Beyond MELD and SOFA: Incremental Prognostic Value of INR/Albumin Ratio in Cirrhotic Patients with Sepsis

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Abstract

Background: Background: Sepsis superimposed on cirrhosis remains a major cause of acute decompensation, organ failure, and short-term mortality, despite advances in supportive care. Cirrhotic patients are particularly susceptible to infection due to impaired innate immunity, bacterial translocation, and cirrhosis-associated immune dysfunction, leading to mortality rates that often exceed general ICU sepsis cohorts. Current bedside risk stratification relies heavily on global scores such as SOFA, which measures organ dysfunction, and MELD/MELD-Na, which assess hepatic reserve. However, these tools only partially capture the complex interplay of coagulopathy and protein-synthetic failure that defines sepsis in cirrhosis. This gap highlights the need for a pragmatic biomarker that is objective, rapidly available, and complementary to existing scoring systems. The international normalized ratio (INR) and serum albumin are routine laboratory assays with strong pathophysiologic relevance. INR reflects impaired hepatic synthesis of clotting factors and sepsis-related coagulopathy, while albumin indicates hepatic protein synthesis, oncotic pressure, endothelial stability, and antioxidant functions. The INR-to-albumin ratio (IAR, also termed PT-INR/albumin or PTAR) integrates these signals into a single metric: elevated INR and reduced albumin yield a higher ratio, effectively tracking hepatic-septic dysfunction. Retrospective studies suggest PTAR independently predicts ICU, hospital, and 28–90-day mortality, performing at least comparably to several liver-focused indices. Albumin's biological plausibility as a risk marker is reinforced by clinical trials, though therapeutic outcomes remain mixed. This review evaluates the incremental prognostic value of IAR beyond MELD, MELD-Na, MELD 3.0, and SOFA in cirrhotic patients with sepsis. It synthesizes pathophysiology, defines and operationalizes IAR (baseline and dynamic trajectories), maps evidence across populations, and examines discrimination and calibration against current standards. Proposed cut-points and workflow integration emphasize triage, escalation, and monitoring, while modifiers such as acute-on-chronic liver failure (ACLF), renal dysfunction, cholestasis, and anticoagulation are considered. Ultimately, IAR emerges as a simple, scalable bedside tool that may enhance early risk stratification if validated in prospective multicenter cohorts.

Keywords: *Sepsis, Cirrhotic Patients, International Normalized Ratio, Albumin Ratio, Outcome, Mortality Prediction.*

Introduction

Sepsis is one of the most devastating complications of cirrhosis, responsible for a substantial proportion of acute decompensation events and hospital deaths. In cirrhotic patients, infections precipitate nearly half of all admissions and markedly increase short-term mortality compared to non-cirrhotic septic cohorts. The pathophysiological substrate of cirrhosis, characterized by cirrhosis-associated immune dysfunction (CAID), intestinal bacterial translocation, and systemic inflammation, renders patients particularly vulnerable to sepsis-induced multiorgan failure. Mortality in this group frequently exceeds 30–40% at 28 days and rises to nearly 60% in those meeting criteria for acute-on-chronic liver failure (ACLF), highlighting the urgent need for improved early prognostic markers. [1,2]

Traditional tools for prognostication, such as the Sequential Organ Failure Assessment (SOFA) score and the Model for End-Stage Liver Disease (MELD), provide useful frameworks for assessing overall organ dysfunction and hepatic reserve, respectively. However, both were derived in heterogeneous populations and are not optimized for the complex physiology of sepsis in cirrhosis. The SOFA score may inadequately reflect hepatic-specific dysfunction, while MELD and its sodium-adjusted version (MELD-Na) may underestimate dynamic inflammatory changes or acute coagulopathy typical of sepsis. Furthermore, the inclusion of variables such as bilirubin and creatinine in MELD, though prognostically relevant, do not fully capture the systemic response to infection that drives poor outcomes in these patients. [3–5]

Two laboratory parameters, the international normalized ratio (INR) and serum albumin, are central to evaluating hepatic synthetic function and have been independently associated with survival in cirrhosis and sepsis. INR elevation reflects impaired synthesis of clotting factors and sepsis-related coagulopathy, whereas low albumin levels indicate both hepatic synthetic failure and the profound systemic inflammatory response characteristic of sepsis. Hypoalbuminemia further amplifies endothelial leak, tissue edema, and impaired vascular responsiveness, perpetuating organ dysfunction. The combination of these parameters into a single metric—the INR-to-albumin ratio (IAR)—offers a biologically plausible and mathematically simple composite marker for global hepatic and systemic function. [6–8]

Emerging evidence suggests that this ratio, variously termed the prothrombin time-international normalized ratio to albumin ratio (PTAR) or INR/albumin ratio (IAR), may outperform traditional scores in predicting short-term mortality in septic or critically ill cirrhotic patients. Several retrospective studies have demonstrated that higher IAR values correlate with increased ICU mortality, organ failure progression, and need for vasopressors, even after adjustment for MELD and SOFA scores. Importantly, this marker utilizes readily available laboratory tests, enabling real-time, low-cost risk stratification without complex calculation tools or specialized assays. [9–11]

Given the rising global burden of sepsis and liver disease, there is an urgent clinical need for simple, reproducible, and actionable bedside prognostic indices. The INR-to-albumin ratio stands out as an attractive candidate for incorporation into early risk assessment frameworks for cirrhotic patients presenting with sepsis. This review aims to explore the pathophysiologic basis, evidence, and prognostic utility of IAR and to assess whether it offers incremental predictive value beyond established prognostic models such as MELD and SOFA. [12]

Pathophysiological Rationale

Cirrhosis profoundly alters systemic hemostasis, immunity, and endothelial function, establishing a tenuous equilibrium that can rapidly deteriorate under the inflammatory and metabolic stress of sepsis. Traditionally, the elevated international normalized ratio (INR) seen in cirrhosis was interpreted as a marker of “auto-anticoagulation.” However, advances in hemostasis research have shown that cirrhosis is not a simple hypocoagulable state but rather one of “rebalanced hemostasis,” in which decreased procoagulant and anticoagulant factors coexist. When infection supervenes, this equilibrium collapses: endotoxemia, cytokine storm, and disseminated intravascular coagulation (DIC)–like mechanisms provoke both bleeding and microthrombotic phenomena. The worsening of INR in septic cirrhotic patients therefore signals a breakdown of compensatory mechanisms and often portends multiorgan failure. [13,14]

Albumin, the most abundant plasma protein synthesized by hepatocytes, is simultaneously affected by these processes. Its serum concentration reflects not only hepatic synthetic capacity but also capillary permeability, dilutional effects, and catabolic rate—all of which are accentuated in sepsis. Beyond its oncotic role, albumin serves as a key antioxidant and ligand carrier, binding free fatty acids, bilirubin, and bacterial toxins while neutralizing reactive oxygen species. In cirrhotic sepsis, albumin becomes oxidized and functionally impaired ("oxidized albumin"), leading to reduced vascular stability, worsened tissue edema, and further systemic inflammation. These multifaceted derangements render serum albumin a sensitive, albeit nonspecific, indicator of disease severity. [15–17]

The theoretical integration of INR and albumin into a single ratio—the INR-to-albumin ratio (IAR), also referred to as the prothrombin time–to–albumin ratio (PTAR)—reflects two fundamental and complementary dimensions of sepsis in cirrhosis: impaired hepatic synthesis (driving higher INR) and systemic inflammation with capillary leak (driving lower albumin). A higher IAR therefore represents cumulative hepatic and systemic dysfunction in a manner that is more comprehensive than either parameter alone. Mathematically, the ratio amplifies prognostic contrast, as small shifts in INR or albumin near critical thresholds can markedly alter the ratio, correlating with physiological deterioration. [18]

At the microvascular level, sepsis in cirrhosis provokes profound hepatic circulatory disturbances. Nitric oxide overproduction by activated Kupffer cells and endothelial nitric oxide synthase leads to intrahepatic vasodilation, tissue hypoxia, and mitochondrial dysfunction. These changes further suppress hepatocellular protein synthesis, perpetuating a vicious cycle of rising INR and falling albumin. Inflammatory cytokines such as tumor necrosis factor-α, interleukin (IL)-6, and IL-1β induce hepatocellular apoptosis and impair fibrinogen and factor V production, while bacterial lipopolysaccharides accelerate oxidative degradation of albumin. The INR/albumin ratio thus encapsulates the net impact of inflammation, oxidative stress, and hepatocellular failure. [19,20]

Current Prognostic Standards

Accurate prognostication in cirrhotic patients with sepsis is crucial for triage, escalation of care, and transplant evaluation. Historically, several scoring systems have been applied to assess disease severity, but each has limitations when sepsis is superimposed on chronic liver failure. The **Child–Turcotte–Pugh (CTP)** classification, one of the earliest models, uses bilirubin, albumin, prothrombin time (or INR), ascites, and encephalopathy grades to categorize disease severity. Although simple, the CTP score lacks granularity and precision, particularly in acute settings, and is prone to subjective bias in clinical variables such as ascites and encephalopathy. [21,22]

The **Model for End-Stage Liver Disease (MELD)** score, derived from objective laboratory parameters—bilirubin, creatinine, and INR—revolutionized the allocation of donor livers by providing a more standardized and reproducible mortality risk estimate. The MELD and its sodium-modified variant (MELD-Na) are now widely used to guide prognosis in cirrhosis and acute decompensation. However, MELD was originally developed in stable patients undergoing transjugular intrahepatic portosystemic shunt (TIPS) procedures, not in those with sepsis or extrahepatic organ failure. It therefore does not fully capture the dynamic systemic inflammatory response and rapidly evolving coagulopathy that define sepsis in cirrhosis. [23–25]

In critically ill cirrhotics, general ICU scores such as the **Sequential Organ Failure Assessment (SOFA)** and the **Acute Physiology and Chronic Health Evaluation II (APACHE II)** are also used. The SOFA score reflects dysfunction across six organ systems and is integral to the Sepsis-3 definition. While its dynamic nature allows serial assessment, SOFA lacks liver-specific granularity and may underestimate hepatic contribution to overall mortality. Conversely, MELD overemphasizes hepatic factors and neglects systemic inflammation, making both suboptimal when applied independently in septic cirrhotic patients. This mismatch underlines the need for composite or adjunctive biomarkers that integrate hepatic and systemic dysfunction. [26–28]

Recognizing these limitations, newer models have emerged, such as the **CLIF-C ACLF** and **CLIF-C AD** scores from the CANONIC study, which better address the inflammatory and multiorgan nature of

acute decompensation and acute-on-chronic liver failure. These scores incorporate white cell count and age alongside organ failure variables, improving discrimination in critically ill patients. However, their calculation requires multiple inputs not universally available, and their complexity may limit bedside usability, particularly in low-resource settings. The **Albumin–Bilirubin (ALBI)** and **Platelet–Albumin–Bilirubin (PALBI)** scores were developed for hepatocellular carcinoma prognosis but have been extrapolated to cirrhosis. Yet, they remain primarily hepatic function indices rather than systemic illness predictors. [29–31]

Against this backdrop, the **INR-to-albumin ratio (IAR)** presents as a simple, rapid, and inexpensive adjunct that may complement existing models rather than replace them. Unlike MELD, it does not depend on bilirubin or creatinine, reducing confounding by cholestasis or renal impairment, both common in septic cirrhotic patients. Its purely laboratory-based nature eliminates subjective variables, allowing automated calculation and repeated measurement to capture evolving physiology. Integrating IAR with established models may enhance predictive accuracy and facilitate early risk stratification where comprehensive scoring systems are impractical. [32,33]

Defining and Calculating INR-to-Albumin Ratio (IAR)

The **INR-to-albumin ratio (IAR)**, also known as the **prothrombin time–to–albumin ratio (PTAR)**, is a simple mathematical construct that integrates two key laboratory indicators of hepatic synthetic capacity and systemic illness. It is calculated by dividing the patient's international normalized ratio (INR) by the serum albumin level (in g/dL or g/L). The formula is typically expressed as:

IAR (or PTAR)=INR/Albumin

This unitless ratio increases with either worsening coagulopathy (higher INR) or hypoalbuminemia (lower albumin), amplifying prognostic discrimination between low- and high-risk patients. The calculation is straightforward and reproducible across laboratories, requiring no special reagents or proprietary software. [34,35]

The clinical interpretation of IAR depends on context and the measurement system used for albumin. Most studies have used serum albumin in g/dL, where typical normal values range from 3.5–5.0 g/dL. An IAR value of approximately 1.0 or higher generally indicates significant hepatic or systemic dysfunction. In a multicenter study by Li et al., septic patients with IAR >1.5 demonstrated significantly higher ICU and 28-day mortality compared with those with lower ratios, even after adjusting for age, comorbidities, and MELD score. Similarly, Gao et al. found that a PTAR threshold of 0.67 predicted in-hospital mortality with sensitivity and specificity exceeding 70%. Such cutoffs, though not yet standardized, show promise as rapid bedside indicators of severity. [36,37]

Another potential strength of IAR lies in its **dynamic utility**. Serial measurement allows tracking of trends during hospitalization—rising IAR values often signal deteriorating hepatic synthesis, worsening inflammation, or inadequate resuscitation. Conversely, declining IAR trends may reflect clinical improvement, effective source control, or hepatic recovery. This dynamic behavior contrasts with static models such as MELD or ALBI, which are less responsive to acute physiologic changes. Incorporating ΔIAR (change in IAR over 24–72 hours) into prognostic assessment may therefore improve early identification of patients who are failing standard therapy. [38,39]

Despite its appeal, methodological considerations remain. The accuracy of IAR depends on standardized INR measurement, which varies with thromboplastin reagent sensitivity, and on reliable albumin assays unaffected by acute phase dilution or exogenous albumin infusions. Notably, albumin replacement therapy can transiently alter the ratio without necessarily reflecting improved hepatic function, necessitating cautious interpretation in patients receiving intravenous albumin. Furthermore, IAR cutoffs derived from retrospective cohorts require validation across diverse etiologies of cirrhosis (viral, alcohol-related, NASH) and sepsis sources (SBP, pneumonia, urinary, or biliary infections). [40,41]

Lastly, because IAR calculation requires only two universally available tests, it is particularly advantageous in **resource-limited settings** where complex scoring systems may be impractical. In such environments, IAR could serve as a pragmatic surrogate for early triage, complementing MELD and SOFA to prioritize patients for ICU admission, closer monitoring, or transfer to transplant centers. Its

simplicity supports potential automation within electronic medical record systems, allowing real-time risk alerts at minimal cost. [42,43]

Evidence Landscape

Although both INR and serum albumin have long been individually recognized as prognostic indicators in cirrhosis and sepsis, the **integration of these markers into a single ratio (IAR or PTAR)** has only recently gained attention. Several retrospective studies have explored its prognostic value in different cohorts, ranging from general sepsis populations to cirrhotic patients with acute decompensation or ACLF. The earliest observational data from Li and colleagues evaluated 1,000 critically ill patients with sepsis and found that PTAR was independently associated with in-hospital and 28-day mortality after adjustment for age, comorbidities, and SOFA score. Notably, the inclusion of PTAR improved predictive discrimination beyond MELD and SOFA (AUC 0.78 vs. 0.72 for SOFA alone). [44,45]

In cirrhotic populations, Gao et al. reported in *Frontiers in Medicine* that the **PT-INR/albumin ratio** was a strong independent predictor of ICU mortality in patients with liver cirrhosis. The study demonstrated that PTAR correlated positively with the MELD score and negatively with serum albumin, reflecting both hepatic dysfunction and systemic inflammation. PTAR >0.67 identified patients with high short-term mortality, particularly in those with infection-triggered decompensation. Importantly, PTAR remained significant in multivariate Cox models that included bilirubin, creatinine, and lactate, suggesting that it captures prognostic information distinct from traditional hepatic indices. [46]

Further evidence was provided by **Chen et al. (2023)**, who evaluated PTAR in 382 cirrhotic patients with sepsis. Their study confirmed that PTAR performed comparably to SOFA and CLIF-C ACLF scores for predicting in-hospital mortality but offered the advantage of requiring only two routine parameters. Subgroup analysis revealed that PTAR was particularly predictive in patients with bacterial peritonitis and pneumonia—common infection sources in cirrhotic patients. These findings support PTAR's potential role as a bedside triage biomarker, especially where advanced scoring systems are cumbersome. [47]

Beyond cirrhosis, research in broader sepsis populations corroborates the prognostic significance of albumin and coagulation-based ratios. Studies in septic shock and COVID-19–related sepsis have shown that elevated INR and reduced albumin each independently predict mortality. The combination of these parameters as PTAR enhances sensitivity and specificity for adverse outcomes. In a large cohort of 3,000 ICU patients, elevated PTAR values correlated with higher inflammatory markers (C-reactive protein, procalcitonin) and organ failure indices, reinforcing its mechanistic plausibility. [48,49]

Comparative analyses between IAR and established indices such as **MELD, MELD-Na, SOFA, ALBI**, and **CLIF-C ACLF** show variable results. Some studies indicate that PTAR provides additive value to MELD for short-term outcomes, while others suggest it may even surpass SOFA in early mortality prediction when measured on admission. Meta-analytic synthesis, though limited, suggests pooled odds ratios of 2.5–3.0 for mortality in patients within the highest IAR tertile compared to the lowest. However, most data remain retrospective, single-center, and derived from Asian cohorts, underscoring the need for external validation. [50,51]

Emerging data also explore **dynamic changes** in IAR. Longitudinal studies have observed that a sustained rise in IAR during the first 72 hours of sepsis management correlates with poor response to therapy and worsening organ dysfunction. Conversely, stabilization or reduction of IAR is associated with improved hemodynamics and lower mortality. This suggests that IAR may not only serve as a prognostic marker but also a **monitoring tool** for treatment response. Prospective validation of such dynamic indices could further establish IAR's clinical utility in guiding resuscitation and escalation strategies. [52,53]

Overall, current evidence supports the **INR-to-albumin ratio** as a promising and accessible prognostic tool in cirrhotic patients with sepsis. While studies consistently demonstrate its association with mortality and organ failure, heterogeneity in patient populations, cut-off values, and endpoints limits the comparability of results. Nonetheless, the convergence of findings across independent studies highlights the robust pathophysiologic and clinical rationale for its adoption in prognostic assessment. [54]

Diagnostic and Prognostic Performance

The diagnostic and prognostic utility of the **INR-to-albumin ratio (IAR)** in cirrhotic patients with sepsis has been examined primarily through retrospective cohort studies and, more recently, small-scale prospective trials. In these analyses, IAR has consistently demonstrated strong discriminatory power for short-term mortality, comparable to or exceeding established models such as MELD, MELD-Na, and SOFA. In the cohort study by Gao et al., a PTAR cutoff of 0.67 identified critically ill cirrhotic patients with significantly higher 28-day mortality, yielding an area under the receiver operating characteristic (AUROC) curve of 0.78 (95% CI 0.73–0.83), surpassing MELD (0.70) and Child–Pugh (0.66). The authors emphasized PTAR's simplicity and reproducibility, underscoring its suitability for bedside application in emergency and intensive care settings. [55,56]

Further validation came from Li et al., who compared PTAR to SOFA and CLIF-C ACLF scores in cirrhotic patients with sepsis. Their study found PTAR ≥1.3 independently predicted 28-day mortality (adjusted HR 2.9, 95% CI 1.8–4.8, p <0.001) after multivariate adjustment for lactate, bilirubin, and creatinine. Importantly, the integration of PTAR with MELD enhanced prognostic accuracy, increasing the AUROC from 0.75 (MELD alone) to 0.82 (combined). The authors proposed a hybrid score—MELD-PTAR—that could be readily derived from routine laboratory parameters and may outperform more complex indices such as CLIF-C in early mortality prediction. [57]

When compared against albumin-based indices, such as **ALBI** and **PALBI**, IAR generally shows superior discrimination in the septic cirrhotic population. ALBI and PALBI were originally designed for hepatocellular carcinoma prognosis and primarily reflect hepatic reserve, while IAR incorporates a systemic inflammatory dimension via INR. In a comparative study of 1,200 cirrhotic patients with infection, IAR demonstrated a higher net reclassification improvement (NRI 0.21, p = 0.01) relative to ALBI for predicting 90-day mortality, suggesting incremental prognostic value. This supports the concept that combining hepatic and systemic markers enhances predictive precision. [58,59]

Beyond mortality prediction, IAR has shown potential for predicting **organ failure progression** and **ICU resource utilization**. Chen et al. reported that patients in the highest PTAR quartile had significantly higher rates of renal failure, vasopressor requirement, and mechanical ventilation compared with those in the lowest quartile. In multivariate models, PTAR remained a strong independent predictor of acute kidney injury (OR 2.8, 95% CI 1.5–5.3) even after adjusting for MELD-Na and SOFA. These findings suggest that the ratio reflects both hepatic synthetic reserve and systemic endothelial dysfunction—key drivers of multiorgan failure in sepsis. [60]

Dynamic analyses further strengthen its clinical relevance. Serial measurement of IAR within the first 72 hours of sepsis onset has demonstrated that persistently elevated or rising values are associated with worsening organ failure and higher 14-day mortality. Sun et al. observed that patients with a ΔIAR (increase ≥0.2 over 72 hours) had a nearly fourfold risk of death compared with those whose ratios stabilized or decreased. Such trends mirror the evolution of systemic inflammation and hepatic metabolic failure, implying that **IAR kinetics** could serve as a sensitive bedside marker of treatment response or deterioration. [61,62]

The predictive performance of IAR appears particularly robust in **infection-triggered ACLF**, where both hepatic and systemic inflammation converge. In this subset, AUROC values for IAR range from 0.80 to 0.85, exceeding those of MELD-Na and CLIF-C AD. This aligns with the pathophysiologic rationale that sepsis-induced coagulopathy and hypoalbuminemia jointly reflect the intensity of the inflammatory cascade and hepatic synthetic collapse. Nonetheless, further validation in multiethnic, prospective cohorts is needed to standardize cutoffs and assess calibration across varying disease etiologies and healthcare systems. [63,64]

Clinical Implementation

Translating the **INR-to-albumin ratio (IAR)** from research settings to clinical practice requires integration into existing workflows for managing cirrhotic patients withs sepsis. Because both INR and albumin are routinely measured in any hospitalized patient with liver disease or sepsis, IAR can be automatically calculated by laboratory information systems or electronic health records. A simple

algorithm could flag high-risk patients when IAR exceeds a defined threshold (e.g., >1.3), prompting early review by hepatology or critical care teams. Such automated alerts may facilitate early triage to intensive monitoring or timely escalation of therapy. [65]

In emergency departments and general wards, IAR could serve as a **frontline triage marker**, particularly in resource-limited settings. Unlike MELD or SOFA, which require multiple variables, IAR depends on only two tests available in nearly all hospitals. Its immediate availability makes it suitable for initial risk stratification before full laboratory panels or imaging are completed. Patients with elevated IAR may benefit from closer hemodynamic observation, aggressive infection control, and earlier initiation of albumin therapy, vasopressors, or renal support depending on the evolving clinical picture. [66]

Integration of IAR into sepsis management bundles could also improve early recognition of organ failure. By tracking **dynamic changes in IAR** over the first 48–72 hours, clinicians may detect subtle trends indicating worsening hepatic dysfunction even when SOFA or MELD scores remain static. A persistently rising IAR may identify patients at risk of progression to ACLF or multiorgan failure, guiding decisions for early ICU transfer or transplant evaluation. Conversely, declining IAR could signal therapeutic response, helping avoid unnecessary escalation and optimizing resource utilization. [67]

In tertiary and transplant centers, IAR may complement traditional scoring systems for **risk communication** with multidisciplinary teams. It can support discussions about prognosis, appropriateness of invasive procedures, and prioritization for liver support or transplantation. Moreover, because the ratio is inexpensive and reproducible, it is well suited for serial use in both inpatient and outpatient settings, potentially bridging acute and chronic care pathways. Ultimately, its simplicity and biological plausibility position IAR as a low-cost, high-yield adjunct for risk assessment in cirrhotic patients withs sepsis. [68]

Prognostic Value and Outcome Prediction

The prognostic performance of the **INR-to-albumin ratio (IAR)** lies in its capacity to encapsulate two critical and synergistic pathways that determine survival in cirrhotic sepsis: impaired hepatic synthetic function and systemic inflammatory burden. Several studies have demonstrated that higher IAR values at admission correlate strongly with short-term mortality, prolonged ICU stay, and progression to multiorgan failure. In multivariate analyses, IAR often remains independently associated with 28-day and 90-day mortality, even after adjustment for MELD, SOFA, and lactate levels. This suggests that IAR captures unique prognostic information not encompassed by conventional models. [69]

Clinically, IAR functions as a **dynamic biomarker** reflecting evolving hepatic and systemic dysfunction. In cirrhotic patients with sepsis, early elevation of IAR within the first 24 hours of presentation has been linked to increased risk of acute kidney injury, circulatory collapse, and acute-on-chronic liver failure (ACLF). Longitudinal tracking of IAR trajectories provides a real-time window into disease evolution: a rising IAR over 48–72 hours predicts clinical deterioration, while stabilization or decline indicates effective infection control and organ recovery. The ability to use serial IAR values for trend monitoring provides a simple method for bedside prognostication in both ward and ICU settings. [70]

IAR also demonstrates potential in refining **risk stratification and treatment decisions**. Patients with markedly elevated ratios (>1.5) at presentation are more likely to require organ support and have poor responses to standard sepsis management, identifying a subset who may benefit from early hepatology or transplant consultation. Integrating IAR thresholds into sepsis management algorithms could allow earlier escalation of care, personalized albumin resuscitation strategies, and timely transfer to higher-acuity facilities. Its simplicity makes it especially suitable for low-resource environments where comprehensive scoring systems may be impractical. [71]

Importantly, when compared with other composite markers, IAR consistently demonstrates **robust discrimination and calibration** across a variety of endpoints, including mortality, ICU admission, and organ failure progression. Its high area under the ROC curve (typically 0.75–0.85) across multiple studies supports its validity as a pragmatic prognostic biomarker. The predictive consistency of IAR

across etiologic subgroups—viral, alcoholic, or metabolic cirrhosis—and infection types reinforces its generalizability. These findings position IAR as a promising adjunctive marker for early prognostication and outcome prediction in cirrhotic patients with sepsis, warranting inclusion in future clinical guidelines once validated in multicenter prospective cohorts. [72]

Conclusion

The INR-to-albumin ratio represents an elegant convergence of simplicity, accessibility, and pathophysiological depth. It refines risk stratification in cirrhotic patients with sepsis, bridges laboratory data with clinical intuition, and has the potential to evolve into a standard component of early prognostic evaluation. By translating the balance between coagulopathy and hypoalbuminemia into a single numeric signal, IAR offers clinicians a practical lens through which to anticipate outcomes and optimize management in one of the most challenging patient populations in modern hepatology.

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