The Role of Laboratory Biomarkers in Optimizing Antibiotic Therapy for Respiratory Infections: A Collaborative Approach between Respiratory Therapists, Pharmacists, and Laboratory Specialists

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Abstract

Background: Optimizing antibiotic therapy in ICU patients with respiratory infections is critical to improving outcomes and preventing complications such as antimicrobial resistance and ventilator-associated pneumonia (VAP). This study aimed to evaluate the use of biomarkers, including procalcitonin (PCT) and C-reactive protein (CRP), in guiding antibiotic therapy and assess the impact of interdisciplinary collaboration between respiratory therapists (RTs), pharmacists, and laboratory specialists (LS) in optimizing patient care.

Methods: A retrospective cohort study was conducted in a tertiary hospital ICU involving 150 patients with bacterial respiratory infections. The biomarker-guided group (n = 80) received antibiotic therapy based on PCT/CRP levels, while the standard care group (n = 70) followed clinical guidelines without biomarker monitoring. Primary outcomes included antibiotic duration, ICU length of stay, and incidence of VAP. Secondary outcomes included mechanical ventilation duration and antibiotic-related adverse events.

Results: The biomarker-guided group had significantly shorter antibiotic durations (6.2 vs. 9.5 days, $p < 0.001$), fewer instances of antibiotic overuse (28% vs. 60%, $p = 0.001$), and shorter ICU stays (10.1 vs. 13.2 days, $p < 0.001$). The incidence of VAP was lower in the biomarker-guided group (7% vs. 14%, $p = 0.048$), and fewer adverse drug events were observed (8% vs. 16%, $p = 0.037$).

Conclusion: Biomarker-guided antibiotic therapy, supported by interdisciplinary collaboration, improves patient outcomes by reducing antibiotic duration, ICU stay, and the risk of VAP. This approach should be integrated into antibiotic stewardship programs to optimize care in ICU settings.

Keywords: Biomarkers, procalcitonin, C-reactive protein, antibiotic therapy, ICU, interdisciplinary collaboration, ventilator-associated pneumonia, antibiotic stewardship

Introduction

Respiratory infections, such as pneumonia and acute exacerbations of chronic obstructive pulmonary disease (COPD), are common in critically ill patients admitted to intensive care units (ICUs). These infections often necessitate prompt antibiotic therapy to prevent complications and reduce mortality. However, the misuse of antibiotics, including inappropriate dosing and extended duration, can lead to adverse effects such as antimicrobial resistance, Clostridioides difficile infection, and other drug-related complications (Schuetz et al., 2013). Optimizing antibiotic therapy, therefore, is essential for improving patient outcomes and mitigating the risks associated with overuse.

Laboratory biomarkers, particularly procalcitonin (PCT) and C-reactive protein (CRP), have emerged as valuable tools in guiding antibiotic therapy for respiratory infections. These biomarkers can provide critical information about the presence and severity of bacterial infections, helping clinicians make informed decisions about when to initiate, escalate, or discontinue antibiotics (Christ-Crain & Müller, 2007). PCT, for instance, has been shown to correlate with bacterial infection severity, and its decline during treatment can indicate that antibiotics are no longer necessary. CRP, another widely used biomarker, reflects systemic inflammation but is less specific to bacterial infections (Schuetz et al., 2013).

The interdisciplinary collaboration between respiratory therapists (RTs), pharmacists, and laboratory specialists (LS) plays a crucial role in optimizing antibiotic therapy for patients with respiratory infections. RTs assess clinical symptoms such as sputum production, oxygenation levels, and ventilator requirements, providing essential information to support antibiotic decisions (Di Pasquale et al., 2019). Pharmacists, as key members of antibiotic stewardship programs, rely on biomarker data and clinical input to ensure the appropriate use of antibiotics, adjusting doses and durations based on patient response and biomarker trends (Liu et al., 2016). Laboratory specialists contribute to diagnostic accuracy by providing real-time biomarker data, facilitating timely adjustments in antibiotic therapy (Nora et al., 2017).

This study aims to examine how laboratory biomarkers such as PCT and CRP can guide antibiotic therapy in ICU patients with respiratory infections. Furthermore, it will explore how collaborative efforts between RTs, pharmacists, and LS improve antibiotic stewardship, ensuring the right antibiotics are used at the right time, for the right duration, ultimately enhancing patient outcomes.

Literature Review

1. Biomarkers in Respiratory Infections

Biomarkers such as procalcitonin (PCT) and C-reactive protein (CRP) are increasingly used in the management of respiratory infections, particularly in intensive care units (ICUs). PCT, a precursor of calcitonin, is released in response to bacterial infections, making it a specific marker for systemic bacterial infections. It has been widely studied and proven effective in guiding antibiotic therapy in respiratory infections such as pneumonia and chronic obstructive pulmonary disease (COPD) exacerbations (Schuetz et al., 2013). Studies have shown that PCT levels rise in bacterial infections and decrease as the infection resolves, providing a reliable indicator for the initiation and discontinuation of antibiotic therapy (Christ-Crain & Müller, 2007).

CRP, an acute-phase protein, reflects systemic inflammation and has been used for decades as a marker of infection. However, CRP is less specific to bacterial infections and can be elevated in various conditions, including viral infections and non-infectious inflammatory diseases (Pepys & Hirschfield, 2003). While CRP is still valuable in diagnosing respiratory infections, it is often used in conjunction with PCT to

improve diagnostic accuracy. The combination of these biomarkers has been shown to reduce unnecessary antibiotic use and guide more appropriate treatment decisions, particularly in ICU settings where rapid decision-making is crucial (Wacker et al., 2013).

2. The Role of Pharmacists in Antibiotic Stewardship

Pharmacists play a central role in antibiotic stewardship programs, which aim to optimize the use of antimicrobial agents and combat the growing issue of antibiotic resistance. By incorporating biomarker data, pharmacists can make informed decisions about the duration, dose, and type of antibiotics used in treating respiratory infections (Voermans et al., 2019). Studies have demonstrated that pharmacist-led interventions, combined with PCT-guided antibiotic protocols, significantly reduce the duration of antibiotic therapy without compromising patient outcomes (Liu et al., 2016). In ICU settings, where patients are at high risk for nosocomial infections and complications from prolonged antibiotic use, the pharmacist's role in adjusting therapy based on biomarker trends is critical to preventing overuse of antibiotics (Schuetz et al., 2013).

Moreover, pharmacist-driven stewardship programs contribute to reducing the incidence of Clostridioides difficile infections, antibiotic resistance, and other complications associated with prolonged antibiotic use (Schouten et al., 2007). By closely monitoring biomarker levels and clinical symptoms, pharmacists help ensure that antibiotics are used effectively and discontinued when they are no longer needed, thus preventing the development of resistance.

3. Respiratory Therapists and Symptom Monitoring

Respiratory therapists (RTs) play an essential role in the management of patients with respiratory infections, particularly those who require mechanical ventilation. RTs are responsible for assessing respiratory status, managing airway clearance, and optimizing ventilator settings to support oxygenation and ventilation. In the context of antibiotic therapy, RTs provide critical input on clinical symptoms such as sputum production, respiratory distress, and changes in oxygenation, which help guide decisions on the continuation or cessation of antibiotics (Di Pasquale et al., 2019).

The collaboration between RTs and pharmacists is particularly important in cases where biomarker levels may not provide a complete picture of the patient's condition. For example, a patient with declining PCT levels but persistent respiratory symptoms may require further clinical evaluation by the RT to determine whether additional interventions, such as bronchodilators or corticosteroids, are needed (Schuetz et al., 2013). This interdisciplinary collaboration ensures that all aspects of the patient's respiratory health are considered when making decisions about antibiotic therapy.

4. Laboratory Specialists and Diagnostic Accuracy

Laboratory specialists (LS) play a pivotal role in ensuring the accuracy and timeliness of biomarker data, which are crucial for guiding clinical decisions in critically ill patients. The use of PCT and CRP in managing respiratory infections requires precise and timely results, as delays in obtaining biomarker data can lead to prolonged or inappropriate antibiotic therapy (Nora et al., 2017). LS are responsible for providing real-time data on these biomarkers, as well as other diagnostic markers such as blood cultures, that aid in identifying the causative pathogens and determining the severity of the infection (Liu et al., 2016).

In addition to providing data on infection markers, LS monitor other critical parameters, such as kidney and liver function, which may influence antibiotic dosing and duration. For instance, in patients with impaired renal function, the pharmacokinetics of antibiotics may be altered, necessitating dose adjustments. The collaboration between LS, pharmacists, and RTs ensures that the antibiotic regimen is tailored to the patient's clinical and physiological status, optimizing therapeutic outcomes (Nora et al., 2017).

5. Interdisciplinary Collaboration and Patient Outcomes

Interdisciplinary collaboration between RTs, pharmacists, and LS is crucial in managing respiratory infections and optimizing antibiotic therapy in ICU patients. Studies have shown that incorporating biomarker-guided antibiotic protocols within an interdisciplinary framework leads to improved patient outcomes, including shorter durations of antibiotic therapy, reduced ICU length of stay, and lower mortality rates (Voermans et al., 2019). The combination of clinical symptom monitoring by RTs, pharmacological expertise from pharmacists, and diagnostic support from LS ensures that antibiotic therapy is both appropriate and timely.

Furthermore, interdisciplinary collaboration has been shown to reduce the incidence of ventilator-associated pneumonia (VAP) and other nosocomial infections by ensuring that antibiotics are used judiciously and only when necessary. The use of biomarkers such as PCT and CRP helps guide decisions on when to start and stop antibiotics, preventing unnecessary treatment that could contribute to antimicrobial resistance (Christ-Crain & Müller, 2007). This team-based approach not only improves patient outcomes but also enhances the overall efficiency of ICU care by reducing the burden of antibiotic overuse and associated complications.

The literature highlights the importance of biomarkers such as PCT and CRP in guiding antibiotic therapy for respiratory infections in ICU patients. The collaborative efforts of RTs, pharmacists, and LS play a critical role in interpreting biomarker data and clinical symptoms, ensuring that antibiotic therapy is optimized to improve patient outcomes and reduce the risk of antimicrobial resistance. This study will further explore the impact of interdisciplinary collaboration on antibiotic stewardship in ICU settings, focusing on the role of biomarkers in guiding therapy decisions.

Methodology

Study Design

This was a retrospective cohort study conducted in the intensive care unit (ICU) of a tertiary care hospital. The study aimed to evaluate the impact of laboratory biomarkers, specifically procalcitonin (PCT) and C-reactive protein (CRP), in optimizing antibiotic therapy for respiratory infections. Additionally, the study explored how collaboration between respiratory therapists (RTs), pharmacists, and laboratory specialists (LS) influenced antibiotic stewardship and improved patient outcomes.

Study Setting and Population

The study was conducted in the 30-bed ICU of a tertiary hospital, which specializes in treating critically ill patients requiring advanced respiratory care and antibiotic therapy. The study included adult patients (aged ≥18 years) admitted to the ICU with a confirmed diagnosis of bacterial respiratory infections, such as pneumonia, bronchitis, or chronic obstructive pulmonary disease (COPD) exacerbations. All patients received antibiotic therapy during their ICU stay, and biomarker data (PCT, CRP) were available for analysis.

Inclusion criteria:
- Patients with confirmed bacterial respiratory infections.
- Patients receiving antibiotic therapy guided by biomarker monitoring (PCT, CRP).
- ICU stay duration of at least 48 hours.

Exclusion criteria:
- Patients with viral respiratory infections.
- Patients with incomplete biomarker data or medical records.
- Patients with terminal illnesses where palliative care was prioritized over active antibiotic therapy.

A total of 150 patients met the inclusion criteria and were divided into two groups:
1. Biomarker-Guided Group (n = 80): Patients whose antibiotic therapy was guided by PCT and CRP levels.
2. Standard Care Group (n = 70): Patients whose antibiotic therapy followed standard clinical guidelines without biomarker monitoring.

Intervention: Multidisciplinary Approach
The intervention in this study involved the collaboration between respiratory therapists (RTs), pharmacists, and laboratory specialists (LS) to guide antibiotic therapy based on biomarker data (PCT, CRP) and clinical symptoms.

- Respiratory Therapists (RTs): RTs monitored patients ’respiratory symptoms, including oxygenation, sputum production, and ventilator settings, providing valuable clinical input to guide antibiotic adjustments. RTs regularly assessed respiratory function, which was correlated with biomarker levels and clinical improvement.

- Pharmacists: Pharmacists used biomarker data and clinical information from RTs to adjust antibiotic dosing, duration, and selection. They played a crucial role in determining when to escalate or de-escalate antibiotic therapy, ensuring antibiotics were used appropriately and discontinued when biomarkers indicated resolution of the infection.

- Laboratory Specialists (LS): LS were responsible for providing real-time biomarker data, particularly PCT and CRP levels, which were used to guide antibiotic therapy. LS ensured the accuracy and timely delivery of biomarker results, which were crucial for the clinical decision-making process.

Data Collection
Data were collected retrospectively from the hospital’s electronic medical record (EMR) system. Data points included:
- Patient Demographics: Age, gender, underlying comorbidities (e.g., COPD, diabetes, renal dysfunction), and primary diagnosis.
- Biomarker Levels: Serial measurements of PCT and CRP levels throughout the course of treatment, collected on admission and at regular intervals during the ICU stay.
- Antibiotic Therapy: Type of antibiotics prescribed, dosage, duration, and whether changes were made based on biomarker levels.
- Respiratory Status: Clinical symptoms recorded by RTs, including oxygenation (PaO_2/FiO_2 ratio), respiratory rate, sputum production, and ventilator settings.

- Patient Outcomes: Length of ICU stay, duration of mechanical ventilation, incidence of ventilator-associated pneumonia (VAP), and in-hospital mortality.
- Adverse Events: Incidence of antibiotic-related complications (e.g., Clostridioides difficile infections, nephrotoxicity).

Outcome Measures

The primary outcome of the study was the optimization of antibiotic therapy, defined as:
- Appropriate antibiotic duration: Based on biomarker-guided decisions (e.g., discontinuation of antibiotics when PCT levels declined below 0.5 ng/mL).
- Reduction in antibiotic overuse: Measured by comparing antibiotic duration in the biomarker-guided group to the standard care group.

Secondary outcomes included:
- ICU length of stay: The total number of days spent in the ICU.
- Duration of mechanical ventilation: The total number of days on mechanical ventilation.
- Incidence of ventilator-associated pneumonia (VAP): Diagnosed based on clinical and microbiological criteria.
- Mortality rates: In-hospital mortality during the ICU stay.
- Adverse drug events: Incidence of antibiotic-related complications, including nephrotoxicity and C. difficile infections.

Data Analysis

Data were analyzed using SPSS. Descriptive statistics (mean, median, standard deviation) were used to summarize patient demographics, biomarker levels, antibiotic use, and clinical outcomes. Inferential statistics were used to compare the outcomes between the biomarker-guided group and the standard care group.

- Independent t-tests were used to compare continuous variables such as ICU length of stay, antibiotic duration, and mechanical ventilation duration.
- Chi-square tests were used to compare categorical variables such as the incidence of VAP, mortality, and adverse drug events.
- Multivariate regression analysis was conducted to adjust for potential confounders, including age, comorbidities, and severity of illness (e.g., APACHE II score).
- Kaplan-Meier survival curves were generated to compare survival rates between the two groups, and the log-rank test was used to assess statistical significance.

Ethical Considerations

The study was approved by the ethics committee. Given the retrospective nature of the study, patient consent was waived. All data were anonymized and stored in compliance with local and national data protection regulations to ensure patient confidentiality.

Limitations

This study was limited by its retrospective design, which may introduce biases related to data collection and patient selection. Additionally, the study was conducted in a single tertiary hospital, which may limit the generalizability of the findings to other healthcare settings. Future prospective studies are recommended to

confirm the findings and further explore the impact of biomarker-guided antibiotic therapy in a broader range of ICUs.

Findings

1. Demographic Characteristics

A total of 150 patients met the inclusion criteria, with 80 patients in the biomarker-guided group and 70 in the standard care group. The mean age of the patients was 64.2 years (SD = 12.7), and 58% were male. The most common comorbidities were chronic obstructive pulmonary disease (COPD) and diabetes. There were no significant differences in baseline characteristics between the two groups.

Table 1: Demographic and Baseline Characteristics of Study Population

Characteristic	Total (n = 150)	Biomarker-Guided (n = 80)	Standard Care (n = 70)	p-value
Mean Age (years)	64.2 ±12.7	63.8 ±12.5	64.6 ±12.9	0.712
Male (%)	58%	56%	60%	0.689
COPD (%)	35%	36%	34%	0.771
Diabetes (%)	29%	30%	28%	0.812
Hypertension (%)	26%	27%	25%	0.801

2. Primary Outcomes

2.1 Optimization of Antibiotic Therapy

Patients in the biomarker-guided group had significantly shorter antibiotic durations compared to the standard care group (mean = 6.2 days vs. 9.5 days, $p < 0.001$). Additionally, 75% of patients in the biomarker-guided group had their antibiotics discontinued based on a reduction in PCT levels below 0.5 ng/mL, compared to 43% in the standard care group ($p = 0.004$). This demonstrates the utility of biomarkers in guiding antibiotic cessation.

Table 2: Antibiotic Duration and Biomarker-Guided Discontinuation

Group	Mean Antibiotic Duration (days)	SD	Antibiotics Discontinued Based on Biomarkers (%)	p-value
Biomarker-Guided	6.2	2.1	75%	< 0.001
Standard Care	9.5	3.4	43%	0.004

2.2 Reduction in Antibiotic Overuse

The biomarker-guided group showed a significant reduction in unnecessary antibiotic use. Specifically, 60% of patients in the standard care group received antibiotics beyond the necessary duration compared to only 28% in the biomarker-guided group ($p = 0.001$).

Table 3: Comparison of Antibiotic Overuse

Group	Antibiotic Overuse (%)	p-value
Biomarker-Guided	28%	0.001
Standard Care	60%	

3. Secondary Outcomes

3.1 ICU Length of Stay

The mean ICU length of stay was significantly shorter in the biomarker-guided group (mean = 10.1 days, SD = 3.5) compared to the standard care group (mean = 13.2 days, SD = 4.1) ($p < 0.001$). This suggests that biomarker-guided antibiotic therapy may contribute to faster recovery and shorter ICU stays.

Table 4: Comparison of ICU Length of Stay

Group	Mean ICU Stay (days)	SD	p-value
Biomarker-Guided	10.1	3.5	< 0.001
Standard Care	13.2	4.1	

3.2 Duration of Mechanical Ventilation

Patients in the biomarker-guided group spent fewer days on mechanical ventilation (mean = 6.8 days, SD = 2.7) compared to the standard care group (mean = 9.3 days, SD = 3.3) ($p = 0.002$), highlighting the potential role of optimized antibiotic therapy in improving respiratory function and reducing ventilator dependence.

Table 5: Comparison of Mechanical Ventilation Duration

Group	Mean Ventilation Duration (days)	SD	p-value
Biomarker-Guided	6.8	2.7	0.002
Standard Care	9.3	3.3	

3.3 Incidence of Ventilator-Associated Pneumonia (VAP)

The incidence of ventilator-associated pneumonia (VAP) was significantly lower in the biomarker-guided group (7%) compared to the standard care group (14%) ($p = 0.048$). This finding suggests that timely antibiotic discontinuation based on biomarker levels may reduce the risk of VAP.

Table 6: Incidence of Ventilator-Associated Pneumonia (VAP)

Group	VAP Incidence (%)	p-value
Biomarker-Guided	7%	0.048
Standard Care		14%

3.4 Mortality Rate

Although the in-hospital mortality rate was lower in the biomarker-guided group (15%) compared to the standard care group (21%), this difference was not statistically significant ($p = 0.218$).

Table 7: Comparison of Mortality Rates

Group	Mortality Rate (%)	p-value
Biomarker-Guided	15%	0.218

Standard Care	21%	

3.5 Adverse Drug Events

The biomarker-guided group experienced fewer antibiotic-related adverse events, including nephrotoxicity and C. difficile infections (8% vs. 16%, p = 0.037). This indicates that biomarker-guided therapy can reduce the risk of complications associated with prolonged antibiotic use.

Table 8: Comparison of Adverse Drug Events

Group	Adverse Events (%)	p-value
Biomarker-Guided	8%	0.037
Standard Care	16%	

Summary of Findings

The results of this study suggest that biomarker-guided antibiotic therapy significantly improves outcomes in ICU patients with respiratory infections. Patients in the biomarker-guided group had shorter antibiotic durations, fewer instances of antibiotic overuse, and better clinical outcomes, including shorter ICU stays, reduced mechanical ventilation time, and lower incidence of VAP. Although the difference in mortality was not statistically significant, the trend toward improved survival and fewer adverse drug events in the biomarker-guided group highlights the potential benefits of using biomarkers such as PCT and CRP to optimize antibiotic therapy.

Discussion

This study aimed to evaluate the role of laboratory biomarkers, specifically procalcitonin (PCT) and C-reactive protein (CRP), in guiding antibiotic therapy for respiratory infections in critically ill ICU patients. Furthermore, it explored how collaboration between respiratory therapists (RTs), pharmacists, and laboratory specialists (LS) improved antibiotic stewardship and patient outcomes. The findings demonstrate that biomarker-guided antibiotic therapy significantly reduces the duration of antibiotic use, decreases ICU length of stay, and lowers the incidence of ventilator-associated pneumonia (VAP), highlighting the value of an interdisciplinary approach in optimizing care.

Optimization of Antibiotic Therapy

The use of biomarkers, particularly PCT, to guide antibiotic therapy resulted in shorter antibiotic durations and a significant reduction in unnecessary antibiotic use. Patients in the biomarker-guided group had an average antibiotic duration of 6.2 days, compared to 9.5 days in the standard care group ($p < 0.001$). Additionally, the majority of patients in the biomarker-guided group had their antibiotics appropriately discontinued based on declining PCT levels, indicating resolution of the bacterial infection. This finding aligns with previous research demonstrating that PCT is a reliable marker for guiding the initiation and cessation of antibiotics, helping to prevent antibiotic overuse (Schuetz et al., 2013).

The reduction in unnecessary antibiotic use is crucial in the context of growing antimicrobial resistance. Overuse of antibiotics has been linked to the development of resistant pathogens, increased healthcare costs, and adverse drug events (Voermans et al., 2019). By incorporating biomarker data into decision-making, pharmacists and physicians can safely discontinue antibiotics when they are no longer needed, minimizing the risks associated with prolonged antibiotic exposure. This finding supports the growing body of evidence advocating for biomarker-guided antibiotic stewardship programs to optimize antimicrobial use in the ICU (Liu et al., 2016).

Improvement in Clinical Outcomes

Patients in the biomarker-guided group experienced significantly better clinical outcomes compared to those receiving standard care. The mean ICU length of stay was shorter in the biomarker-guided group (10.1 days vs. 13.2 days, $p < 0.001$), which suggests that optimized antibiotic therapy may contribute to faster recovery and reduced time in intensive care. Shorter ICU stays are associated with lower healthcare costs, reduced risk of hospital-acquired infections, and better overall patient outcomes (Nora et al., 2017).

Similarly, patients in the biomarker-guided group spent fewer days on mechanical ventilation (6.8 days vs. 9.3 days, $p = 0.002$), which is a critical finding given the risks associated with prolonged ventilation, such as VAP and other complications. The lower incidence of VAP in the biomarker-guided group (7% vs. 14%, $p = 0.048$) underscores the importance of timely and appropriate antibiotic discontinuation. VAP is a serious complication in mechanically ventilated patients, and reducing its incidence is a key goal in ICU management (Di Pasquale et al., 2019). The use of biomarkers to guide therapy likely contributed to better infection control and reduced VAP incidence, as evidenced in previous studies (Schuetz et al., 2013).

Adverse Drug Events and Antibiotic-Related Complications

One of the important findings of this study is the reduction in adverse drug events, particularly those related to antibiotic overuse. Patients in the biomarker-guided group had fewer instances of nephrotoxicity and C. difficile infections (8% vs. 16%, $p = 0.037$). Prolonged antibiotic use is a known risk factor for these complications, and reducing antibiotic exposure through biomarker-guided therapy can significantly lower the risk (Schouten et al., 2007). This highlights the role of pharmacists in monitoring biomarker trends and adjusting antibiotic regimens to prevent unnecessary exposure to potentially harmful drugs.

Role of Interdisciplinary Collaboration

The interdisciplinary collaboration between RTs, pharmacists, and LS was critical to the success of biomarker-guided antibiotic therapy. RTs provided real-time clinical data, such as changes in respiratory symptoms and ventilator settings, which helped contextualize biomarker levels and informed decisions on antibiotic use. Pharmacists played a central role in adjusting antibiotic dosing and duration based on biomarker trends and clinical data, ensuring that therapy was both safe and effective. LS ensured the timely and accurate reporting of biomarker levels, allowing for rapid decision-making in the ICU.

This collaborative approach aligns with previous studies demonstrating that interdisciplinary care models improve patient outcomes and enhance the effectiveness of antibiotic stewardship programs (Voermans et al., 2019). By working together, these healthcare professionals were able to optimize antibiotic therapy, reduce unnecessary antibiotic use, and improve overall patient outcomes.

Mortality Rates

Although there was a lower mortality rate in the biomarker-guided group compared to the standard care group (15% vs. 21%), this difference was not statistically significant ($p = 0.218$). While biomarkers may have contributed to better clinical outcomes, mortality is often influenced by a wide range of factors beyond antibiotic therapy, including the severity of the underlying disease and the presence of comorbidities. Further research with larger sample sizes may be needed to assess the impact of biomarker-guided therapy on mortality.

Clinical Implications

The findings of this study have important clinical implications for ICU management and antibiotic stewardship. Biomarker-guided antibiotic therapy not only reduces the duration of antibiotic use but also improves clinical outcomes by reducing ICU length of stay, mechanical ventilation duration, and the incidence of VAP. Implementing biomarker-driven protocols in ICUs can help optimize antibiotic use, minimize the risks of antibiotic overuse, and improve patient outcomes.

Moreover, this study highlights the importance of interdisciplinary collaboration in the ICU. By integrating the expertise of RTs, pharmacists, and LS, healthcare teams can provide more personalized and effective care, ensuring that antibiotics are used appropriately and only for as long as necessary. This collaborative approach should be encouraged in ICUs as part of antibiotic stewardship programs.

Limitations

While this study provides valuable insights into the benefits of biomarker-guided antibiotic therapy, it has several limitations. The retrospective design may introduce selection bias, and the study was conducted in a single tertiary hospital, which may limit the generalizability of the findings to other healthcare settings. Additionally, the sample size may not have been large enough to detect statistically significant differences in mortality rates. Future prospective studies are recommended to further explore the long-term benefits of biomarker-guided therapy in diverse ICU settings.

Conclusion

In conclusion, this study demonstrates that biomarker-guided antibiotic therapy, supported by interdisciplinary collaboration between RTs, pharmacists, and LS, significantly improves clinical outcomes in ICU patients with respiratory infections. The use of biomarkers such as PCT and CRP reduces the duration of antibiotic use, decreases ICU length of stay, and lowers the incidence of VAP, while also minimizing the risk of antibiotic-related complications. These findings underscore the importance of integrating biomarker data into antibiotic stewardship programs and promoting interdisciplinary collaboration in critical care settings.

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