

# Comprehensive Management Approach for Sepsis: A Review of Key Steps and Strategies

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## Abstract

Sepsis, a life-threatening condition resulting from a dysregulated host response to infection, necessitates prompt recognition and timely intervention to improve patient outcomes. This study presents a comprehensive overview of the management approach for sepsis, encompassing recognition, diagnosis, supportive care, antibiotic therapy, source control, hemodynamic support, organ function support, close monitoring, and adjunctive therapies. Recognition and diagnosis serve as crucial initial steps in sepsis management. Timely identification is imperative, utilizing clinical findings such as infection-related signs and symptoms coupled with evidence of organ dysfunction. The provision of supportive care, including adequate oxygenation, fluid resuscitation, and vigilant monitoring of vital signs, is pivotal in maintaining physiological stability. The administration of oxygen to sustain saturation above 90% and intravenous fluids to restore and optimize blood flow are essential components of this phase. The prompt initiation of broad-spectrum antibiotics, guided by factors such as suspected infection source, local resistance patterns, and individual patient considerations, forms a vital aspect of sepsis management. Effective source control strategies, such as abscess drainage, tissue debridement, and removal of infected devices, play a pivotal role in mitigating ongoing infection and promoting recovery. Hemodynamic support assumes paramount importance due to the frequent occurrence of blood pressure instability and compromised organ perfusion in septic patients. While fluid resuscitation is the initial approach, vasopressor medications may be required to ensure adequate blood pressure and tissue perfusion. Organ function support becomes essential when sepsis progresses to severe sepsis or septic shock, leading to organ dysfunction. Specific interventions tailored to individual organ systems, including respiratory support with mechanical ventilation, renal replacement therapy for kidney failure, and supportive care for other affected organs, aid in maintaining vital functions. Close monitoring of vital signs, laboratory parameters, and organ function is imperative throughout the management process. Serial assessments provide valuable insights into the response to treatment, enabling healthcare professionals to make informed decisions and adjust interventions as necessary. Adjunctive therapies, such as corticosteroids or activated protein C

(drotrecogin alfa), may be considered in select cases based on patient-specific factors and established guidelines.

**Keywords:** *Sepsis, Management approach, Recognition and diagnosis, Supportive care, Antibiotic therapy, Hemodynamic support, Organ function support*

## Introduction

Sepsis is a life-threatening medical condition characterized by a systemic response to infection [1]. It occurs when the body's immune system overreacts to an infection, leading to widespread inflammation and organ dysfunction [2]. Sepsis can result from various types of infections, including bacterial, viral, or fungal infections. The condition can affect anyone, but individuals with weakened immune systems, such as the elderly, young children, and those with chronic illnesses, are more susceptible. Sepsis is a medical emergency that requires immediate attention and treatment, as it can rapidly progress to septic shock, a severe form of the condition associated with low blood pressure and organ failure [3].

Early recognition and prompt treatment are crucial in managing sepsis effectively. Healthcare providers typically use a combination of clinical assessments and laboratory tests to diagnose sepsis. Common symptoms include fever, rapid heart rate, rapid breathing, and altered mental status. Laboratory tests, such as blood cultures, complete blood count, and biomarkers like procalcitonin, are used to identify the underlying infection and assess the severity of the condition. Once diagnosed, treatment involves administering broad-spectrum antibiotics to target the suspected infection, along with intravenous fluids to maintain adequate blood pressure and organ function. Additional interventions, such as vasopressor medications, may be necessary in cases of septic shock to support blood pressure [4].

Sepsis can lead to various complications, such as acute respiratory distress syndrome (ARDS), acute kidney injury, disseminated intravascular coagulation (DIC), and multiple organ dysfunction syndrome (MODS). Healthcare providers must be vigilant in monitoring for these complications and intervene promptly when necessary. Strategies to prevent complications may include lung-protective ventilation strategies, maintaining adequate fluid balance, optimizing hemodynamics, and implementing measures to prevent hospital-acquired infections [5], [6].

Various organizations, such as the Surviving Sepsis Campaign, have developed guidelines to standardize the care of septic patients [7]. These guidelines provide recommendations on various aspects of sepsis management, including early recognition, resuscitation, antimicrobial therapy, and organ support [8]. Adherence to these guidelines has been associated with improved outcomes, including reduced mortality rates. Therefore, healthcare providers should familiarize themselves with these guidelines and strive to implement them in their clinical practice.

The purpose of this study is to provide a comprehensive overview of the management approach for sepsis. The study aims to outline the key steps and strategies involved in

the recognition, diagnosis, and treatment of sepsis, with a focus on improving patient outcomes.

## Key steps in the management of sepsis

### *Recognition and diagnosis:*

Recognition and diagnosis of sepsis are crucial for timely intervention and effective treatment. Early identification of sepsis allows healthcare professionals to initiate appropriate measures promptly, reducing the risk of complications and improving patient outcomes. Diagnosis is primarily based on a combination of clinical findings and evidence of organ dysfunction.

One of the key aspects in recognizing sepsis is identifying signs of infection. Fever, elevated heart rate, respiratory rate, and an increased white blood cell count are common indicators of an underlying infection. Fever is a systemic response to infection, and an elevated heart rate and respiratory rate reflect the body's attempt to compensate for the inflammatory process [9]. A high white blood cell count is often seen in response to infection, as the immune system mobilizes to combat pathogens.

In addition to signs of infection, evidence of organ dysfunction plays a critical role in diagnosing sepsis. Sepsis can affect multiple organs, leading to dysfunction or failure. Commonly affected organs include the kidneys, liver, lungs, and heart. Laboratory tests, such as liver function tests, kidney function tests, arterial blood gas analysis, and cardiac markers, can provide insights into organ function and aid in the diagnosis of sepsis [10].

Furthermore, healthcare professionals utilize various scoring systems and clinical criteria to aid in the recognition and diagnosis of sepsis. The Sequential Organ Failure Assessment (SOFA) score and the quick Sequential Organ Failure Assessment (qSOFA) score are commonly used to assess the severity of organ dysfunction and guide clinical decision-making. These scores evaluate parameters such as blood pressure, Glasgow Coma Scale, bilirubin levels, platelet count, and respiratory status, providing a standardized approach to assessing organ dysfunction in sepsis.

It is worth noting that the diagnosis of sepsis requires a holistic approach, taking into account the patient's medical history, physical examination findings, and results from diagnostic tests. The clinical judgment of healthcare professionals is instrumental in recognizing the subtle signs and symptoms of sepsis that may not be captured by individual parameters alone. Collaboration among healthcare providers, including physicians, nurses, and laboratory staff, is crucial to ensure a comprehensive evaluation and accurate diagnosis.

### *Supportive care:*

Supportive care plays a vital role in the management of sepsis, aiming to stabilize the patient's condition, optimize organ function, and prevent further complications. Adequate oxygenation, fluid resuscitation, and vigilant monitoring of vital signs are integral components of supportive care for patients with sepsis [11], [12].

Maintaining optimal oxygenation is crucial in sepsis management. Oxygen therapy is administered to ensure that oxygen saturation levels remain above 90%. This is typically achieved through the use of supplemental oxygen via nasal prongs, a face mask, or mechanical ventilation, depending on the severity of respiratory distress. Oxygen supplementation helps improve tissue oxygenation, as sepsis can impair oxygen delivery due to compromised cardiovascular function.

Fluid resuscitation is another fundamental aspect of supportive care in sepsis. Intravenous fluids are administered to restore and maintain adequate blood flow to vital organs. This approach helps improve tissue perfusion, mitigate hypoperfusion-related organ dysfunction, and support the body's ability to fight the underlying infection. The choice of fluid type (such as crystalloids or colloids) and the rate of administration are tailored to the individual patient's needs, guided by clinical assessment and monitoring parameters.

Vigilant monitoring of vital signs is essential throughout the management of sepsis. This includes regular assessment of blood pressure, heart rate, respiratory rate, oxygen saturation, and temperature. Continuous monitoring techniques, such as arterial blood pressure monitoring or central venous pressure monitoring, may be employed in critically ill patients. These monitoring modalities help healthcare professionals identify any signs of deterioration or inadequate response to treatment, enabling timely interventions and adjustments to the supportive care plan [13].

In addition to oxygenation, fluid resuscitation, and vital sign monitoring, other aspects of supportive care in sepsis may include pain management, nutritional support, and infection control measures. Pain control, typically achieved with analgesic medications, is essential for patient comfort and overall well-being. Nutritional support aims to meet the increased energy and nutrient requirements of patients with sepsis, often utilizing enteral or parenteral nutrition methods. Strict infection control measures, including hand hygiene, isolation protocols, and appropriate use of antibiotics, are crucial to prevent the spread of infection and optimize treatment outcomes.

#### *Antibiotic therapy:*

Antibiotic therapy is a critical component in the management of sepsis, as it targets the underlying infection and helps prevent its progression. Prompt initiation of broad-spectrum antibiotics is essential to effectively combat the pathogens responsible for sepsis. The choice of antibiotics should be guided by several factors, including the suspected source of infection, local resistance patterns, and individual patient considerations.

Once sepsis is suspected, appropriate cultures should be obtained to identify the causative microorganisms and determine their susceptibility to antibiotics. Blood cultures, as well as cultures from suspected sites of infection such as urine, respiratory secretions, or wound swabs, are commonly collected. This allows for a more targeted antibiotic therapy based on the identified pathogens.

Broad-spectrum antibiotics are initially administered to cover a wide range of potential pathogens while awaiting culture results. These antibiotics have activity against a broad spectrum of bacteria, including both Gram-positive and Gram-negative organisms. They are selected based on the likely sources of infection and the common pathogens associated with those sources. Commonly used broad-spectrum antibiotics include cephalosporins, carbapenems, and combination therapies that cover multiple bacterial groups.

It is important to consider local resistance patterns when selecting antibiotics for sepsis treatment. Regional patterns of bacterial resistance may vary, and healthcare providers should be aware of the prevalence of resistant organisms in their specific healthcare setting. This knowledge helps guide the choice of antibiotics to ensure effective treatment and minimize the risk of treatment failure due to antibiotic resistance.

Individual patient factors also play a role in antibiotic selection. This includes patient characteristics such as age, underlying health conditions, allergies, and previous exposure to antibiotics. The choice of antibiotics should take into account factors such as renal or hepatic function, drug interactions, and potential adverse effects. Adjustments in dosing or choice of antibiotics may be necessary for patients with specific considerations to optimize therapy and minimize the risk of complications.

Once culture results become available, antibiotic therapy can be tailored to target the specific pathogens and adjust the spectrum of coverage accordingly. This approach, known as targeted or de-escalation therapy, helps optimize antibiotic selection and minimize the use of broad-spectrum agents, which can contribute to antibiotic resistance and adverse effects [14], [15].

#### *Source control:*

Source control is a crucial component of sepsis management, aiming to eliminate or control the underlying source of infection. Prompt identification and intervention at the source of infection are vital to prevent ongoing bacterial proliferation, reduce the risk of complications, and improve patient outcomes. Source control measures can include various interventions such as draining abscesses, removing infected tissues, debriding wounds, or removing infected devices like catheters.

Draining abscesses is an important source control measure, particularly in cases where localized collections of pus are present. Abscesses can occur in various body sites, such as the abdomen, lungs, or soft tissues. Abscess drainage may involve percutaneous techniques guided by imaging, surgical drainage, or placement of drainage catheters to facilitate the removal of pus and promote the resolution of infection.

In cases where infected tissues are identified, surgical intervention may be necessary to remove or debride the infected areas. This can involve procedures such as surgical excision, debridement, or amputation, depending on the extent and severity of the infection. Removing infected tissues helps eliminate the nidus of infection and reduces the bacterial load, allowing for better control of the septic process.

Wound debridement is another important source control measure, particularly in cases of infected wounds or ulcers. Debridement involves the removal of devitalized or necrotic tissue from the wound, which can serve as a breeding ground for bacteria. By removing the infected and non-viable tissue, wound healing is facilitated, and the risk of persistent or recurrent infection is reduced.

In some cases, infected medical devices such as catheters or prosthetic implants may serve as a source of infection. Timely removal or replacement of these devices is necessary to control the infection. Catheter-associated bloodstream infections, for example, often require prompt removal of the infected catheter to prevent further spread of the infection and potential complications.

Source control measures are typically performed in conjunction with other sepsis management strategies, such as antibiotic therapy and supportive care. These interventions work synergistically to control the infection, optimize organ function, and promote patient recovery. It is important to note that source control should be individualized based on the specific circumstances of each patient. The decision to perform a specific intervention, such as drainage, debridement, or device removal, should be based on clinical judgment, assessment of the severity of infection, and consideration of the patient's overall clinical condition [16], [17].

#### *Hemodynamic support:*

Hemodynamic support plays a critical role in the management of patients with sepsis, particularly in cases where there is hemodynamic instability and compromised organ perfusion. Sepsis can lead to decreased blood pressure and inadequate tissue perfusion, which require timely intervention to maintain organ function and prevent further damage. Hemodynamic support includes fluid resuscitation as the initial approach, followed by the potential use of vasopressor medications when necessary.

Fluid resuscitation is the initial step in hemodynamic support for sepsis patients. Intravenous fluids, typically crystalloids, are administered to restore and maintain adequate blood volume. The goal is to improve cardiac preload and optimize tissue perfusion. The choice of fluid type and the rate of administration are guided by clinical assessment and monitoring parameters. Close monitoring of the patient's response to fluid administration is crucial to avoid fluid overload and pulmonary edema.

In cases where fluid resuscitation alone is insufficient to maintain adequate blood pressure and tissue perfusion, vasopressor medications may be necessary. Vasopressors are drugs that constrict blood vessels, thereby increasing systemic vascular resistance and blood pressure. Commonly used vasopressors in sepsis management include norepinephrine, dopamine, and vasopressin. These medications are administered through intravenous infusion, with careful titration to achieve the desired hemodynamic targets.

The decision to initiate vasopressor therapy is based on the patient's clinical condition, such as persistent hypotension despite fluid resuscitation and signs of inadequate organ perfusion. Hemodynamic monitoring, including blood pressure measurements, central

venous pressure monitoring, and assessment of end-organ function, guides the initiation and titration of vasopressor therapy. The aim is to maintain adequate blood pressure and tissue perfusion while balancing the risks of potential complications associated with vasopressor use.

It is important to note that hemodynamic support should be individualized based on the patient's specific needs and response to therapy. Close monitoring and regular reassessment of the patient's hemodynamic status are crucial to guide treatment adjustments. Additionally, consideration should be given to potential underlying causes of hemodynamic instability, such as myocardial dysfunction or adrenal insufficiency, which may require targeted interventions or additional therapies.

*Organ function support:*

Organ function support is crucial in the management of sepsis, particularly in cases where severe sepsis or septic shock leads to organ dysfunction. Sepsis can affect multiple organ systems, including the respiratory, renal, cardiovascular, and central nervous systems. Specific interventions may be necessary to support organ function and prevent further deterioration.

Respiratory support is commonly required in sepsis patients who develop acute respiratory distress syndrome (ARDS) or respiratory failure. Mechanical ventilation is utilized to provide adequate oxygenation and ventilation when the patient's own respiratory efforts are inadequate. Ventilator settings are adjusted to optimize lung function, maintain oxygenation, and minimize the risk of ventilator-associated complications [18], [19].

In cases where sepsis leads to kidney failure or severe impairment of renal function, renal replacement therapy (RRT) may be necessary. RRT, such as hemodialysis or continuous renal replacement therapy, helps remove waste products, regulate fluid and electrolyte balance, and maintain acid-base equilibrium. It provides temporary support while allowing the kidneys time to recover, or in cases where kidney function does not improve, it may be required as a long-term intervention [20], [21].

Supportive care for other affected organs is also critical. For example, if sepsis leads to cardiovascular dysfunction, interventions such as inotropic support or vasopressor therapy may be necessary to optimize cardiac function and maintain hemodynamic stability. Neurological support may be provided to manage altered mental status, seizures, or other neurological complications associated with sepsis.

In addition to specific interventions for organ dysfunction, general supportive care measures are implemented to promote organ recovery and overall patient well-being. These may include adequate pain management, nutritional support, prevention of complications such as pressure ulcers or deep vein thrombosis, and early mobilization when feasible.

The specific interventions for organ function support are tailored to the individual patient's needs and the severity of organ dysfunction. Regular assessment of organ

function, through laboratory tests, imaging studies, and clinical evaluation, guides the initiation and adjustment of these interventions. A multidisciplinary approach involving healthcare professionals from various specialties, including critical care physicians, nephrologists, respiratory therapists, and others, ensures comprehensive care and optimal organ support.

It is important to note that organ function support is not only aimed at maintaining organ function but also at treating the underlying cause of organ dysfunction, which is often the sepsis itself. By addressing the source of infection, providing appropriate antibiotic therapy, and implementing timely source control measures, the overall burden on the organs can be reduced, facilitating organ recovery [22].

*Close monitoring:*

Close monitoring is an integral part of sepsis management, ensuring the timely identification of changes in a patient's condition and guiding treatment decisions. Continuous monitoring of vital signs, laboratory parameters, and organ function allows healthcare providers to assess the response to treatment and make necessary adjustments as needed.

Vital signs, including blood pressure, heart rate, respiratory rate, oxygen saturation, and temperature, are monitored regularly. Serial measurements provide valuable information on the stability of the patient's cardiovascular system, respiratory status, and overall clinical condition. Deviations from normal ranges or trends indicating deterioration can prompt immediate interventions or further investigations.

Laboratory parameters are closely monitored to assess the patient's response to therapy and identify any underlying abnormalities. Complete blood count, coagulation studies, electrolyte levels, liver and kidney function tests, and markers of inflammation are among the commonly monitored laboratory parameters. Serial measurements help track the patient's hematological, metabolic, and inflammatory status, allowing healthcare providers to tailor treatment and detect any signs of organ dysfunction or systemic complications.

Organ function is assessed through various means, depending on the specific organs at risk and the patient's clinical presentation. For example, cardiac function may be monitored through electrocardiography (ECG), echocardiography, or invasive hemodynamic monitoring. Renal function is evaluated by monitoring urine output, serum creatinine levels, and other renal markers. Neurological status is assessed through regular neurological examinations, including assessments of consciousness, pupillary reactions, and motor responses [23].

Serial assessments and close monitoring enable healthcare providers to evaluate the patient's response to treatment and guide further management decisions. These assessments may include clinical evaluations, physical examinations, and review of imaging studies. The gathered information helps healthcare providers determine the effectiveness of interventions, identify any signs of treatment failure or complications, and adjust the treatment plan accordingly [24].



In addition to the routine monitoring of vital signs and laboratory parameters, specific monitoring techniques may be employed in critically ill sepsis patients. This can include invasive monitoring, such as arterial blood pressure monitoring, central venous pressure monitoring, or continuous cardiac output monitoring. These techniques provide real-time data on hemodynamic status, fluid responsiveness, and tissue perfusion, assisting in the optimization of supportive care and hemodynamic support.

Regular reassessment and monitoring throughout the course of sepsis management allow healthcare providers to detect any changes or deterioration promptly. This enables early interventions, adjustment of treatment strategies, and the implementation of supportive measures to mitigate complications and improve patient outcomes.

#### *Adjunctive therapies:*

Adjunctive therapies can play a role in the management of sepsis in certain cases, although their use may vary depending on the individual patient's condition and specific guidelines. Two examples of adjunctive therapies that have been considered in sepsis management are corticosteroids and activated protein C (drotrecogin alfa) [25], [26].

The use of steroids in the management of sepsis, particularly septic shock, has been associated with ambiguity and ongoing debate [27]. Ambiguity arises from uncertainties in patient selection, optimal dosage and duration of therapy, and effectiveness in specific sepsis populations [28]. Conflicting results from clinical trials have further added to the complexity. While guidelines have provided some recommendations, the optimal use of steroids in sepsis remains a dynamic area of research and requires a personalized approach based on patient characteristics and evolving evidence. Corticosteroids, such as hydrocortisone or methylprednisolone, have been studied as adjunctive therapy in sepsis, particularly in cases of septic shock [29], [30]. The rationale behind their use is based on their potential anti-inflammatory and immunomodulatory effects. Corticosteroids may help suppress excessive inflammation and modulate the body's immune response, which can be dysregulated in sepsis. However, the use of corticosteroids in sepsis remains a topic of debate, and guidelines regarding their administration differ. The decision to use corticosteroids as an adjunctive therapy should be made on a case-by-case basis, considering factors such as the severity of sepsis, underlying comorbidities, and the individual patient's response to treatment [31], [32].

Activated protein C, also known as drotrecogin alfa, was previously considered as an adjunctive therapy for severe sepsis. Activated protein C is a naturally occurring anticoagulant with potential anti-inflammatory and anti-apoptotic effects. It was thought to modulate the coagulation system and reduce inflammation, potentially improving outcomes in sepsis. However, clinical trials evaluating the use of activated protein C did not consistently demonstrate significant benefits, and its use has become controversial. As a result, the use of activated protein C is not widely recommended, and its availability may vary depending on regional guidelines and healthcare practices.

The decision to employ these therapies should be based on the individual patient's condition, taking into account factors such as the severity of sepsis, the presence of specific organ dysfunctions, and the overall clinical picture [33], [34]. Furthermore, adherence to evidence-based guidelines and consultation with specialists or a multidisciplinary team experienced in sepsis management can help inform treatment decisions and optimize patient care. As research and clinical guidelines evolve, new adjunctive therapies may emerge, and existing recommendations may change.

## Conclusion

Recognition and diagnosis of sepsis involve a combination of clinical findings and evidence of organ dysfunction. Identifying signs of infection, such as fever, elevated heart rate, respiratory rate, and white blood cell count, provides initial clues. However, the presence of organ dysfunction, assessed through laboratory tests and clinical scoring systems, confirms the diagnosis. A multidisciplinary approach and clinical expertise are essential to promptly recognize sepsis and initiate timely treatment, ultimately improving patient outcomes.

Supportive care in sepsis is a comprehensive approach that encompasses adequate oxygenation, fluid resuscitation, and vigilant monitoring of vital signs. These interventions aim to stabilize the patient's condition, optimize organ function, and promote recovery. Implementing a multidisciplinary approach with close collaboration between healthcare professionals is crucial to ensure the timely and appropriate delivery of supportive care measures in septic patients.

Antibiotic therapy is a crucial aspect of sepsis management. Prompt administration of broad-spectrum antibiotics is essential, guided by the suspected source of infection, local resistance patterns, and individual patient factors. Cultures should be obtained to identify the pathogens and guide targeted antibiotic therapy. Regular reassessment of the choice of antibiotics and adjustments based on culture results are important to optimize treatment efficacy while considering the potential for antibiotic resistance and individual patient considerations.

Source control plays a vital role in sepsis management. Identifying and controlling the source of infection are crucial steps to prevent ongoing bacterial proliferation and improve patient outcomes. Drainage of abscesses, removal of infected tissues, debridement of wounds, and removal of infected devices are some of the key interventions employed in source control. These measures are typically performed in conjunction with other sepsis management strategies, ensuring a comprehensive approach to the treatment of sepsis.

Hemodynamic support is a critical component of sepsis management, aiming to maintain adequate blood pressure and tissue perfusion. Fluid resuscitation is the initial approach, followed by the potential use of vasopressor medications when fluid resuscitation alone is insufficient. Individualized treatment, careful monitoring, and regular reassessment are essential to optimize hemodynamic support and improve patient outcomes in sepsis.

Organ function support is a crucial aspect of sepsis management, particularly in cases of severe sepsis or septic shock. Specific interventions, such as respiratory support, renal replacement therapy, and supportive care for other affected organs, are implemented to optimize organ function, prevent further deterioration, and promote patient recovery. Individualized treatment and close monitoring of organ function are essential to guide interventions and improve outcomes in sepsis.

Close monitoring is an essential component of sepsis management. Continuous monitoring of vital signs, laboratory parameters, and organ function provides valuable information on the patient's response to treatment, helps identify signs of deterioration, and guides further management decisions. Serial assessments and regular reassessment play a crucial role in optimizing care and improving outcomes for patients with sepsis.

Adjunctive therapies such as corticosteroids and activated protein C have been considered in sepsis management, although their use may depend on individual patient factors and specific guidelines. The decision to utilize these therapies should be made on a case-by-case basis, considering the severity of sepsis, underlying comorbidities, and response to treatment. Staying informed about evolving evidence and guidelines is important to guide the use of adjunctive therapies effectively in sepsis management.

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