RESEARCH PAPER

Multidisciplinary Management of Sepsis: Early Recognition, Diagnostic Approaches, and Therapeutic Strategies for Improved Patient Outcomes

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ABSTRACT
Sepsis represents a life-threatening condition characterized by a dysregulated host response to infection, resulting in organ dysfunction and accounting for millions of deaths globally each year. The heterogeneity of clinical presentation necessitates a multimodal diagnostic approach and coordinated multidisciplinary management strategies. Early recognition and prompt intervention within the first hour of sepsis presentation significantly improve survival outcomes. This comprehensive review synthesizes current evidence on sepsis management, emphasizing the critical roles of healthcare professionals across multiple disciplines including nursing staff, pharmacists, emergency medical services personnel, social workers, laboratory specialists, and nursing technicians. The review addresses early recognition strategies utilizing clinical indicators and rapid diagnostic biomarkers, antimicrobial therapy selection based on infection source and local epidemiology, source control interventions, hemodynamic support, and long-term follow-up care for sepsis survivors. Implementation of sepsis alert systems, multidisciplinary sepsis emergency response teams, and adherence to evidence-based bundles has been shown to reduce mortality and hospital length of stay. Post-sepsis syndrome represents an emerging concern requiring rehabilitation strategies and comprehensive multidisciplinary follow-up to optimize quality of life in survivors. This review provides an integrated perspective on sepsis management that acknowledges the interconnected contributions of all healthcare professions essential for optimal patient outcomes.

Keywords: Sepsis, multidisciplinary care, early recognition, biomarkers, antimicrobial stewardship, patient outcomes, theraputic strategies
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INTRODUCTION

Sepsis remains a leading cause of morbidity and mortality worldwide, affecting over 50 million people annually and resulting in approximately 11 million deaths across all age groups and clinical settings (1). Despite advances in supportive care, antimicrobial agents, and critical care management, mortality rates from sepsis continue to remain unacceptably high, particularly in resource-limited settings. The condition emerges when the body's response to infection becomes dysregulated, leading to life-threatening organ dysfunction rather than the infection itself being the primary cause of death (2). This dysregulation involves excessive production of pro-inflammatory cytokines, impaired immune function, endothelial dysfunction, and microvascular thrombosis, creating a complex pathophysiological landscape that requires sophisticated diagnostic and therapeutic approaches.

The epidemiology of sepsis has evolved significantly over the past two decades. Contemporary data from the Surviving Sepsis Campaign and related studies demonstrate that sepsis affects patients across all clinical settings: emergency departments, intensive care units, hospital wards, and increasingly, in community and home-based settings (3). Risk factors include advanced age, immunocompromised states, chronic comorbidities such as diabetes mellitus and chronic kidney disease, and recent invasive procedures or hospitalization. The most common sources of infection in sepsis include respiratory tract infections, urinary tract infections, intra-abdominal infections, and skin and soft tissue infections (4). In developed healthcare systems, hospital-acquired sepsis has

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become increasingly prevalent, while in low- and middle-income countries, community-acquired sepsis remains the primary burden.

The economic impact of sepsis is substantial, with estimates suggesting that sepsis care accounts for 5-10% of total intensive care unit expenditures globally (5). Beyond the acute phase, sepsis survivors experience significant long-term sequelae collectively termed post-sepsis syndrome, which encompasses physical disability, cognitive impairment, psychological complications including anxiety and depression, and profound reductions in quality of life (6). These long-term complications result from persistent inflammatory changes, neuroinflammation, vascular dysfunction, and skeletal muscle wasting that extend far beyond hospital discharge.

Contemporary sepsis management represents a paradigm shift from single-discipline approaches to truly integrated multidisciplinary care. The Surviving Sepsis Campaign, established in 2004 and updated most recently in 2021, has fundamentally transformed sepsis care through evidence-based bundles that emphasize time-sensitive interventions (7). However, implementation of these bundles remains inconsistent across healthcare systems, highlighting the critical need for improved coordination among healthcare professionals. Every member of the healthcare team—from emergency medical services personnel providing pre-hospital care, to nurses conducting bedside assessment, to pharmacists optimizing antimicrobial selection, to laboratory specialists providing rapid diagnostic confirmation, to social workers facilitating transitions of care—contributes essential elements to the sepsis response (8).

LITERATURE REVIEW

Historical Evolution and Definitions

The definition of sepsis has evolved substantially over the past three decades, reflecting our improving understanding of the pathophysiological mechanisms underlying this complex condition. Prior classifications defined sepsis according to systemic inflammatory response syndrome criteria, which emphasized the presence of fever, tachycardia, tachypnea, and abnormal white blood cell counts (9). However, these criteria lacked specificity, leading to overdiagnosis in conditions without infection and underdiagnosis in immunocompromised patients where traditional inflammatory responses may be blunted. The 2016 Sepsis-3 consensus definition redefined sepsis as "life-threatening organ dysfunction caused by a dysregulated host response to infection," fundamentally shifting focus from inflammatory markers to organ dysfunction assessment using the Sequential Organ Failure Assessment score (10). This definition acknowledged that sepsis is not merely systemic inflammation but rather a failure of homeostatic mechanisms with resultant end-organ damage.

Septic shock, the most severe form of sepsis, is defined as a subset of sepsis where particularly profound circulatory, cellular, and metabolic abnormalities are associated with a greater risk of mortality than sepsis alone (11). Patients with septic shock exhibit hypotension requiring vasopressor support to maintain mean arterial pressure above 65 mmHg, despite adequate fluid resuscitation, and demonstrate elevated lactate levels reflecting tissue hypoperfusion and anaerobic metabolism (12).

Epidemiology and Burden of Disease

Recent epidemiological data underscore the substantial and evolving burden of sepsis globally. The Frontiers in Medicine 2025 comprehensive review emphasizes that sepsis demands comprehensive care spanning from early identification to patient rehabilitation, with the sepsis survival chain encompassing early recognition, severity assessment, activation of emergency services, initial antimicrobial therapy, hemodynamic stabilization, and integrated rehabilitation (13). The burden of sepsis is not uniformly distributed; it disproportionately affects older adults, immunocompromised individuals, and populations in resource-limited settings where diagnostic tools and antimicrobials may be unavailable.

The spectrum of organisms causing sepsis varies by geographic region, patient population, and infection source. In developed countries, Gram-negative organisms including Escherichia coli and Pseudomonas aeruginosa predominate in nosocomial sepsis, while in community settings Streptococcus pneumoniae and Staphylococcus aureus remain common pathogens (14). In developing regions, polymicrobial infections and fungal sepsis are increasingly recognized, particularly in immunocompromised populations.

Early Recognition and Risk Stratification

Early recognition of sepsis represents the foundational element upon which all subsequent management depends. Studies consistently demonstrate that delays in recognition translate directly to delayed treatment initiation and increased mortality (15). The challenge in early recognition stems from the nonspecific nature of sepsis presentations; early symptoms frequently mimic other common acute illnesses including urinary tract infections without systemic toxicity, gastroenteritis, or influenza. Consequently, systematic approaches to sepsis screening have become essential components of modern healthcare delivery.

Nursing staff, as the healthcare professionals with the most frequent and prolonged direct patient contact, play a pivotal role in early sepsis recognition. A 2024 systematic review examining critical care nurses' knowledge, confidence, and clinical reasoning in sepsis management found that nurses equipped with systematic screening protocols and standardized assessment tools demonstrated significantly improved rates of early recognition and appropriate escalation of care (16). The review identified that when nurses employed structured assessment including evaluation of body temperature, heart rate, respiratory rate, systolic blood pressure, and mean arterial pressure in combination with assessment for new or worsening infection, diagnostic accuracy for early sepsis identification increased substantially.

Triage protocols have been standardized in many emergency departments to facilitate early sepsis identification at the point of initial assessment. A prospective multicenter study evaluating sepsis prediction

at emergency department triage identified procalcitonin ≥1 ng/mL, C-reactive protein-to-albumin ratio ≥32, partial pressure of carbon dioxide ≤28 mmHg, and mean arterial pressure <85 mmHg as independent predictors of sepsis with specific negative predictive values enabling safe observation strategies (17). The implementation of standardized triage protocols has been associated with improved doorway-to-antibiotic times and reduced mortality.

Diagnostic Biomarkers and Laboratory Approaches

The diagnostic evaluation of suspected sepsis requires integration of clinical assessment with rapidly available laboratory markers. A multimodal diagnostic approach combining nursing clinical indicators, laboratory biomarkers, and radiologic imaging has demonstrated superior diagnostic accuracy compared to any single diagnostic modality alone (18).

Procalcitonin as a Diagnostic Marker:

Procalcitonin has emerged as the most extensively studied biomarker for sepsis diagnosis and monitoring. A 2024 systematic review and meta-analysis examining procalcitonin accuracy in emergency department sepsis diagnosis synthesized evidence from ten studies involving 2,980 adult sepsis patients (19). The analysis revealed that procalcitonin emerged as the primary early diagnostic biomarker, with elevated levels (mean 29.3 ± 85.3 ng/mL) present in sepsis patients. Procalcitonin demonstrated moderate accuracy for diagnosing sepsis and showed particular utility in rapidly and precisely distinguishing between viral and bacterial inflammations. A separate 2024 study evaluating procalcitonin, C-reactive protein, and presepsin as diagnostic biomarkers found presepsin to be the superior marker with sensitivity of 89.1% and specificity of 88.9%, followed by procalcitonin with sensitivity of 82.7% and specificity of 80%, and C-reactive protein with sensitivity of 74.5% and specificity of 75.6% (20).

C-Reactive Protein and the CRP-to-Albumin Ratio:

C-reactive protein, an acute-phase reactant, has long been used as a marker of systemic inflammation. However, CRP lacks specificity for infectious versus non-infectious inflammatory processes. Recent evidence has demonstrated superior diagnostic performance of the C-reactive protein-to-albumin ratio compared to CRP alone. The CRP-to-albumin ratio has been shown to have prognostic value for sepsis severity and mortality, and is increasingly used as a clinical biochemical marker in diagnosing and monitoring sepsis patients (21). In multivariable analyses at emergency department triage, a CRP-to-albumin ratio ≥32 was an independent predictor of sepsis with an odds ratio of 6.6 and specificity of 89% (17).

Lactate and Tissue Hypoperfusion Markers:

Elevated serum lactate, reflecting anaerobic metabolism and tissue hypoperfusion, represents another critical diagnostic and prognostic marker in sepsis. Among single biomarkers, lactate has demonstrated the highest diagnostic accuracy for severe sepsis and septic shock according to Sepsis-2 criteria, with an area under the receiver operating characteristic curve of 0.81 (22). Lactate elevation of >4 mmol/L has been associated with significantly higher mortality risk and represents a component of major sepsis assessment protocols. Serial lactate measurement, demonstrating trend toward normalization with appropriate management, serves as both a prognostic indicator and a therapeutic target during the acute phase of sepsis management.

Interleukin-6 and Emerging Molecular Biomarkers:

Pro-inflammatory cytokines including interleukin-6 have been investigated as sepsis biomarkers. A recent cross-sectional study assessed interleukins and procalcitonin in patients with severe illness and suspected sepsis, finding interleukin-6 levels significantly elevated in the infectious disease group compared to non-infectious controls ($p<0.001$), with an area under the receiver operating characteristic curve of 0.95 (23). However, the practical implementation of interleukin-6 measurement remains limited by turnaround time and cost considerations in many healthcare settings.

Recent advances have identified novel emerging biomarkers including circular RNAs, microRNA-486-5p, protein C, triiodothyronine, and prokineticin 2, which demonstrate potential for improved sensitivity and specificity in future sepsis management (24). Gene signature assays such as SeptiCyte RAPID have shown superior discrimination between sepsis and non-infectious systemic inflammation compared to conventional biomarkers alone, though their clinical utility remains under evaluation.

Point-of-Care Testing and Rapid Diagnostics:

Point-of-care testing of biomarkers offers a critical time advantage essential for early sepsis recognition. A prospective diagnostic accuracy study evaluated point-of-care testing of C-reactive protein, interleukin-6, and procalcitonin in 82 neonates with clinically suspected sepsis (25). The mean time for point-of-care estimation of these markers was 12 ± 3 minutes, which was significantly less than 366 ± 61 minutes required for standard laboratory techniques ($p<0.001$). Point-of-care C-reactive protein demonstrated good correlation with standard CRP ($r = 0.8001$), with C-reactive protein showing maximum diagnostic accuracy among the three biomarkers (area under the curve – 0.73), followed by procalcitonin (area under the curve – 0.65) and interleukin-6 (area under the curve – 0.55).

Imaging and Microbiological Diagnosis

Radiological imaging plays a crucial role in both confirming suspected infection sources and identifying complications of sepsis. Point-of-care ultrasound has emerged as an increasingly valuable diagnostic tool in sepsis management, particularly in resource-limited settings where computed tomography availability may be restricted (26). Point-of-care ultrasound enables rapid bedside assessment of cardiac function, assessment of volume status through inferior vena cava measurement, and identification of free fluid or loculated collections amenable to drainage.

Microbiological diagnosis remains the gold standard for pathogen identification. Blood cultures obtained prior to

antibiotic administration remain essential for identifying causative organisms and guiding targeted antimicrobial therapy. However, blood culture turnaround time (typically 48-72 hours) necessitates empirical broad-spectrum therapy at sepsis presentation. The proportion of blood cultures that yield growth, approximately 50% according to recent studies, reflects both true bacteremia and contamination; however, positive cultures provide invaluable information for de-escalation strategies (27).

Multidisciplinary Team-Based Sepsis Management

Nursing Leadership in Early Recognition and Response

Nursing professionals serve as the essential frontline for sepsis recognition, assessment, and coordinated response. A comprehensive systematic review examining nursing care for patients with sepsis found that nurses equipped with structured knowledge and decision-making support demonstrated significantly improved patient outcomes through earlier recognition, more consistent protocol adherence, and improved communication with interprofessional teams (16). When nurses received targeted sepsis education programs incorporating early recognition strategies, guideline adherence, and protocol-driven interventions, their clinical decision-making in sepsis management improved substantially, ultimately leading to better patient outcomes in intensive care units.

The knowledge-attitude-practice framework has revealed important insights regarding nursing competency in sepsis management. A 2024 cross-sectional study examining knowledge, attitudes, and practices of nurses regarding sepsis assessment in critically ill patients found considerable gaps in nursing knowledge, with 83% of nurses demonstrating poor awareness of sepsis, despite this being a condition they encounter regularly (28). Notably, 85% of nurses displayed negative attitudes toward sepsis management, and 72% demonstrated poor practice skills despite having exposure to sepsis cases. These findings underscore the critical need for targeted education and systematic training to enhance nursing competency in sepsis care.

Role of Sepsis Response Teams Led by Nurses:

Nursing-led sepsis emergency response teams represent an emerging best practice that has demonstrated substantial improvements in adherence to sepsis bundles and patient outcomes. A 2024 comprehensive review of nursing-led sepsis response teams employing point-of-care ultrasound found that these teams can improve bundle compliance and individualize intravenous fluid therapy early in sepsis care (29). The sepsis response team framework includes organization (defined trigger points for activation), response personnel and equipment, and systematic quality improvement mechanisms. Of 26 studies examining sepsis emergency response teams published through 2023, 13 studies (50%) found statistically significant reductions in mortality associated with sepsis emergency response team implementation, with a median mortality reduction of 8% (interquartile range: -5% to -18%). Additionally, sepsis emergency response teams were near-ubiquitously associated with improved adherence to guideline components including time to antibiotics, blood culture collection, lactate measurement, and fluid resuscitation.

Pharmacist Integration in Antimicrobial Stewardship

Clinical pharmacists represent essential members of multidisciplinary sepsis management teams, contributing critical expertise in antimicrobial selection, dosing optimization, therapeutic drug monitoring, and de-escalation strategies. A systematic review examining pharmacist involvement in sepsis response identified 10 studies including 1,772 patients with sepsis or septic shock where a pharmacist was integrated into the sepsis response (30). Seven of these studies demonstrated a significant reduction in time to antibiotic administration with sepsis response teams incorporating pharmacist involvement, with timeframes ranging from 30 minutes to 2 hours earlier compared to usual care. Beyond improving timeliness, pharmacist involvement was also associated with improved selection of appropriate initial antibiotics; in one study, pharmacist interventions increased the proportion of patients receiving appropriate initial antibiotics from 81% to 97% ($p=0.0008$).

Clinical pharmacists' contributions to sepsis management extend beyond antimicrobial selection to encompass broader medication safety and optimization. A 2024 study evaluating clinical pharmacist intervention on antimicrobial therapy optimization in intensive care unit patients with septic shock found that pharmacist-guided interventions significantly improved rational use of antibiotics, enhanced tissue oxygenation, reduced systemic inflammation markers (interleukin-1β and procalcitonin), and improved medication safety compared to standard care (31). Specifically, patients receiving pharmacist-guided care demonstrated superior outcomes including higher mixed venous oxygen saturation and lower procalcitonin levels, suggesting more effective antimicrobial therapy and reduced inflammatory burden.

Antimicrobial Stewardship and De-escalation:

Appropriate antimicrobial stewardship requires balancing the need for rapid empirical broad-spectrum coverage with the imperative to minimize unnecessary antibiotic exposure. Current guidelines recommend empiric broad-spectrum therapy with one or more antimicrobials covering likely pathogens including bacterial and potentially fungal or viral organisms (32). However, within 48-72 hours of culture results becoming available, antimicrobial regimens should be reviewed for appropriateness and de-escalated when possible. The Infectious Diseases Society of America 2024 guidance on antimicrobial resistance provides detailed recommendations for antimicrobial selection based on infection source, local resistance patterns, and patient factors.

For extended-spectrum β-lactamase-producing Enterobacteriaceae infections, carbapenems (meropenem or imipenem-cilastatin) are preferred for infections outside the urinary tract, with consideration of agent selection based on patient severity and risk factors including hypoalbuminemia (33). Recent evidence suggests that the previous emphasis on extremely rapid antibiotic administration within narrow timeframes may require

recalibration; a critical assessment of time-to-antibiotics in sepsis found that patients receiving antibiotics within 30 minutes of sepsis recognition had greater odds of mortality than those receiving antibiotics within 30-330 minutes (odds ratio 1.3, $p<0.01$), suggesting a non-linear relationship between antibiotic timing and outcomes and highlighting the importance of balancing speed with diagnostic certainty and appropriate pathogen coverage.

Emergency Medical Services and Pre-Hospital Recognition

Emergency medical services personnel represent the initial interface with sepsis patients in the pre-hospital setting. A systematic review examining prehospital sepsis screening tools found that recognition of sepsis by ambulance clinicians is highly variable, with failure to recognize sepsis occurring in substantial proportions of patients even when sufficient diagnostic criteria were available (34). Training emergency medical services personnel to recognize sepsis using systematic screening tools based on Surviving Sepsis Campaign diagnostic criteria improved sepsis recognition substantially compared to clinical judgment alone.

The implementation of pre-hospital sepsis screening protocols has enabled earlier initiation of appropriate interventions. A randomized controlled trial comparing pre-hospital antibiotics to usual care found that patients receiving pre-hospital antibiotics received antibiotics a median of 96 minutes earlier than those randomized to usual care, with usual care patients receiving antibiotics a median of 70 minutes after emergency department arrival (35). This demonstrates the substantial opportunity for time savings through integrated pre-hospital sepsis recognition and initial intervention.

Laboratory and Imaging Specialist Contributions

Laboratory specialists provide essential rapid diagnostic information that enables prompt clinical decision-making. The coordination between nursing assessment, rapid laboratory biomarker testing, and point-of-care imaging represents a multimodal diagnostic approach. A systematic review examining the diagnostic accuracy of combining nursing clinical indicators with rapid laboratory biomarkers and radiologic imaging findings found that this multimodal approach significantly improved sepsis diagnostic accuracy compared to single-modality approaches (18). The coordination of these multiple diagnostic streams requires effective communication and prioritization mechanisms within the laboratory.

Social Work and Care Coordination

Social workers play an essential role in the transition from acute hospital sepsis care to discharge planning and ongoing management in the community. Post-discharge care coordination significantly impacts readmission rates and long-term outcomes in sepsis survivors. A pragmatic randomized controlled trial evaluating structured, proactive care coordination versus usual care for improving outcomes during post-acute care transitions for sepsis found that implementation of dedicated nurse care coordinators (supported by social work) improved post-discharge follow-up adherence and reduced 30-day readmissions (36). The sepsis survivor transition program model included a nurse facilitator who coordinated communication between hospital and post-acute care providers, ensured patients received appropriate outpatient follow-up appointments, and facilitated access to rehabilitation services.

Clinical Applications and Diagnostic Strategies

Sepsis Alert Systems and Quality Improvement

Sepsis alert systems, encompassing both electronic clinical decision support and manual notification protocols, have emerged as critical quality improvement interventions. A 2024 systematic review and meta-analysis examining sepsis alert systems in emergency departments synthesized evidence from 22 studies including 19,580 patients (37). The analysis found that sepsis alert systems were associated with lower mortality (relative risk 0.76, 95% confidence interval 0.62-0.93), shorter hospital length of stay, and significantly improved adherence to sepsis bundle components. Electronic alert systems, which are integrated into electronic health records and use algorithmic detection of patients meeting sepsis criteria, were particularly associated with reduced mortality (relative risk 0.78, 95% confidence interval 0.67-0.92) and improved adherence with blood culture guidelines (relative risk 1.14, 95% confidence interval 1.03-1.27).

The implementation of real-time sepsis care monitoring and alerting platforms in emergency department environments has demonstrated substantial clinical utility. A study describing design and implementation of a real-time monitoring platform for optimal sepsis care found that high proportions of patients with at least one alert indicated significant potential for such platforms to improve care, while the overall number of alerts per clinician remained low enough to minimize alarm fatigue (38). The integration of these systems into existing workflows requires careful attention to prevent alert fatigue, which has been recognized as a barrier to uptake and sustainability of alert systems.

Hemodynamic Management and Fluid Resuscitation

Appropriate hemodynamic management represents a cornerstone of sepsis therapy. The Surviving Sepsis Campaign bundles recommend fluid resuscitation with crystalloids to restore perfusion pressures. However, there is ongoing evolution in our understanding of optimal fluid volumes and strategies for individualizing fluid therapy (39). Excessive fluid administration may lead to fluid overload and pulmonary edema, while inadequate resuscitation results in persistent hypoperfusion and organ dysfunction. Point-of-care ultrasound assessment of fluid responsiveness, including measurement of inferior vena cava collapsibility and assessment of ventricular function, enables more individualized fluid management approaches. The use of vasopressor agents, most commonly norepinephrine, becomes necessary when hypotension persists despite adequate fluid resuscitation. Mean arterial pressure targets of $\geq$65 mmHg are standard; however, recent evidence suggests that higher targets may benefit some patient populations, particularly those with chronic hypertension (40).

Antimicrobial Selection Based on Infection Source

Rational antimicrobial selection requires consideration of the suspected source of infection, local resistance epidemiology, patient-specific factors including renal and hepatic function, and penetration of the antimicrobial into the suspected infected site.

Respiratory Tract Infections:

For community-acquired pneumonia-associated sepsis, empirical coverage should include atypical organisms including Legionella pneumophila and Mycoplasma species in addition to typical bacterial pathogens. Recommendations typically include beta-lactam therapy (piperacillin-tazobactam or a respiratory fluoroquinolone) with consideration of adding coverage for atypical organisms (41).

Urinary Tract Infections:

Sepsis from urinary tract sources, particularly in the setting of obstruction or hospital-acquired pathogens, requires broader spectrum coverage considering extended-spectrum β-lactamase producers and Pseudomonas aeruginosa. Empirical therapy with a carbapenem or antipseudomonal beta-lactam is typically appropriate (14).

Intra-Abdominal Infections:

Source control represents the cornerstone of management for intra-abdominal infections causing sepsis. Alongside surgical or percutaneous drainage, empirical antimicrobial therapy should cover both aerobic and anaerobic organisms. Typical regimens include carbapenems, piperacillin-tazobactam, or alternative agents depending on local resistance patterns (42).

Source Control Interventions

Source control is defined as all physical actions undertaken to eliminate the source of infection and control ongoing contamination. This encompasses surgical interventions, percutaneous drainage procedures, and removal of infected devices. A comprehensive overview of source control in sepsis management emphasizes that source control addresses the root cause of sepsis rather than merely treating symptoms (43). Studies have demonstrated that mortality is substantially higher in patients requiring source control who do not achieve it, underscoring the importance of timely and adequate source control.

The timing of source control significantly impacts outcomes. A meta-analysis examining timing of source control demonstrated that early source control (within 6 hours) was associated with reduced mortality, with patients having higher disease severity scores, infections from gastrointestinal sources, intra-abdominal infections, or soft tissue infections benefiting most from expedited source control interventions (43).

The selection of source control strategy—whether surgical versus percutaneous intervention—should be individualized based on the nature and extent of the infectious process. Recent practice patterns have shifted toward percutaneous catheter drainage for many intra-abdominal infections; a Korean multicenter study revealed that two-thirds of patients were managed with percutaneous catheter drainage or endoscopic intervention, with only 20% requiring surgical procedures (43). However, diffuse peritonitis or ongoing contamination often mandates surgical intervention.

A critical challenge in source control is determining adequacy of the procedure. Evidence indicates that source control interventions are often unsuccessful; in one multicenter study, less than half of patients achieved source control on the first attempt, with approximately 30% of patients requiring multiple interventions—some requiring up to seven procedures before adequate source control was achieved (43). This underscores the importance of multidisciplinary assessment of source control adequacy and consideration of repeated interventions when clinical improvement is not observed.

Post-Sepsis Syndrome and Long-Term Outcomes

Prevalence and Clinical Manifestations

Post-sepsis syndrome represents a multifaceted condition affecting sepsis survivors, manifesting as long-term physical, cognitive, and psychological complications that persist weeks to years after hospital discharge (44). Recent systematic reviews and longitudinal studies have documented the substantial burden of post-sepsis syndrome on survivors and healthcare systems.

The long-term sequelae of sepsis extend across multiple organ systems. Physical complications include skeletal muscle weakness and wasting, leading to persistent functional disability and reduced ability to perform activities of daily living (45). Cognitive impairment, termed sepsis-associated delirium and post-sepsis cognitive impairment, affects a substantial proportion of survivors, with some studies documenting cognitive deficits persisting for years following sepsis (46). Psychological complications including anxiety, depression, and post-traumatic stress disorder occur in 20-40% of sepsis survivors (47).

Sepsis-induced brain injury represents an increasingly recognized complication of sepsis with long-term consequences. The mechanisms underlying sepsis-induced cognitive impairment involve neuroinflammation, blood-brain barrier dysfunction, endothelial dysfunction, and pathological accumulation of amyloid-beta and tau proteins similar to changes observed in neurodegenerative diseases (44). Strategies to mitigate sepsis-induced brain damage include targeting neuroinflammation, maintaining vascular integrity, preventing amyloid-beta and tau accumulation, and developing senotherapy approaches (44).

Rehabilitation and Recovery

Rehabilitation following sepsis represents an essential component of comprehensive post-sepsis care. A prospective study of post-acute rehabilitation effects on mortality and nursing care dependency in sepsis survivors found that rehabilitation within the first 6 months after intensive care unit-treated sepsis was associated with significantly higher long-term survival rates (90.4% vs. 88.7%, odds ratio 1.2, 95% confidence interval 1.1–1.3, p=0.003) (48). Among intensive care unit-treated sepsis patients specifically, those receiving rehabilitation had higher short-term and long-term survival rates compared to those without rehabilitation (short-term: 93.5% vs. 90.9%,

odds ratio 1.5, 95% confidence interval 1.2–1.7; long-term: 89.1% vs. 86.3%, odds ratio 1.3, 95% confidence interval 1.1–1.5).

Structured rehabilitation programs addressing physical reconditioning, cognitive rehabilitation through targeted cognitive training, and psychological support through counseling and peer support networks have demonstrated effectiveness in improving outcomes for sepsis survivors (49). However, rehabilitation remains underutilized; nationwide, only 28% of sepsis survivors who transitioned to home health care received the recommended timely follow-up visit protocol including nursing visits within 2 days of hospital discharge, additional nursing visits during the first week, and outpatient provider follow-up within 7 days (50).

Quality of Life and Psychosocial Outcomes

A systematic review examining factors impacting quality of life among sepsis survivors during and after hospitalization identified numerous factors influencing long-term outcomes (51). The review found that sepsis survivors experience significant reductions in quality of life across physical, psychological, and social domains compared to pre-sepsis baseline status and compared to age-matched control populations without sepsis history.

Psychological support and structured follow-up programs addressing depression, anxiety, and post-traumatic stress have demonstrated effectiveness in improving mental health outcomes in sepsis survivors (52). Patient and family education regarding the long-term effects of sepsis, realistic expectations for recovery, and available support resources facilitate adjustment to life after sepsis.

Healthcare System Implementation and Adherence

Adherence to Sepsis Bundles and Guidelines

The Surviving Sepsis Campaign provides evidence-based bundles emphasizing specific time-sensitive interventions. However, adherence to these bundles remains suboptimal globally. Early assessment of diagnostic procedures for sepsis recognition found that substantial proportions of emergency department patients with sepsis did not receive key diagnostic procedures in a timely manner: 72.9% had documented triage within 15 minutes, 44.9% were examined by a physician in accordance with triage priority, and only 25.4% received antibiotics within 1 hour (53). Delay or non-completion of key diagnostic procedures was predictive of delays exceeding 2.5 hours to antibiotic treatment. Patients receiving antibiotics within 1 hour demonstrated 30-day all-cause mortality of 13.6%, compared to 5.9% for those receiving antibiotics in 2-3 hours and 10.5% for those receiving antibiotics 4 hours or later after admission.

Implementation of nurse-led sepsis protocols based on evidence-based care bundles, supplemented by training and performance feedback, has demonstrated substantial improvements in adherence. A prospective before-and-after intervention study in an emergency department found that bundle compliance markedly increased from 3.5% at baseline to 12.4% following implementation of a comprehensive program including a nurse-led protocol, staff training, and feedback (54). Particularly substantial improvements were observed in serum lactate measurement (increasing from 23% to 80%), chest X-ray acquisition (from 67% to 83%), and blood culture collection with antibiotic administration within 3 hours (increasing substantially postintervention).

Resource Requirements and System Factors

Effective multidisciplinary sepsis management requires adequate healthcare system resources including staffing (sufficient nursing personnel, physician availability, pharmacist coverage, and support services), diagnostic resources (rapid laboratory testing capabilities and imaging), antimicrobial formulary availability, and information technology infrastructure supporting electronic sepsis alert systems. A study examining associations between hospital nursing resources and postsurgical sepsis found that better nursing work environment quality was associated with lower odds of sepsis development, and while mortality among septic patients was nearly seven times that of non-septic patients, better nursing resources were associated with reduced mortality for all patients (55). This suggests that nursing staffing adequacy and work environment improvements represent investable quality improvement priorities.

Financial and infrastructural limitations in low-resource settings pose substantial barriers to effective sepsis management implementation. The 2025 comprehensive review on sepsis and post-sepsis syndrome emphasizes that precision medicine approaches, artificial intelligence-driven early warning systems, and optimized referral networks can enhance early detection and personalized treatment (56). However, implementing these innovations requires healthcare system investments that many low-income countries cannot currently afford, creating a substantial disparity in sepsis outcomes between resource-rich and resource-limited settings.

CONCLUSION

Sepsis represents a critical global health challenge requiring integrated, multidisciplinary approaches to optimize patient outcomes at all stages from early recognition through post-acute care transition and long-term rehabilitation. The evidence synthesized in this review demonstrates that sepsis management has fundamentally evolved from single-discipline approaches to truly collaborative care models engaging nursing professionals, pharmacists, emergency medical services personnel, laboratory specialists, radiologists, surgeons, infectious disease specialists, social workers, and nursing technicians in coordinated sepsis responses.

Early recognition remains the cornerstone of effective sepsis management. Healthcare professionals equipped with systematic screening protocols, access to rapid diagnostic biomarkers including procalcitonin and the C-reactive protein-to-albumin ratio, and integration into multidisciplinary alert systems demonstrate substantially improved sepsis detection rates and treatment initiation times. Implementation of sepsis alert systems, particularly electronic alert systems integrated into electronic health records, has demonstrated clear associations with reduced

mortality and improved bundle adherence in multiple healthcare settings.

Antimicrobial therapy must be selected based on suspected infection source, local resistance epidemiology, and individual patient factors, with rapid de-escalation once culture results are available to minimize unnecessary broad-spectrum antibiotic exposure and reduce antimicrobial resistance development. Pharmacist involvement in sepsis management significantly improves antimicrobial selection appropriateness, reduces time to antibiotic administration, and enhances medication safety through therapeutic drug monitoring and adverse event prevention.

Source control represents an essential and often underemphasized element of sepsis management. Timely and adequate source control through surgical intervention, percutaneous drainage, or device removal directly impacts survival outcomes. Multidisciplinary discussion involving surgeons, interventional radiologists, infectious disease specialists, and intensivists ensures optimal selection of source control strategies tailored to individual patient anatomy, physiology, and infection characteristics.

Hemodynamic support through judicious fluid resuscitation and vasopressor therapy when necessary represents a critical management element. The evolution of point-of-care ultrasound has enabled more individualized approaches to fluid management, balancing the need for adequate perfusion pressure with the risks of fluid overload and pulmonary edema.

Long-term follow-up and rehabilitation of sepsis survivors represents an increasingly important yet frequently neglected aspect of sepsis management. Post-sepsis syndrome, characterized by physical disability, cognitive impairment, and psychological complications, persists in substantial proportions of survivors for months to years following sepsis. Structured rehabilitation programs, psychological support, and coordinated healthcare transitions have demonstrated effectiveness in improving long-term outcomes and quality of life for sepsis survivors.

Implementation of evidence-based sepsis management requires healthcare system investments including adequate staffing, access to diagnostic resources, electronic alert systems, and structured quality improvement programs. The substantial variations in sepsis adherence and outcomes across different healthcare settings and geographic regions underscore that having evidence-based guidelines is necessary but insufficient; effective implementation mechanisms including education, feedback, and accountability are essential for translating evidence into improved patient care.

Future directions in sepsis management include development and validation of novel biomarkers with superior sensitivity and specificity for sepsis diagnosis, implementation of precision medicine approaches utilizing genomic and proteomic biomarkers to tailor therapy to individual patient phenotypes, continued refinement of hemodynamic management through point-of-care imaging, expanded roles for artificial intelligence and machine learning in early sepsis detection and prediction, and strengthening of rehabilitation and long-term follow-up services for sepsis survivors to maximize recovery and quality of life.

The multidisciplinary perspective presented in this review acknowledges the critical and interdependent contributions of all healthcare professions to sepsis outcomes. Sepsis represents a condition where the coordinated efforts of every team member—from the emergency medical services paramedic providing pre-hospital care, to the emergency department nurse conducting rapid triage, to the laboratory technician providing urgent biomarker results, to the pharmacist optimizing antibiotic selection, to the surgeon performing timely source control, to the social worker coordinating post-discharge care—collectively determine whether patients survive with preserved function or experience death or long-term disability. Investment in training, coordination, and quality improvement processes supporting multidisciplinary sepsis management represents one of the highest-yield interventions available for improving healthcare outcomes globally..

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