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The Role of Nursing Staff in the Early Detection and Management of Hospital-Acquired Infections Using Laboratory Biomarkers

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ABSTRACT

Hospital-acquired infections (HAIs) are among the most significant preventable complications of modern healthcare, associated with increased morbidity, mortality, length of stay, and cost. Nurses, who provide continuous bedside surveillance, are crucial in detecting early signs of infection and initiating timely interventions. In recent years, laboratory biomarkers—such as C-reactive protein (CRP), procalcitonin (PCT), leukocyte indices, lactate, and organ function markers—have become integral to the early recognition and management of HAIs and sepsis.

This paper discusses the burden of HAIs, reviews key laboratory biomarkers used in infection detection and monitoring and examines the central role of nursing staff in integrating biomarker data with clinical assessment. It highlights how nurses contribute to early detection, antimicrobial stewardship, and ongoing evaluation of treatment response. Conceptual tables, figures, and graphs are incorporated to summarize biomarker properties and illustrate nursing workflows. Barriers to effective biomarker use—such as knowledge gaps, workflow constraints, and limited informatics support—are explored, along with system-level enablers including protocols, education, and interprofessional collaboration.

The paper concludes that biomarker-informed nursing practice can support earlier recognition of HAIs, more rational antibiotic use, and improved patient outcomes, provided biomarkers are interpreted within clinical context and supported by robust protocols and education (Schuetz et al., 2012; Singer et al., 2016). Practical recommendations are offered for nursing education, protocol development, data visualization, and quality improvement to strengthen the contribution of nurses in biomarker-guided HAI detection and management.

KEYWORDS: Burden of Hospital-Acquired Infections and Rationale for Early Detection, Overview of Laboratory Biomarkers Relevant to HAIs.

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INTRODUCTION

Hospital-acquired infections are defined as infections that are not present or incubating at the time of hospital admission and typically emerge 48 hours or more after admission or within a defined period after discharge or invasive procedures (World Health Organization [WHO], 2011). Common HAIs include catheter-associated urinary tract infection, central line–associated bloodstream infection, ventilator-associated pneumonia, and surgical site infection (Haque et al., 2018). These infections increase patient suffering, institutional costs, and the risk of antimicrobial resistance, making them a central concern for patient safety and quality of care (Allegranzi et al., 2011).

Despite major advances in infection prevention—such as hand hygiene programs, bundles for invasive devices, environmental cleaning, and antimicrobial stewardship—HAIs remain frequent in both high- and low-resource settings (Allegranzi et al., 2011; Haque et al., 2018). While prevention is essential, it cannot fully eliminate risk, especially in critically ill or immunocompromised patients. Therefore, early detection and prompt management of emerging hospital-acquired infections become crucial to reduce

progression to severe sepsis or septic shock and to avert long-term complications.

Nurses occupy a unique position in this landscape. They are the health professionals who spend the most time with patients, observe subtle changes in condition, perform invasive procedures, and carry out many aspects of infection-prevention bundles (Bleakley et al., 2020; Odell, Victor, & Oliver, 2009). Traditional early detection of infection relied on clinical signs—fever, tachycardia, tachypnea, hypotension, altered mental status—and microbiological culture results, which often require days to become available. This created a window during which patients could deteriorate before results confirmed infection (Rhodes et al., 2017).

To narrow this window, clinicians increasingly use laboratory biomarkers—objective measurements indicating inflammation, infection, perfusion, and organ dysfunction. Biomarkers such as CRP and PCT can rise hours after the onset of a bacterial infection; lactate reflects hypoperfusion; leukocyte counts and differentials reveal systemic inflammatory responses; and creatinine, bilirubin, and platelet counts reflect organ involvement (Pepys & Hirschfield, 2003; Pierrakos & Vincent, 2010; Rhodes et al., 2017). Large trials and meta-analyses show that biomarkers, especially when used in algorithms, can support earlier recognition of infection and guide antibiotic initiation and de-escalation (Schuetz et al., 2012; Wacker, Prkno, Brunkhorst, & Schlattmann, 2013).

For nurses, this evolving landscape means that infection recognition is no longer based only on vital signs and subjective impressions; it also involves understanding which biomarkers are relevant, when to draw them, how to interpret their trends, and how to act on abnormal results. Many institutions now use nurse-driven sepsis screening tools that combine clinical criteria (e.g., temperature, respiratory rate) with laboratory criteria (e.g., leukocyte count, lactate) to trigger sepsis bundles (Levy, Evans, & Rhodes, 2018; Bleakley et al., 2020).

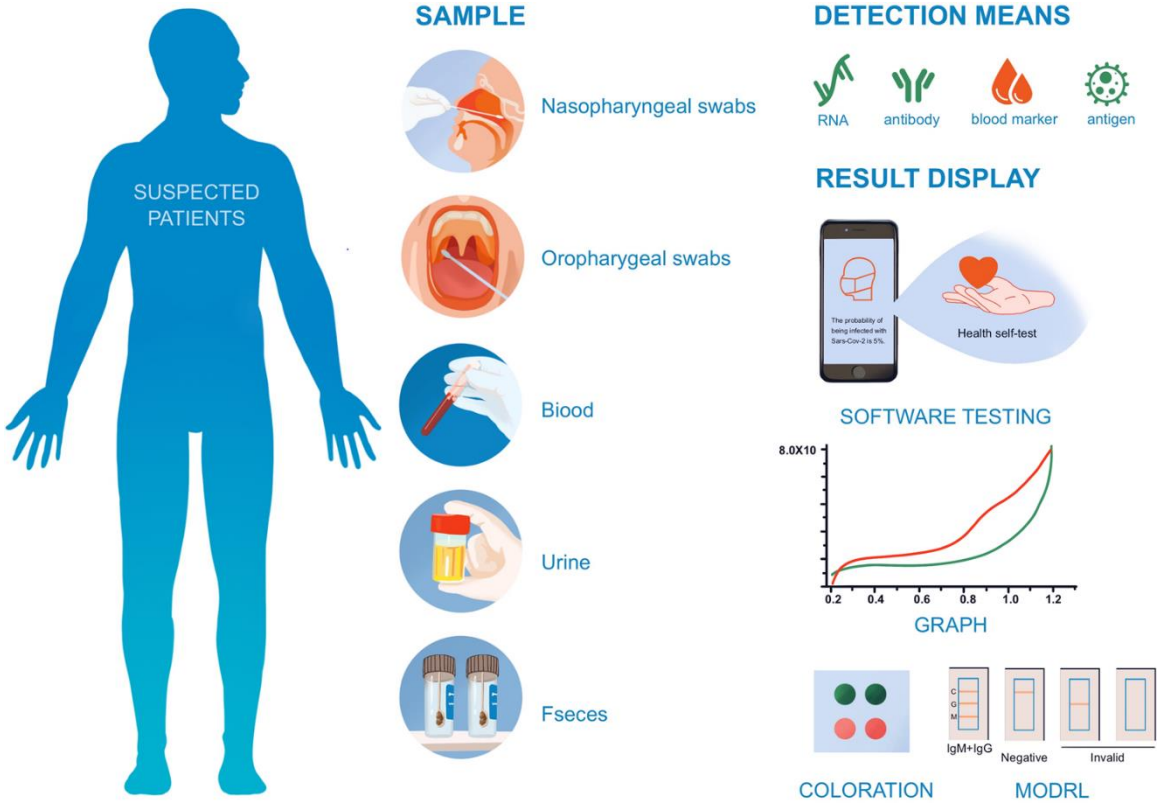

Figure 1: Applications of laboratory findings in the prevention, diagnosis, treatment, and monitoring disease

The objective of this paper is to:

1. Describe the burden of HAIs and the rationale for early detection.
2. Provide an overview of key laboratory biomarkers used for infection and sepsis.
3. Analyze the role of nursing staff in early detection and management of HAIs using laboratory biomarkers.
4. Present conceptual graphs, figures, and tables summarizing biomarkers and nursing actions.
5. Offer conclusions and recommendations for practice, education, and policy.

BODY

2.1. Burden of Hospital-Acquired Infections and Rationale for Early Detection

HAIs represent a major global burden. A landmark review found that in some regions of the world, between 5% and 15% of hospitalized patients acquire at least one healthcare-associated infection, with even higher rates in intensive care units (Allegranzi et al., 2011). HAIs prolong hospitalization, require additional diagnostics and interventions, increase antibiotic exposure, and are associated with substantial mortality (Haque et al., 2018).

From a systems perspective, HAIs are also costly: they contribute to bed occupancy pressures, readmissions, and financial penalties under pay-for-performance schemes (Haque et al., 2018). Because many HAIs are preventable through evidence-based interventions—such as appropriate insertion and care of invasive devices—international agencies treat HAI rates as sensitive indicators of the quality and safety of a healthcare system (WHO, 2011).

Even in hospitals with robust prevention strategies, there remain high-risk populations: patients with major surgery, trauma, burns, immunosuppression, prolonged ICU stays, or exposure to multidrug-resistant organisms. In these groups, complete prevention is unrealistic, making rapid recognition of infection the next line of defense. Delay in recognizing sepsis and initiating appropriate therapy, particularly antibiotics and source control, is associated with increased risk of organ failure and death (Rhodes et al., 2017; Singer et al., 2016).

Nursing surveillance plays a pivotal role in bridging the gap between the initial development of HAI and the initiation of effective management. Continuous bedside presence allows nurses to notice early changes in vital signs, mental status, or wound appearance that could signal infection (Odell et al., 2009). When this surveillance is coupled with timely ordering and review of laboratory biomarkers, the potential exists to detect and treat HAIs before they progress to life-threatening sepsis.

2.2. Overview of Laboratory Biomarkers Relevant to HAIs

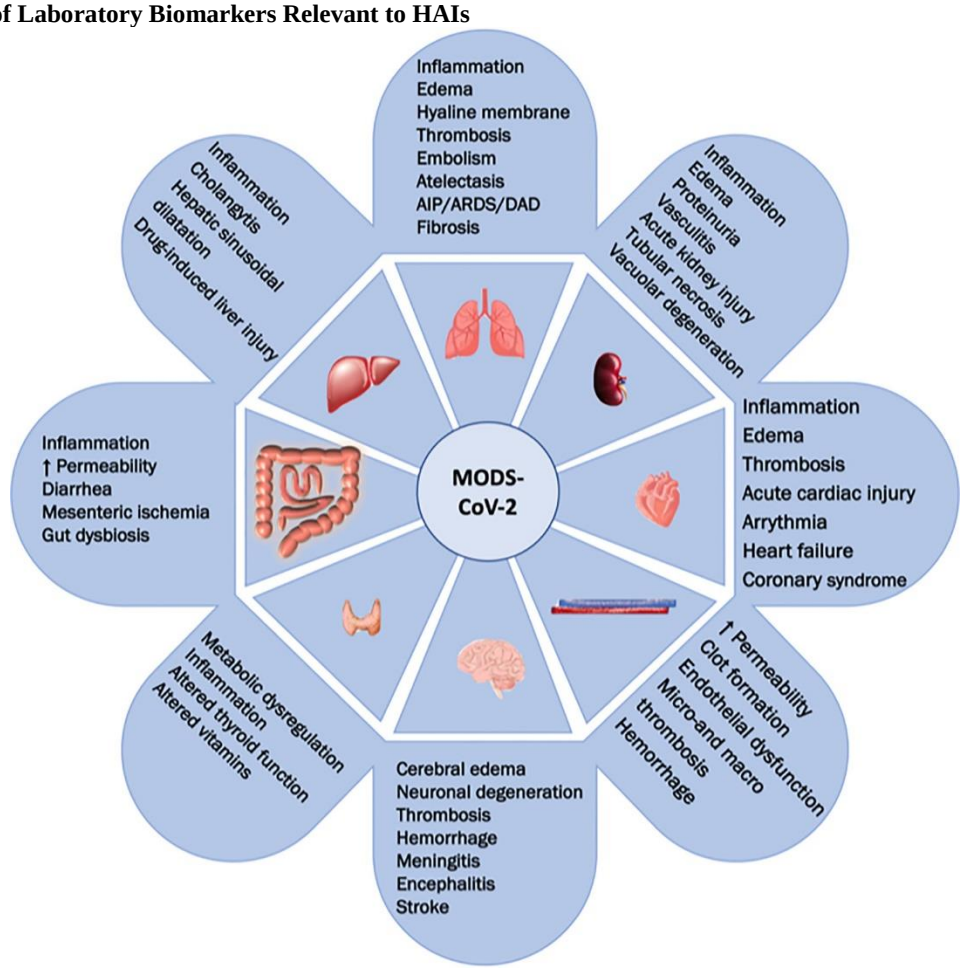

Figure 2: Laboratory Biomarkers for Diagnosis and Prognosis in COVID-19

A biomarker is a measurable indicator of biological processes, often obtained from blood or other body fluids. In infection and sepsis, biomarkers may reflect:

- **Systemic inflammation** (e.g., CRP, leukocyte count);
- **Bacterial infection specifically** (e.g., PCT);
- **Tissue hypoperfusion and metabolic stress** (e.g., lactate);
- **Organ dysfunction** (e.g., creatinine, bilirubin, platelet count).

Pierrakos and Vincent (2010) note that an ideal sepsis biomarker would be highly sensitive, specific, rapidly available, and able to distinguish infection from other inflammatory states. No current biomarker fully meets these criteria, but several provide useful information when interpreted in context.

Key biomarkers used in HAI detection and management include:

- **C-reactive protein (CRP)** – an acute-phase protein produced by the liver in response to inflammatory cytokines; rises within hours of infection or tissue injury (Pepys & Hirschfield, 2003).

- **Procalcitonin (PCT)** – a precursor of calcitonin that rises in systemic bacterial infections and tends to be lower in viral or non-infectious inflammation (Wacker et al., 2013).
- **Leukocyte indices** – total white blood cell (WBC) count, neutrophil count, and neutrophil-to-lymphocyte ratio (NLR), widely available indicators of systemic inflammatory response (Pierrakos & Vincent, 2010).
- **Lactate** – an indicator of anaerobic metabolism, often elevated in sepsis, shock, or severe hypoperfusion; associated with worse outcomes (Rhodes et al., 2017).
- **Organ function markers** – such as serum creatinine, total bilirubin, platelet count, and coagulation parameters, which are incorporated into organ dysfunction scores like the Sequential Organ Failure Assessment (SOFA) (Singer et al., 2016).

Rather than relying on a single biomarker, clinicians and nurses often interpret combinations of biomarkers and follow their trends over time. Figure 1 (described below) illustrates this concept.

2.3. Specific Biomarkers and Their Clinical Interpretation

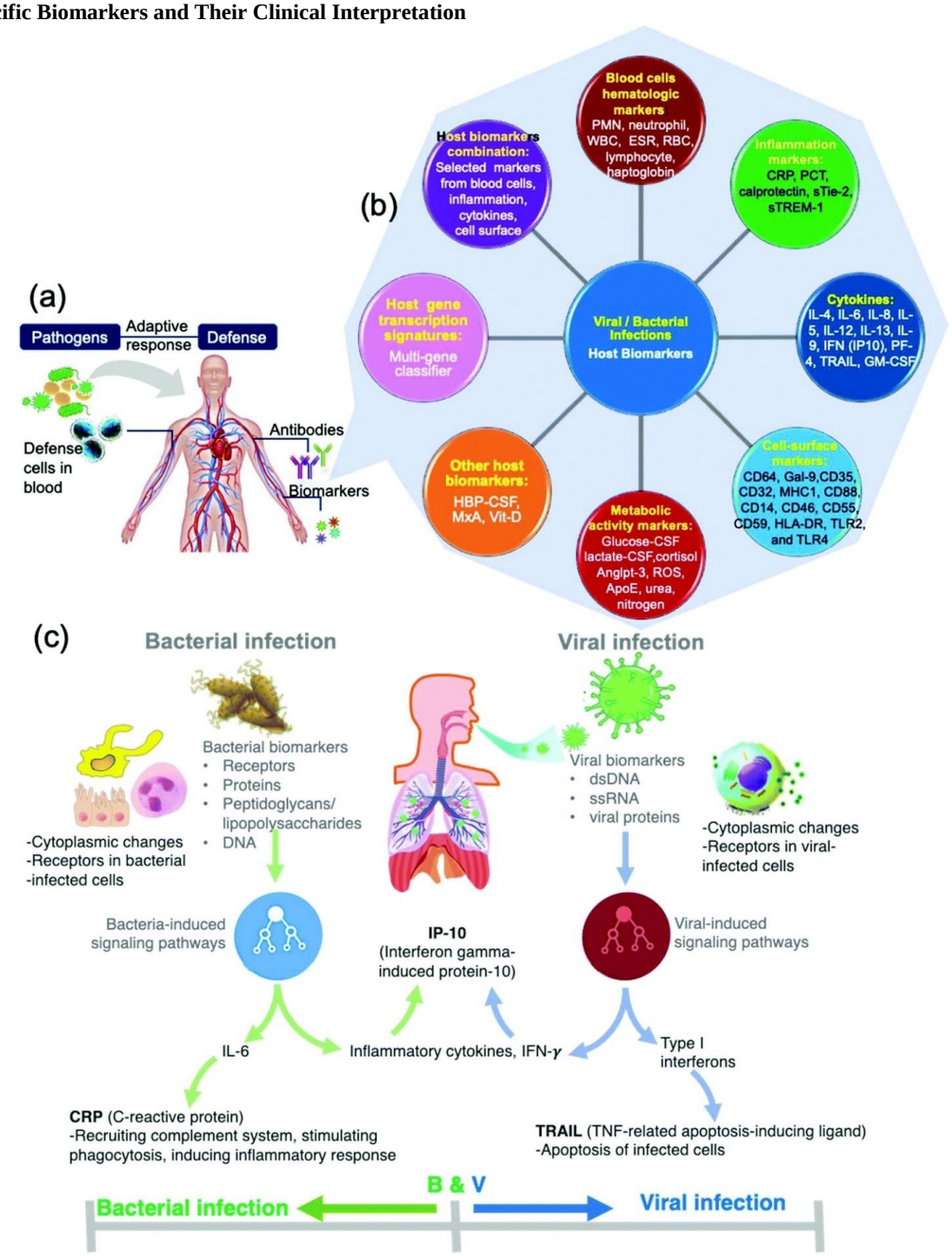

Figure 3: Biomarkers: Definitions, Types, and Applications

2.3.1 C-reactive protein (CRP)

CRP is widely used as a nonspecific marker of inflammation. In healthy individuals, serum CRP is low; with acute infection or tissue injury, levels can increase rapidly and markedly (Pepys & Hirschfield, 2003). In critically ill patients, serial CRP trends have been associated with the presence and course of infection: persistent elevation or failure to decrease is linked with poorer outcomes (Póvoa, 2002; Póvoa et al., 2005).

For HAIs, a rising CRP in a hospitalized patient who was previously stable may suggest emerging infection, particularly when accompanied by fever, leukocytosis, or localizing signs such as purulent wound drainage. However, CRP is not specific; surgery, trauma, autoimmune disease, and malignancy can also elevate CRP (Pepys & Hirschfield, 2003).

Nursing implications for CRP include:

- Recognizing that a new or large increase in CRP warrants careful clinical reassessment of the patient.
- Comparing CRP values with previous results and correlating with vital signs and physical findings.
- Communicating significant rises to the medical team and advocating for further evaluation or cultures when indicated.
- Explaining to patients that CRP is one component of a broader assessment, not a stand-alone diagnosis.

2.3.2 Procalcitonin (PCT)

PCT has attracted considerable interest because it tends to rise more in systemic bacterial infections than in viral infections or non-infectious inflammation, making it a potential tool for differentiating bacterial from non-bacterial causes of fever (Wacker et al., 2013). Randomized trials and meta-analyses show that PCT-guided algorithms can safely reduce antibiotic exposure in respiratory tract infections and sepsis without increasing mortality or treatment failure (Schuetz et al., 2012).
In practice, PCT is often used in two ways:

1. **To support decisions about starting antibiotics** in patients with suspected infection, particularly when clinical findings are ambiguous.
2. **To guide decisions about stopping or de-escalating antibiotics**, usually based on absolute PCT levels and their percentage decrease over time.

Nonetheless, PCT is imperfect. Levels can rise in major surgery, trauma, or cardiogenic shock even without infection, and may be low early in infection or in localized infections (Pierrakos & Vincent, 2010). The Surviving Sepsis Campaign advises using PCT to support decisions about discontinuing antibiotics in sepsis, but not as the sole reason to withhold antibiotics when infection is strongly suspected (Rhodes et al., 2017).

Nursing implications for PCT include:

- Understanding the local **PCT algorithm** (for example, thresholds for considering antibiotic discontinuation in stable patients).
- Ensuring that PCT samples are drawn at recommended intervals (often at baseline and 24–72 hours later).
- Watching for clinical–biomarker mismatches (e.g., a low PCT in a clinically unstable patient) and escalating concerns rather than relying solely on the laboratory value.
- Educating patients and families that PCT-guided decisions aim to avoid unnecessary antibiotics and reduce side effects and resistance.

2.3.3 Leukocyte indices

Full blood counts are among the most frequently ordered tests. Leukocytosis with neutrophilia is common in bacterial infection, while leukopenia (very low WBC) in the context of sepsis may signal bone marrow suppression or immune exhaustion and is associated with worse outcomes (Pierrakos & Vincent, 2010). The neutrophil-to-lymphocyte ratio (NLR) has been proposed as a simple marker of systemic inflammation and infection, with higher ratios associated with more severe disease.

Nurses frequently see WBC results and can link sudden changes to clinical events—for example, a rising WBC after central line insertion may prompt consideration of catheter-related infection.

2.3.4 Lactate

Lactate is a key biomarker in sepsis care bundles. Elevated lactate reflects impaired tissue perfusion and is a strong predictor of mortality in sepsis and septic shock (Singer et al., 2016). Current guidelines recommend measuring lactate early in patients with suspected sepsis and repeating it if initially elevated (Rhodes et al., 2017).

Nursing responsibilities around lactate include ensuring timely blood draws, recognizing the seriousness of elevated values, and escalating care when lactate remains high or increases despite fluid resuscitation.

2.3.5 Organ dysfunction markers

Markers such as serum creatinine, liver enzymes, bilirubin, platelet count, and coagulation tests are incorporated into severity scores like SOFA and help define sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection (Singer et al., 2016). For nurses, recognizing changes in these markers—especially when combined with abnormal vital signs—is critical to recognizing progression from uncomplicated infection to severe sepsis.

2.4. Tables : Summarizing Biomarkers and Nursing Actions

Below is a conceptual table summarizing key biomarkers and the associated nursing implications.

Table 1: ***Key Biomarkers for Hospital-Acquired Infections and Related Nursing Actions***

Biomarker	Primary meaning	Strengths	Limitations	Example nursing actions
CRP	General systemic inflammation; often elevated in infection	Widely available; useful for serial trend monitoring	Nonspecific; elevated in many non-infectious conditions	Monitor trends; correlate with clinical signs; report significant rises and advocate for further assessment (Pepys & Hirschfield, 2003; Póvoa, 2002).
PCT	More specific marker of systemic bacterial infection	Helps guide antibiotic initiation and de-escalation; evidence-based algorithms	Costly; false positives/negatives in some conditions	Ensure timely sampling; apply local PCT algorithm; escalate when trends and clinical picture conflict (Schuetz et al., 2012; Wacker et al., 2013).
WBC/NLR	Systemic inflammatory response	Routinely available, inexpensive	Affected by many medications and conditions	Act on sudden changes; prioritize reassessment of patients with marked leukocytosis or leukopenia (Pierrakos & Vincent, 2010).
Lactate	Tissue hypoperfusion and metabolic stress	Strong prognostic value in sepsis; integral to bundles	Elevated in many forms of shock, not only infection	Ensure prompt measurement; repeat as ordered; trigger sepsis or rapid-response pathways when elevated (Rhodes et al., 2017; Singer et al., 2016).
Organ markers (creatinine, bilirubin, platelets, etc.)	Reflect organ dysfunction in sepsis	Directly linked to SOFA scoring and severity	Not specific to infection	Recognize progression to severe sepsis; advocate for higher level of care; increase monitoring frequency (Singer et al., 2016).

2.5. Nursing Staff in the Early Detection of HAIs Using Biomarkers

2.5.1 Bedside surveillance and sepsis screening

Nursing surveillance has been described as a continuous, systematic process of observing, recognizing, and interpreting patient data, followed by decision-making and action (Odell et al., 2009). In the context of HAIs, surveillance includes monitoring vital signs, mental status, pain, wound or catheter sites, urine output, and laboratory results. Multidisciplinary sepsis initiatives repeatedly show that nurses are often the first to suspect sepsis and initiate prompts to the medical team (Levy et al., 2018; Bleakley et al., 2020).

Many institutions have implemented nurse-led sepsis screening tools. These typically combine clinical criteria (e.g., temperature >38°C or <36°C, heart rate >90, respiratory rate >22, altered mentation) with laboratory criteria (e.g., WBC abnormalities, lactate, or PCT thresholds) (Rhodes et al., 2017). When screening criteria are met, protocols may empower nurses to:

- Draw blood cultures and other specimens.
- Request or draw specific biomarkers (e.g., lactate, CRP, PCT) according to standing orders.
- Activate a rapid-response team or sepsis alert for immediate medical review.

Research suggests that such nurse-driven screening accelerates recognition, reduces time to antibiotics, and can improve outcomes (Levy et al., 2018; Bleakley et al., 2020).

2.5.2 Specimen collection, timing, and pre-analytical quality

The accuracy of biomarker results depends on appropriate pre-analytical handling, including correct patient identification, choice of tubes, timing of sampling, and prompt transportation to the laboratory. Nurses, phlebotomists, or both are usually responsible for these steps.

For example, lactate should be drawn as soon as sepsis is suspected and processed quickly to avoid falsely elevated values; PCT and CRP should be obtained at consistent times if trends are to be interpreted meaningfully (Rhodes et al., 2017). Poor technique or delays can cause hemolysis or degradation of analytes, leading to misleading results and potential mismanagement.
By adhering strictly to protocols for blood sampling and documentation, nurses help ensure that biomarker data are reliable.

2.5.3 Interpreting and acting on biomarker results

Nursing interpretation of biomarkers does not replace medical diagnosis but involves recognizing when results are abnormal or trending in a concerning direction and linking them to clinical changes. In practice, this might involve:

- Reviewing daily lab results during handover and highlighting significant changes in CRP, PCT, WBC, or lactate.
- Using early warning scores that integrate vital signs and laboratory data to identify patients at risk of deterioration.
- Requesting urgent medical review when biomarker trends and clinical status suggest sepsis or treatment failure.

For example, a nurse caring for a postoperative patient may note that CRP and WBC, previously decreasing, are now rising again, and the patient appears more tachycardic and febrile. Recognizing the pattern, the nurse can escalate promptly to investigate for possible intra-abdominal sepsis.

2.5.4 Communication and interdisciplinary collaboration

Effective communication is essential when biomarker results suggest possible HAI or sepsis. Strategies such as SBAR (Situation, Background, Assessment, Recommendation) help nurses present objective data and clear recommendations. For instance:

- *Situation:* "Mr. A is febrile and hypotensive."
- *Background:* "He is day 5 post laparotomy, previously stable."
- *Assessment:* "CRP has increased from 60 to 180 mg/L over 48 hours; lactate is 3.0 mmol/L; WBC is 18,000/mm³; he is tachycardic and oliguria."
- *Recommendation:* "I am concerned about intra-abdominal sepsis and recommend urgent medical review and imaging."

Such structured communication integrates biomarker trends with bedside findings, facilitating rapid, collaborative decision-making (Bleakley et al., 2020).

2.6. Nursing Role in Biomarker-Guided Management of HAIs

2.6.1 Antimicrobial stewardship

Excessive or prolonged antibiotic use drives antimicrobial resistance and predisposes to Clostridioides difficile infection. Biomarkers, especially PCT, can support more rational antibiotic use by indicating when bacterial infection is unlikely or when infection has likely resolved (Schuetz et al., 2012).

Nurses contribute to antimicrobial stewardship by:

- Reminding prescribers when biomarker-guided reassessment points are due (e.g., 48–72 hours after starting antibiotics).
- Documenting and reporting clinical improvement together with falling biomarker levels, supporting decisions to shorten or narrow therapy.
- Educating patients and families about why antibiotics are being stopped or changed, emphasizing the role of biomarker evidence and the importance of avoiding unnecessary antibiotics (van Huizen et al., 2021).

2.6.2 Monitoring response and detecting complications

Serial biomarker measurements provide a window into the trajectory of infection. Table 2 gives examples of how nurses might respond to different patterns.

Table 2: ***Examples of Biomarker Trends and Nursing Responses in Patients with HAIs***

Biomarker pattern	Possible interpretation	Example nursing response
CRP and PCT steadily fall over several days; vital signs normalize	Good response to therapy; infection resolving	Continue monitoring; support early mobilization; remind team about potential for de-escalation or oral switch.
CRP and/or PCT remain high or increase; WBC rising; persistent fever	Possible inadequate source control, resistant organism, or new infection focus	Notify physician promptly; ensure cultures obtained; prepare patient for imaging or invasive procedures; intensify monitoring.
Lactate remains >2 mmol/L or rises despite fluids; hypotension and oliguria	Progression to septic shock; high risk of deterioration	Activate rapid response or sepsis bundle; ensure IV access and fluid/vasopressor readiness; escalate to ICU if needed (Rhodes et al., 2017).
New thrombocytopenia, rising creatinine and bilirubin in infected patient	Evolving multi-organ dysfunction	Increase observation frequency; discuss with team need for higher level of care and possible goals-of-care conversation (Singer et al., 2016).

These scenarios show that biomarker trends shape nursing priorities, from intensified monitoring to rapid escalation.

2.6.3 Patient and family education

Biomarkers can be confusing for patients and families. Nurses can explain them in simple terms, for example:

- CRP and PCT as "infection and inflammation markers" that help determine whether antibiotics are needed and how well they are working.
- Lactate as a "stress marker" that rises when tissues are not receiving enough oxygen.

By explaining that treatment decisions are based on both how the patient looks and feels and what their blood tests show, nurses help maintain trust and engagement in the care plan.

2.7. Barriers and Enablers to Effective Biomarker Use by Nurses

Several **barriers** limit optimal biomarker use in nursing practice:

- **Knowledge gaps:** Studies have found that nurses' knowledge of sepsis recognition and related laboratory tests is often incomplete, especially regarding advanced biomarkers such as PCT (Bartulewicz et al., 2025).
- **Lack of clear protocols:** When institutions do not provide explicit guidance on when and how to use biomarkers, practices vary widely among clinicians (Pierrakos & Vincent, 2010).
- **Workload and staffing constraints:** High patient-to-nurse ratios make it difficult to continuously track trends and re-check laboratory results, particularly in busy wards.

- **Informatics limitations:** Electronic health record systems may not provide intuitive dashboards or alerts that highlight worsening biomarker trends (Levy et al., 2018).

Conversely, several enablers support effective biomarker use:

- **Strong nursing leadership and a culture of safety**, which encourage nurses to initiate sepsis alerts and speak up when concerned (Levy et al., 2018).
- **Interdisciplinary education and collaboration**, in which nurses, physicians, pharmacists, and laboratory staff share perspectives on biomarker interpretation and stewardship (van Huizen et al., 2021).
- **Standardized sepsis and HAI bundles** that embed biomarker thresholds and specify nursing actions at each step (Rhodes et al., 2017).
- **Data visualization tools**, such as color-coded graphs and trend indicators, that help nurses quickly see the "bigger picture" of a patient's laboratory trajectory.

CONCLUSION AND RECOMMENDATIONS

Hospital-acquired infections remain a substantial challenge for healthcare systems worldwide, contributing to preventable morbidity, mortality, and cost . Alongside preventive strategies, early detection and prompt management of HAIs are critical to limiting harm. Laboratory biomarkers such as CRP, PCT, WBC indices, lactate, and organ function markers provide objective data that can help identify infection earlier, stratify risk, and monitor response to treatment.

Nurses, through continuous bedside presence and comprehensive surveillance, play a central role in leveraging biomarkers for patient benefit. Their responsibilities include recognizing early signs of infection, initiating sepsis screening, ensuring correct and timely specimen collection, interpreting biomarker trends in context, escalating care when warranted, and supporting antimicrobial stewardship. When supported by clear protocols, robust education, and effective communication pathways, nurses can use biomarkers to detect HAIs earlier and improve patient trajectories.

However, biomarkers are not substitutes for clinical judgment. Over-reliance on laboratory values risks missing clinically evident deterioration, especially when assays are normal or delayed. Interpretation must always integrate the whole patient picture—history, examination, comorbidities, and the trajectory of vital signs. The most effective use of biomarkers occurs within interprofessional teams that value nursing insights and support nurse-led surveillance and escalation.

RECOMMENDATIONS

1. **Education and training**
   - Integrate biomarker concepts (CRP, PCT, lactate, leukocyte indices, organ markers) into undergraduate and postgraduate nursing curricula, with emphasis on trend interpretation and clinical context.
   - Provide ongoing in-service training and simulation scenarios that incorporate nurse-driven sepsis screening and biomarker use (Bartulewicz et al., 2025; Bleakley et al., 2020).
2. **Standardized protocols and bundles**
   - Develop or update sepsis and HAI bundles to specify when biomarkers should be ordered, threshold values for concern, and expected nursing actions (Rhodes et al., 2017).
   - Include nurse-initiated pathways allowing biomarkers and cultures to be obtained under standing orders when screening criteria are met.
3. **Informatics and visualization**
   - Implement electronic dashboards and alerts that display biomarker trends (e.g., CRP, PCT, lactate) alongside vital signs, highlighting concerning patterns.
   - Ensure that critical values generate real-time notifications to responsible nurses and physicians.
4. **Interdisciplinary collaboration and stewardship**
   - Encourage regular interdisciplinary rounds where nurses present biomarker trends and clinical impressions, contributing actively to treatment and stewardship decisions (van Huizen et al., 2021).
   - Involve nurses in antimicrobial stewardship committees and quality-improvement projects related to HAI and sepsis.
5. **Quality improvement and feedback**
   - Monitor key indicators such as time from screening to biomarker sampling, time to antibiotics, and adherence to biomarker-guided de-escalation protocols.
   - Review HAI and sepsis cases for missed opportunities in early detection or biomarker use and feed lessons back into practice.

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