

The Role of the Nurse in Early Detection of Sepsis Using Laboratory Markers

Nuha Abdullah Almowallid¹, Sharifah Yahya Shami Alasiri¹, Wasmiah Faihan Muzwid Alanazi², Alanazi, Samiyah Fahis A³, Alenezi Maha Abbas S⁴, Maram Hejjie Eid Alanazi⁵, Manar Salah Farhan Al Dhamshi⁶, Ahmed Mohammed Saeed Alanazi⁷, Abdulelah Mohammed Jamaan Alghamdi⁸, Yasser Taraki S Alenazi⁹

¹Senior Nursing Specialist, East Jeddah General Hospital, Jeddah in Saudi Arabia

²Specialist-Laboratory, Prince Abdulaziz bin Musa'ed Hospital, Arar, Saudi Arabia

³Specialist-Laboratory, Forensic Medical Services Center Arar in Saudi Arabia

⁴Laboratory Specialist, Maternity and Children's Hospital in Arar, Saudi Arabia

⁵Laboratory specialist, Forensic Medical Services Center Arar, Saudi Arabia

⁶Laboratory specialist, King Fahd Dahia Health Center, Arar, Saudi Arabia

⁷Technician-laboratory, Prince Abdulaziz bin Musa'ed Hospital, Arar, Saudi Arabia

⁸Technician-Laboratory, King Abdulaziz University Hospital, Jeddah, Saudi Arabia

⁹Health Assistant, North Medical Tower, Arar, Saudi Arabia

Abstract

The role of nurses in the early detection of sepsis is critical, as they are often the first healthcare professionals to assess patients and recognize changes in their clinical status. Nurses perform ongoing vital sign assessments, physical examinations, and patient history evaluations, all of which are essential in identifying potential sepsis symptoms. Early recognition of signs such as fever, tachycardia, and altered mental status can rapidly trigger a patient response protocol. Moreover, nurses play an essential role in the timely collection and processing of laboratory samples. They ensure that specimens for essential biomarkers—such as lactate levels, complete blood counts, and blood cultures—are obtained quickly to facilitate early diagnosis. Given the time-sensitive nature of sepsis treatment, swift nursing actions can significantly improve patient outcomes. In addition to identifying clinical symptoms and managing laboratory procedures, nurses also interpret laboratory results in the context of the patient's overall clinical picture. They have the expertise to recognize significant deviations from normal ranges and understand their implications for sepsis diagnosis. For instance, elevated lactate levels can indicate tissue hypoperfusion, a hallmark of sepsis, prompting further interventions. Furthermore, nurses serve as vital communicators within the healthcare team, relaying critical laboratory findings to physicians and other providers to ensure coordinated and immediate responses to suspected sepsis cases. By employing an evidence-based approach and utilizing laboratory markers effectively, nurses can be at the forefront of sepsis management, ultimately enhancing the quality of care and improving survival rates for critically ill patients.

Keywords: Sepsis, Nursing Role, Early Detection, Laboratory Markers, Patient Outcomes, Clinical

Assessment, Healthcare, Nursing Education.

1. Introduction

Sepsis, defined as a life-threatening organ dysfunction caused by a dysregulated host response to infection, remains one of the leading causes of morbidity and mortality in healthcare settings worldwide. Its complex pathophysiology and swift progression present significant challenges to effective management, making early detection crucial in improving patient outcomes. The pivotal role of nurses in this context cannot be overstated; they are often the first point of contact for patients within the healthcare system. Therefore, the integration of laboratory markers into nursing practice may significantly enhance the early recognition of sepsis, facilitating timely interventions and improving survival rates [1].

Historically, the detection of sepsis has relied heavily on clinical assessments and observational signs, often leading to delayed recognition and treatment. Standard clinical symptoms, including fever, tachycardia, and altered mental status, are frequently nonspecific and can overlap with other medical conditions. Such ambiguities emphasize the need for more reliable diagnostic tools, particularly laboratory markers that can aid in the prompt identification of sepsis. Commonly utilized laboratory markers include procalcitonin, C-reactive protein, and lactate levels, which can provide critical information on the presence of infection, systemic inflammation, and tissue perfusion, respectively. This laboratory data, when interpreted in conjunction with clinical assessments, may offer a more nuanced understanding of a patient's condition, allowing for timely and appropriate intervention [2].

Nurses, by virtue of their extensive training and their continuous bedside presence, are uniquely positioned to facilitate early detection of sepsis. They are responsible for monitoring vital signs, assessing patients' clinical presentations, and collecting specimens for laboratory testing. Therefore, understanding the implications of laboratory markers in the context of sepsis is essential for nursing practice. A well-orchestrated nursing approach that incorporates the effective utilization of these markers could bridge the gap between initial assessment and the critical decision-making that dictates treatment pathways. Moreover, the evolving landscape of sepsis care necessitates that nurses stay abreast of current guidelines and best practices to ensure that evidenced-based approaches are implemented in clinical decision-making [3].

Research has shown that timely identification and initiation of treatment for sepsis can significantly reduce mortality rates. Consequently, the incorporation of laboratory markers into nursing protocols and educational curricula is vital. Not only would this enhance the ability of nurses to identify at-risk patients earlier, but it would also empower them to contribute actively to the multidisciplinary healthcare team focused on sepsis management. Additionally, as healthcare systems increasingly embrace collaborative models of care, nurses serve as critical liaisons between patients and other healthcare providers, advocating for patient needs while facilitating communication about laboratory findings that require urgent attention [4].

Given the dire consequences associated with delayed sepsis recognition, this research seeks to explore the specific role of nursing in the early detection of sepsis using laboratory markers. By investigating current practices, attitudes, knowledge gaps, and training needs among nursing staff, this study aims to highlight the potential for targeted interventions that can enhance the nursing role in sepsis identification. Furthermore, this research will provide a framework for developing educational programs that equip nurses with the skills and knowledge necessary to leverage laboratory markers effectively in their assessments, leading to integrated and comprehensive approaches to sepsis care [5].

The interplay between nursing practice and laboratory diagnostics is a critical component of patient-centered care in the context of sepsis. As healthcare continues to evolve, nursing practice must adapt to incorporate technological advancements and improved diagnostic methodologies. By focusing on the role of nurses in the early detection of sepsis through the use of laboratory markers, this research aims not only to uncover current challenges within the clinical landscape but also to propose actionable strategies that can enhance patient safety and care outcomes [6].

Sepsis and Its Significance

Sepsis, a complex and often life-threatening condition, represents a significant global health challenge characterized by the body's overwhelming and potentially detrimental response to infection. It arises from a dysregulated host response to pathogens, leading to widespread inflammation, tissue damage, and, if untreated, multi-organ failure. As a leading cause of morbidity and mortality across healthcare settings, sepsis underscores the necessity of understanding its mechanisms, prevalence, and the profound impact it exerts on patient outcomes [6].

At its core, sepsis is defined as a life-threatening organ dysfunction caused by a dysregulated host response to infection. The condition can be triggered by a variety of infectious agents, including bacteria, viruses, fungi, and parasites. When the body encounters these pathogens, it typically mounts an immune response. However, in sepsis, the immune system's response becomes exaggerated, leading to a catastrophic cascade of events that can result in widespread inflammation [7].

The mechanisms of sepsis involve complex interplays between the immune system and various organ systems. When the body detects an infection, the innate immune system responds by releasing signaling molecules known as cytokines. In sepsis, this response is magnified, resulting in an overproduction of pro-inflammatory cytokines and inadequately controlled anti-inflammatory responses. The subsequent sepsis-induced inflammatory response can lead to endothelial dysfunction, increased vascular permeability, and microcirculatory disturbances, ultimately resulting in organ dysfunction [8].

Sepsis is categorized into several clinical definitions, including sepsis, severe sepsis, and septic shock. Sepsis is identified by the presence of infection along with signs of organ dysfunction, such as alterations in mental status, breathing difficulties, or an altered heart rate. Severe sepsis involves more pronounced organ dysfunction or tissue hypoperfusion, while septic shock is

characterized by persistent hypotension despite adequate fluid resuscitation, leading to a higher risk of death [9].

Sepsis remains a predominant cause of critical illness worldwide. According to the World Health Organization (WHO), sepsis affects an estimated 30 million individuals globally each year, with an alarming mortality rate that ranges from 10% to 60%, depending on the severity and timeliness of treatment. The prevalence of sepsis has been on the rise, reflecting several intertwined factors, including aging populations, the increasing incidence of immunocompromising conditions (such as diabetes and cancer), and the growing prevalence of antibiotic-resistant pathogens [10].

Healthcare-associated infections have contributed significantly to the development of sepsis, particularly in settings like intensive care units (ICUs) where patients are at increased risk due to their underlying conditions or prolonged interventions. Data suggest that one in four patients who develop sepsis dies as a consequence, emphasizing the urgency of addressing this public health issue [7].

The impact of sepsis on patient outcomes is profound and multifaceted. Beyond the immediate risk to survival, sepsis can have long-lasting implications for those who survive. Many individuals will experience post-sepsis syndrome, which encompasses a range of physical, psychological, and cognitive impairments. Survivors may encounter challenges such as fatigue, muscle weakness, depression, and difficulties with memory and concentration, significantly affecting their quality of life [11].

In addition to its direct toll on survivors, sepsis places an enormous burden on healthcare systems. The costs associated with sepsis treatment are significant, comprising hospital stays, long-term rehabilitation, and outpatient care. The economic impact is particularly acute in resource-limited settings, where the availability of critical care resources may be inadequate to meet the demand created by sepsis events [12].

Furthermore, the increasing rates of antibiotic resistance complicate the treatment landscape for sepsis. As resistant strains of bacteria become more prevalent, the effectiveness of standard antibiotic therapies diminishes, leading to extended hospital stays and higher mortality rates. This escalating public health concern has prompted a reinvigorated focus on sepsis prevention, timely identification, and effective management strategies [11].

Laboratory Markers for Sepsis Detection

The timely identification of sepsis is paramount for effective management, but its early diagnosis can be challenging due to the nonspecific nature of clinical symptoms. Consequently, laboratory markers play a pivotal role in sepsis detection, assisting healthcare providers in risk stratification and guiding therapeutic interventions [13].

Classification of Laboratory Markers

Laboratory markers for sepsis can be broadly classified into three categories: biochemical markers, immunologic markers, and microbiological markers.

1. Biochemical Markers

- o C-Reactive Protein (CRP): CRP is an acute-phase protein synthesized by the liver in response to inflammation. Elevated levels of CRP are commonly seen in patients with sepsis, as it reflects the acute inflammatory response. Though it is not specific to infection, a significant increase in CRP is often associated with severe sepsis and septic shock [7].
- o Procalcitonin (PCT): PCT is a precursor of the hormone calcitonin and is produced in response to bacterial infection or inflammation, predominantly by the thyroid gland and other tissues. High levels of PCT are indicative of bacterial sepsis and can aid in differentiating between bacterial and viral infections. Its levels often correlate with the severity of infection, making it a valuable prognostic marker [14].
- o Lactate: Serum lactate levels reflect tissue hypoperfusion and metabolic acidosis, which are common in septic patients. Elevated lactate indicates impaired oxygen delivery to tissues and is associated with increased mortality. Therefore, lactate measurement is integral to sepsis management, especially in critically ill patients [9].

2. Immunologic Markers

- o White Blood Cell Count (WBC): The total WBC count is a traditional laboratory test used to evaluate infection. In sepsis, patients typically present with leukocytosis (elevated WBC count), though leukopenia (low WBC count) can also occur, particularly in advanced stages. The presence of immature neutrophils, or "left shift," can indicate an acute inflammatory response and sepsis [7].
- o D-dimer: D-dimer is a fibrin degradation product elevated in various conditions, including sepsis. It reflects ongoing coagulation and fibrinolysis and can be useful in assessing the risk of thrombosis. High levels are associated with sepsis and can give insight into the patient's coagulation status, which is often disrupted in septic patients [9].

3. Microbiological Markers

- o Blood Cultures: The cornerstone of microbiological diagnosis in sepsis is blood cultures, which identify causative pathogens. Positive blood cultures confirm sepsis and can guide targeted antibiotic therapy. However, the sensitivity may be low, particularly in patients who have previously received antibiotics. Despite this limitation, a negative blood culture cannot exclude a diagnosis of sepsis [11].
- o Molecular Diagnostics: Advances in molecular techniques, such as polymerase chain reaction (PCR), have increased the sensitivity and speed of pathogen detection. Rapid PCR tests can identify specific bacterial and viral DNA/RNA within hours, allowing for prompt initiation of appropriate therapy, even before traditional culture results are available [15].

Clinical Relevance of Laboratory Markers

The clinical utility of laboratory markers in sepsis lies not only in their diagnostic capabilities but also in their role in prognostication, treatment monitoring, and guiding clinical decisions [2].

1. Early Diagnosis and Risk Stratification

The timely identification of sepsis is critical to improving outcomes. In cases of suspected sepsis, a combination of laboratory markers can enhance diagnostic accuracy. For instance, elevated CRP and PCT levels, alongside clinical signs such as fever, tachycardia, and hypotension, can suggest the need for urgent intervention. Combining markers can improve sensitivity and specificity, aiding clinicians in risk stratification for further management [16].

2. Guiding Therapeutic Interventions

Laboratory markers can guide timely interventions, such as antibiotics, fluids, and vasopressors. Monitoring PCT and CRP levels can help assess the effectiveness of antibiotic therapy, as a decrease in these markers may indicate a positive response to treatment. Additionally, lactate levels can inform the need for aggressive resuscitation; persistently high lactate post-initial resuscitation may prompt further evaluation and intervention [17].

3. Prognostic Value

Certain laboratory markers are associated with disease severity and prognosis. For example, an elevated lactate level is a powerful predictor of mortality in sepsis. Studies have demonstrated that patients with higher plasma lactate levels upon presentation are at increased risk of progression to severe sepsis or septic shock [4].

4. Monitoring Disease Progression

Sequential monitoring of laboratory markers can provide insights into a patient's clinical trajectory. Changes in WBC count, CRP, or PCT during the course of therapy can inform clinicians about the presence or resolution of infection, guiding future treatment decisions [11].

Nursing Assessment: Recognizing Sepsis Symptoms

Sepsis typically begins with an infection that triggers a systemic inflammatory response syndrome (SIRS). This inflammatory cascade is initiated when pathogens or their toxins enter the bloodstream, leading to the release of pro-inflammatory mediators. The resultant systemic response can result in widespread vasodilation, increased vascular permeability, and ultimately, abnormal blood flow to vital organs. This phenomenon can lead to multiple organ dysfunction syndrome (MODS), characterized by the failure of two or more organic systems. Understanding the underlying mechanisms of sepsis is essential for nurses to recognize early signs and intervene appropriately [2].

Identifying Clinical Signs and Symptoms

Clinical signs and symptoms of sepsis can vary significantly, depending on the individual's health status, the nature of the infection, and the stage of the condition. However, some common indicators warrant close attention:

1. **Temperature Abnormalities:** Patients with sepsis often exhibit temperature fluctuations. Hypothermia (body temperature below 36°C or 96.8°F) and hyperthermia (temperature above

38°C or 100.4°F) are both common. Nurses should accurately assess temperature with a reliable method and monitor for signs of fever or chills [16].

2. **Heart Rate Changes:** Tachycardia is a frequent early sign of sepsis, with heart rates often exceeding 90 beats per minute. This cardiovascular response occurs as the body tries to improve perfusion to deprived tissues. Nurses should assess baseline heart rates, being aware that significant deviations from normal can indicate hemodynamic instability [4].

3. **Respiratory Symptoms:** Patients may experience increased respiratory rates (tachypnea) and can present with difficulty breathing. A respiratory rate greater than 20 breaths per minute is concerning. Moreover, hypoxemia, evident from low oxygen saturation levels on pulse oximetry, can signal the presence of sepsis leading to pulmonary complications [11].

4. **Altered Mental Status:** Sepsis can significantly affect neurological status. Patients may become confused, exhibit agitation, or demonstrate lethargy. Monitoring the patient's level of consciousness is crucial; tools such as the Glasgow Coma Scale can be beneficial for consistent assessment [16].

5. **Skin Changes:** The skin may exhibit various changes, including mottling or pallor. In severe cases of sepsis, patients may develop cool extremities, characterized by delayed capillary refill and weak peripheral pulses. Such findings can signify poor perfusion and warrant immediate attention [12].

6. **Urine Output:** Oliguria (reduced urine output) or anuria (absence of urine output) is a critical sign of renal impairment associated with sepsis. Monitoring urine output through hourly assessments allows for early detection of renal dysfunction, a common complication of sepsis [14].

7. **Blood Pressure Changes:** Hypotension, defined as a systolic blood pressure below 90 mmHg or a significant drop from baseline, may indicate septic shock, a severe form of sepsis. Nurses must routinely assess blood pressure and understand the importance of fluid resuscitation and vasopressor therapy in management [12].

8. **Laboratory Indicators:** While nurses are not the primary interpreters of laboratory results, understanding the clinical relevance of parameters like leukocyte counts, lactate levels, and procalcitonin can aid in recognizing the risk of sepsis. An elevated white blood cell count, particularly with a predominance of immature neutrophils, and elevated lactate levels are suspect findings [16].

Certain populations are at increased risk for developing sepsis, making vigilant assessment even more critical. Patients with chronic illnesses such as diabetes, chronic lung disease, or immunosuppression (due to medications or conditions) are more susceptible to infections that can precipitate sepsis. The elderly, particularly those over 65, also exhibit altered immune responses, thus necessitating heightened vigilance during assessment [11].

Nursing assessment consists of systematic, thorough evaluations of the patient. Early identification of sepsis symptoms can significantly affect patient outcomes. Nurses are uniquely

positioned to perform comprehensive assessments due to their ongoing patient interactions and holistic understanding of patient needs. They employ clinical judgment and communication skills to discern subtle changes in a patient's status and employ appropriate screening tools such as the "qSOFA" (quick Sequential Organ Failure Assessment) score or the SIRS criteria to aid in their assessment [2].

Moreover, stringent documentation is vital, as it supports continuity of care and enables other healthcare professionals to be aware of the patient's evolving condition. Any concerning findings should trigger the implementation of hospital protocols for suspected sepsis, such as sepsis bundles that advocate for early intervention strategies [2].

The interpretation of laboratory results does not stand in isolation; it must be integrated with the patient's clinical presentation. Nurses are the primary providers of patient data in most clinical settings and have the advantage of continuous monitoring and interaction with patients. By carefully observing clinical signs—such as fever, tachycardia, hypotension, altered mental status, and respiratory distress—nurses can correlate laboratory findings with the patient's overall clinical picture, providing a more comprehensive assessment [17].

For example, a patient exhibiting elevated lactate levels and a high WBC count alongside a rapid heartbeat and hypotension is more indicative of sepsis than a patient with isolated lab abnormalities. Nurses who recognize these correlations can initiate timely interventions, such as fluid resuscitation or alerting physicians for potential sepsis protocols. Moreover, nurses can assess trends in vital signs and laboratory results over time, which is paramount in understanding the progression or resolution of sepsis [18].

Communication and Interdisciplinary Collaboration

Effective communication within the healthcare team is crucial for successful interpretation of laboratory results and subsequent clinical management. Nurses often serve as the liaison between patients and other healthcare professionals, including physicians, laboratory staff, and pharmacists. Their insights on lab results can facilitate faster decision-making and intervention strategies [17].

For instance, when a nurse interprets abnormal lab results indicating potential sepsis, they should swiftly communicate this information to the attending physician or rapid response team. By articulating the patient's clinical status alongside the laboratory data, nurses can advocate for essential interventions such as initiating broad-spectrum antibiotics, fluid resuscitation, and further diagnostic testing. Additionally, they can engage patients and their families in discussions around the implications of laboratory findings, empowering them with knowledge and easing anxieties related to acute illness [19].

Given the dynamic nature of healthcare and the increasing reliance on laboratory data for timely decision-making, continuous education and training for nurses are paramount. Nurses should be encouraged to pursue further education on the interpretation of lab findings, particularly in high-stakes areas such as sepsis management. Simulations, workshops, and professional development programs can enhance their analytical skills and confidence in utilizing laboratory data

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effectively. Furthermore, nurses can benefit from interdisciplinary education that fosters collaboration with laboratory professionals. Understanding how laboratory tests are performed and the nuances behind their results can foster greater competency in interpretation and patient advocacy [20].

2. Conclusion

In conclusion, nurses play an essential role in interpreting laboratory results, particularly in identifying sepsis. Their ability to understand the nuances of laboratory tests, integrate clinical findings, and communicate effectively within the healthcare team significantly impacts patient outcomes. In an era where timely identification and intervention in sepsis can mean the difference between life and death, empowering nurses with the knowledge and skills to interpret laboratory data is crucial. By enhancing their expertise in this area, the nursing profession can continue to advance patient care, ensuring that patients with sepsis receive rapid and effective intervention, ultimately improving survival rates and quality of care.

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