) and Iba et al. (2024), underscores the importance of extravascular fluid accumulation as a key determinant of organ dysfunction. In this context, BIA provides a unique advantage by quantifying extracellular water; as demonstrated in the systematic review by Madsen et al. (2021) and supported by clinical findings from Chung et al. (2024), this approach offers insight into interstitial edema and capillary leak that are not adequately captured by conventional tools. This is particularly relevant in the late phases of septic shock, where hemodynamic stability may coexist with significant tissue edema.

However, several critical considerations must be addressed. First, the interpretation of BIA-derived parameters is influenced by multiple factors; for instance, Madsen et al. (2021) and Cleymaet et al. (2024) highlighted that patient positioning, presence of edema, mechanical ventilation, and device variability may introduce measurement bias in critically ill patients. Second, although studies such as those by Chae et al. (2021) and Karpaviči et al. (2021) consistently report associations between elevated ECW/TBW ratio and adverse outcomes, causality remains unproven. Fluid overload may therefore represent both a marker and a mediator of disease severity, complicating interpretation of therapeutic interventions. Third, compared to advanced monitoring modalities, Giangregorio et al. (2025) and Patel et al. (2023) noted that techniques such as transpulmonary thermodilution and ultrasound-based congestion assessment provide more organ-specific information, whereas BIA reflects global fluid distribution, which may limit its role in guiding targeted interventions in complex hemodynamic states.

Despite these limitations, the integration of BIA into a multimodal monitoring strategy offers significant clinical potential. Evidence synthesized by Graziani et al. (2025) and Weigl et al. (2022) suggests that combining clinical assessment, hemodynamic monitoring, and adjunctive tools improves fluid management decisions; within this framework, BIA may enhance the clinician's ability to detect early fluid accumulation, identify the transition from fluid responsiveness to intolerance, and optimize the timing of de-resuscitation.

Building upon this concept, a pragmatic bedside approach can be proposed to integrate BIA into septic shock management. During the initial resuscitation phase within the first 24 hours, management should follow established guidelines; as outlined by Ramesh & Adams (2023) and supported by epidemiological insights from La Via et al. (2025), fluid resuscitation and vasopressor therapy should aim to achieve a mean arterial pressure of at least 65 mmHg and adequate lactate clearance. At this stage, BIA may be used to obtain a baseline ECW/TBW measurement, which serves as a reference for subsequent evaluation of fluid distribution.

During the optimization phase, typically between 24 and 72 hours, clinical assessment should focus on fluid responsiveness, vasopressor requirements, and organ function. Evidence from Chae et al. (2021), who identified an ECW/TBW threshold associated with mortality, and Shin et al. (2021), who demonstrated altered fluid distribution in septic patients, supports the interpretation of BIA measurements during this phase. An ECW/TBW ratio below 0.39 may suggest a euvolemic state, values between 0.39 and 0.41 indicate a borderline condition, and values above 0.41 reflect a high risk of fluid overload.

The transition to de-resuscitation should be considered once hemodynamic stabilization has been achieved; observational findings by Dahlan et al. (2025) and Kyosebekirov et al. (2024) demonstrate that extracellular fluid accumulation correlates with edema severity and fluid balance, supporting the use of ECW/TBW thresholds above approximately 0.40–0.41 as a trigger. In this phase, therapeutic strategies may include diuretic administration in stable patients and initiation of renal replacement therapy in severe cases, as supported by interventional data from Vaara et al. (2021).

Ongoing management requires serial monitoring, and repeated BIA measurements every 24 to 48 hours allow evaluation of dynamic changes in fluid distribution. As fluid overload has been associated with impaired oxygenation and prolonged mechanical ventilation in studies such as Sbaraini Zernini et al. (2025), treatment goals should include reduction in ECW/TBW alongside clinical improvement. De-resuscitation may be tapered once normalization of fluid distribution is achieved. Importantly, this approach illustrates how BIA can be translated from a purely diagnostic modality into a dynamic therapeutic guide, enabling precision fluid management tailored to individual patient physiology.

Evidence supporting this application, although still limited, is promising. The randomized controlled trial conducted by Chung et al. (2024) demonstrated that

ECW/TBW-guided fluid management reduced 28-day mortality and complications in critically ill postoperative patients, while the REVERSE-AKI trial by Vaara et al. (2021) showed that a restrictive fluid strategy improved fluid balance and reduced adverse events. These findings support the concept that targeting fluid distribution rather than volume alone may lead to improved outcomes.

These studies collectively reinforce the role of precision fluid management guided by objective tools. Compared to traditional approaches, Madsen et al. (2021) and Myatchin et al. (2019) emphasized that BIA provides a more comprehensive and repeatable assessment of fluid distribution, making it particularly suitable for bedside application. Nevertheless, several challenges remain before widespread implementation can be recommended. There is currently no standardized protocol defining how BIA measurements should be integrated into clinical decision-making, and cut-off values for clinically significant fluid overload vary across studies. Furthermore, most available evidence remains observational, with a lack of high-quality randomized controlled trials specifically evaluating BIA-guided de-resuscitation in septic shock. In summary, BIA represents a promising tool that bridges physiological understanding and clinical application in fluid management. By enabling quantitative assessment of extracellular fluid accumulation, it offers a unique advantage in guiding de-resuscitation strategies. However, further well-designed studies are required to validate its clinical utility, establish standardized protocols, and determine its impact on patient-centered outcomes in septic shock.

4. Limitations

This review has several limitations that should be acknowledged. First, the majority of the available evidence on BIA in critically ill and septic patients is derived from observational studies, which limits the ability to establish causal relationships. Although consistent associations have been observed between BIA-derived parameters and adverse clinical outcomes, these findings may be influenced by confounding factors such as disease severity, comorbidities, and variations in fluid management practices.

Second, there is considerable heterogeneity among included studies in terms of patient populations, clinical settings, and study designs. Some studies focus specifically on septic shock, while others include broader ICU populations or patients with conditions such as acute kidney injury or postoperative critical illness. This variability may limit the generalizability of findings specifically to septic shock patients.

Third, differences in BIA devices, measurement techniques, and timing of assessment represent another important limitation. Variations in electrode placement, patient positioning, and clinical conditions such as edema or mechanical ventilation may affect measurement accuracy. In addition, there is currently no standardized protocol regarding the optimal timing or frequency of BIA assessment in critically ill patients.

Fourth, the lack of standardized cut-off values for defining fluid overload using BIA parameters, particularly ECW and ECW/TBW ratio, remains a significant challenge. While some studies propose thresholds associated with worse outcomes, these values are not universally validated and may vary across populations and clinical contexts.

Finally, evidence supporting the use of BIA for guiding de-resuscitation strategies remains limited. Although some interventional studies suggest potential benefits of fluid management strategies aligned with BIA principles, there is a lack of large-scale randomized controlled trials specifically evaluating BIA-guided de-resuscitation in septic shock. As a result, the clinical applicability of BIA as a decision-making tool in this context has yet to be fully established.

Given these limitations, further well-designed, multicenter studies are needed to validate the role of BIA, establish standardized protocols, and determine its impact on clinically meaningful outcomes in patients with septic shock.

5. Conclucions

Bioimpedance analysis represents a promising tool for advancing precision fluid management in septic shock by enabling quantitative assessment of fluid distribution. Beyond its diagnostic and prognostic value, BIA has the potential to guide de-resuscitation strategies through dynamic monitoring of extracellular fluid accumulation. However, its role should be considered complementary within a multimodal monitoring framework. While current evidence supports its

association with clinical outcomes, further high-quality studies are required to establish causality and validate its use as a therapeutic guide. The integration of BIA into clinical algorithms may represent an important step toward personalized, physiology-driven fluid stewardship in critical care.

Declarations

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

RRHRR conceptualized the study, performed the literature search, and drafted the manuscript. HN contributed to study design, critical revision of the manuscript, and supervisionAll authors read and approved the final manuscript.

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