Antibiotic Stewardship and Patient Safety in Intensive Care Units: An Interprofessional Approach to Improving Clinical Outcomes — A Narrative Review

Abdullah Saeed Alharthi[1*], Saud Ahmed Alshehri[2], Ali Mohammed Asiri[3], Rawan Fayez Alshehri[4], Nawaf Abdullah Al-turky[5], Nawaf Saeed Albuhairi[6], Essa Hamed Aljuhani[7], Saud Mordi Sloom Alnofiae[8]

[1]Consultant Family Medicine, Prince Sultan Military Hospital, Taif
Email: Drabdullah100@outllook.com

[2]Respiratory Therapist, Armed Forces Hospital Southern Region, Khamis Mushait
Email: S.alshehri1420@gmail.com

[3]Respiratory Therapist, Armed Forces Hospital Southern Region, Khamis Mushait
Email: ali88a1222@gmail.com

[4]Respiratory Therapist, Armed Forces Hospital Southern Region (AFHSR), Khamis Mushait
Email: Rawanalshehri29@hotmail.com

[5]Respiratory Therapist, Armed Forces Hospital, Abha
Email: official.nwaf2@gmail.com

[6]Respiratory Therapist, Armed Forces Hospital Southern Region, Khamis Mushait
Email: Nawaf.albehairi@gmail.com

[7]Lab Technician, Taif Armed Forces Hospitals, Taif
Email: Morphin40@gmail.com

[8]Emergency Medical Technician Assistant, Armed Forces Hospital Alhada, Taif
Email: saud11_ems@icloud.com

***Corresponding Author:** Abdullah Saeed Alharthi, Consultant Family Medicine, Prince Sultan Military Hospital, Taif
Email: Drabdullah100@outllook.com

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ABSTRACT

Background:
Antibiotics are among the most frequently prescribed medications in intensive care units (ICUs). Their timely administration is often essential for treating life-threatening infections, particularly sepsis, pneumonia, and bloodstream infections. However, the widespread use of broad-spectrum antibiotics has raised concerns about antimicrobial resistance, medication-related complications, and unnecessary treatment. Managing these challenges requires more than appropriate prescribing; it depends on effective collaboration among healthcare professionals involved in the care of critically ill patients.

Objective:
This narrative review explores how physicians, pharmacists, and respiratory therapists contribute to antibiotic stewardship in intensive care units, with particular attention to patient safety, treatment optimization, and clinical outcomes.

Methods:
This narrative review discusses published clinical guidelines and relevant literature on antimicrobial stewardship, critical care pharmacotherapy, respiratory infection management, and interprofessional collaboration. Particular attention is given to antibiotic selection, dose optimization, respiratory assessment, microbiological investigations, antimicrobial de-escalation, and prevention of ventilator-associated complications.

Discussion:
Antibiotic stewardship in critical care is a shared clinical responsibility. Physicians assess suspected infections and determine treatment strategies, while pharmacists help ensure that antibiotic regimens are effective, appropriately dosed, and safe. Respiratory therapists contribute through respiratory monitoring, ventilator management, and assistance with respiratory specimen collection. When these professionals communicate effectively, they can recognize changes in patient condition earlier, reassess treatment

decisions, and reduce avoidable antibiotic exposure. Nevertheless, evidence regarding the independent impact of each professional group on clinical outcomes remains limited.

Conclusion:
Integrating physicians, pharmacists, and respiratory therapists into antibiotic stewardship activities may improve the quality and safety of antimicrobial treatment in intensive care units. Regular multidisciplinary discussions, individualized treatment decisions, and timely reassessment of antibiotics are important elements of this approach.

Keywords: Antibiotic Stewardship; Intensive Care Unit; Patient Safety; Interprofessional Collaboration; Clinical Pharmacy; Respiratory Therapy; Antimicrobial Resistance.

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edema, atelectasis, or other noninfectious conditions.

Antibiotic stewardship programs were developed to support appropriate antimicrobial prescribing and reduce the consequences of unnecessary antibiotic exposure. These programs encourage clinicians to select suitable antibiotics, optimize dosing, monitor treatment response, and reassess therapy as additional clinical and microbiological information becomes available 1,4.

Although physicians are responsible for most antimicrobial prescribing decisions, effective stewardship increasingly depends on the contributions of other healthcare professionals. Clinical pharmacists bring expertise in antimicrobial pharmacotherapy, medication safety, and therapeutic drug monitoring. Respiratory therapists, particularly in mechanically ventilated patients, provide valuable information about respiratory function, airway secretions, and ventilator-related complications.

The relationship between these professional roles deserves greater attention. Much of the existing stewardship literature focuses on physicians, pharmacists, and infectious disease specialists, while the contribution of respiratory therapists is less frequently discussed.

This narrative review examines antibiotic stewardship in intensive care units from an interprofessional perspective, emphasizing how collaboration among physicians, pharmacists,

1. Introduction

Antibiotics have transformed the treatment of infectious diseases and remain essential in modern intensive care. For patients with severe pneumonia, septic shock, or other serious bacterial infections, receiving effective antimicrobial treatment at the right time can make a substantial difference in their chances of recovery. Yet the same medications that save lives can also cause harm when they are prescribed unnecessarily, administered at inappropriate doses, or continued longer than needed.

This creates a difficult balance for healthcare professionals working in intensive care units. On one hand, delaying antibiotics in a patient with septic shock can have serious consequences. On the other, prescribing broad-spectrum antibiotics to every patient with fever or respiratory deterioration may lead to unnecessary treatment, adverse drug reactions, and increased antimicrobial resistance. Finding the right balance is one of the central challenges of antibiotic stewardship.

The ICU environment makes this challenge even more complicated. Critically ill patients often have multiple medical conditions, unstable organ function, and invasive devices such as central venous catheters and mechanical ventilators. These factors increase the risk of infection while also making diagnosis more difficult. A patient with worsening oxygenation, for example, may have bacterial pneumonia, but similar findings can occur with pulmonary

requires continuous assessment throughout the patient's ICU stay.

3. The Physician's Role in Appropriate Antibiotic Management

Physicians play a central role in diagnosing infections and determining when antimicrobial treatment is necessary. In the ICU, these decisions are often made under considerable time pressure, particularly when patients are hemodynamically unstable or showing signs of organ failure.

The initial decision to prescribe antibiotics should be based on the patient's clinical presentation, suspected source of infection, severity of illness, previous antibiotic exposure, and local resistance patterns. When a serious bacterial infection is likely, treatment should begin promptly. At the same time, unnecessary broad-spectrum coverage should be avoided whenever a more targeted approach is clinically appropriate.

One of the most important responsibilities of the treating physician is to revisit the original diagnosis. Clinical findings can change rapidly, and information that was unavailable when treatment started may become available within the following days.

For example, a patient admitted with suspected pneumonia may initially require broad-spectrum antibiotics. If subsequent imaging, microbiological results, and clinical evaluation suggest a noninfectious cause of respiratory failure, the physician should reconsider whether antibiotics remain necessary.

This process requires clinical judgment rather than automatic reliance on laboratory findings. A positive respiratory culture does not always indicate infection, just as a negative culture does not completely exclude bacterial disease.

Physicians also determine when antibiotic treatment can be narrowed, changed, or discontinued. These decisions are often strengthened by input from pharmacists and respiratory therapists, who may identify medication-related concerns or respiratory findings that influence the overall assessment.

4. The Clinical Pharmacist's Contribution to Antibiotic Stewardship

and respiratory therapists can support safer antimicrobial treatment and better-informed clinical decisions.

2. Antibiotic Use and Stewardship Challenges in Intensive Care

Antibiotic prescribing in the ICU is rarely straightforward. Many critically ill patients develop symptoms that suggest infection, such as fever, hypotension, elevated inflammatory markers, or worsening respiratory function. However, these findings may also be caused by noninfectious conditions. Because the consequences of missing a serious bacterial infection can be severe, clinicians often begin empirical antibiotic treatment before the diagnosis is confirmed.

This approach is appropriate when the clinical situation requires urgent treatment, particularly in septic shock. Problems arise when empirical antibiotics are not reassessed after additional information becomes available.

A patient may initially receive several broad-spectrum antibiotics because the source of infection is uncertain. Two or three days later, microbiological results may identify a pathogen susceptible to a narrower agent, or the clinical assessment may suggest that infection was unlikely. Without a structured review process, the original treatment may continue unnecessarily.

Prolonged or inappropriate antibiotic exposure increases the risk of adverse effects and may contribute to the emergence of resistant microorganisms. Some antibiotics can cause kidney injury, liver dysfunction, allergic reactions, or gastrointestinal complications. These risks are especially important in critically ill patients, whose organ function may already be compromised.

Another difficulty involves selecting an appropriate dose. Physiological changes during critical illness can alter how antibiotics are distributed and eliminated from the body. Some patients may clear medications faster than expected, while others experience reduced clearance because of renal or hepatic dysfunction. As a result, standard dosing may produce insufficient antibiotic exposure or increase the likelihood of toxicity 3.

These challenges demonstrate why antibiotic stewardship cannot be limited to choosing an antibiotic at the beginning of treatment. It

ventilation. Their routine clinical assessments provide information that can influence decisions about respiratory infection management.

Although respiratory therapists do not generally select or prescribe antibiotics, their contribution to stewardship is relevant because respiratory infections are a common reason for antimicrobial use in intensive care.

5.1 Recognizing Changes in Respiratory Condition

Respiratory therapists regularly monitor oxygen requirements, ventilator settings, respiratory mechanics, and airway secretions. They may be among the first healthcare professionals to recognize changes in a patient's respiratory condition.

For example, an increase in oxygen requirements accompanied by changes in respiratory secretions may raise concern about pneumonia. However, these findings alone cannot confirm bacterial infection.

A patient may develop similar changes because of pulmonary edema, mucus plugging, atelectasis, or other respiratory complications. Communicating these possibilities to the treating physician can support a more complete assessment before decisions about antibiotic treatment are made.

5.2 Supporting Microbiological Investigations

Respiratory cultures are frequently used when ventilator-associated pneumonia is suspected. Respiratory therapists may assist in collecting endotracheal aspirates or other respiratory specimens according to institutional protocols.

The quality of these specimens matters. Poor collection techniques or contamination may produce results that are difficult to interpret and could contribute to unnecessary antibiotic treatment.

Appropriate specimen collection, timely transportation, and clear documentation can improve the usefulness of microbiological investigations.

5.3 Preventing Ventilator-Associated Complications

Clinical pharmacists contribute to antibiotic stewardship by helping ensure that antimicrobial treatment is appropriate for each patient's condition. Their role extends beyond checking prescriptions and includes evaluating treatment effectiveness, preventing medication-related harm, and supporting clinical decisions.

One of the most important areas of pharmacist involvement is antibiotic dose optimization. Critically ill patients often experience substantial changes in renal function, fluid balance, and drug distribution. These changes may affect antibiotic concentrations and make conventional dosing less reliable.

For instance, a patient with acute kidney injury may accumulate renally eliminated antibiotics, increasing the risk of toxicity. In contrast, some critically ill patients experience augmented renal clearance, which can result in lower-than-expected drug concentrations. Pharmacists can help identify these situations and recommend appropriate dosing adjustments 3.

Therapeutic drug monitoring is another valuable contribution. For antibiotics such as vancomycin and aminoglycosides, monitoring drug exposure can help clinicians balance treatment effectiveness against potential toxicity. Current recommendations for serious methicillin-resistant Staphylococcus aureus infections emphasize area-under-the-curve-guided vancomycin monitoring when feasible 6.

Pharmacists also evaluate drug interactions, duplicate antibiotic coverage, allergies, and the need for ongoing antimicrobial treatment.

Their involvement becomes particularly valuable during daily ICU rounds. A pharmacist may notice that a patient's renal function has improved, requiring dose reassessment, or that culture results support replacing a broad-spectrum antibiotic with a narrower alternative.

These interventions may appear relatively small when considered individually, but they are important components of safe medication management.

5. The Respiratory Therapist's Role in Supporting Antibiotic Stewardship

Respiratory therapists are closely involved in the care of patients with respiratory failure, particularly those receiving mechanical

Over the next several days, each professional contributes information that helps the team understand whether treatment is working.

If cultures identify a susceptible organism, the pharmacist may recommend narrowing antibiotic coverage. If respiratory function improves and the patient remains clinically stable, the physician may reassess treatment duration. If oxygenation worsens despite antimicrobial therapy, the respiratory therapist's findings may prompt consideration of alternative respiratory complications.

This example illustrates how collaboration can improve the quality of clinical decisions. No single professional has all the information required to manage every aspect of a critically ill patient's treatment.

Interprofessional communication may also help prevent errors caused by fragmented care. When information about microbiological results, renal function, or respiratory deterioration is not communicated effectively, treatment decisions may be delayed or based on incomplete information.

Regular multidisciplinary rounds create opportunities to address these issues before they affect patient safety.

7. Ventilator-Associated Pneumonia and Antibiotic Stewardship

Ventilator-associated pneumonia is among the most challenging infections encountered in critical care. Patients receiving mechanical ventilation are exposed to several risk factors for respiratory infection, including impaired airway defenses and the presence of an artificial airway.

Diagnosing ventilator-associated pneumonia can be difficult because fever, abnormal chest imaging, respiratory secretions, and impaired oxygenation are not specific to bacterial infection.

This diagnostic uncertainty often leads clinicians to initiate broad-spectrum antibiotic treatment. While empirical therapy may be necessary in patients with suspected serious infection, continued treatment should depend on clinical reassessment and available microbiological evidence.

Respiratory therapists also contribute to preventing complications associated with mechanical ventilation. Their responsibilities include ventilator monitoring, airway management, participation in spontaneous breathing trials, and assessment of readiness for ventilator liberation.

Reducing unnecessary mechanical ventilation and supporting evidence-based respiratory care may help decrease exposure to ventilator-associated complications.

These preventive activities are not antibiotic stewardship interventions in the traditional prescribing sense. Nevertheless, they support infection prevention and may reduce situations in which antimicrobial treatment is considered.

5.4 Communication During ICU Rounds

Respiratory therapists can provide valuable information during multidisciplinary rounds, including changes in oxygenation, ventilator requirements, secretion characteristics, and respiratory mechanics.

Such information can help physicians and pharmacists interpret a patient's response to treatment and determine whether further investigation is needed.

Their contribution is therefore best understood as part of a wider team-based approach to infection assessment and patient safety.

6. Why Interprofessional Collaboration Matters

Antibiotic stewardship is often described in terms of prescribing guidelines and treatment protocols. While these tools are important, they cannot replace communication among the healthcare professionals caring for the patient.

Consider a patient receiving mechanical ventilation who develops fever and increasing oxygen requirements. The physician may suspect ventilator-associated pneumonia and initiate empirical antibiotics after appropriate assessment. The respiratory therapist may assist with obtaining a respiratory specimen and report changes in ventilator requirements. The pharmacist may review the prescribed antibiotics and identify the need for dose adjustment because of impaired renal function.

Pharmacists can identify potentially harmful drug combinations and recommend appropriate laboratory monitoring. Physicians can determine whether ongoing antimicrobial treatment remains clinically justified. Respiratory therapists can provide information about respiratory status that may help distinguish infection-related deterioration from other causes.

Together, these activities support a broader understanding of antibiotic stewardship as a patient safety responsibility rather than simply a strategy to control antimicrobial resistance.

9. Practical Approaches to Strengthening ICU Antibiotic Stewardship

Improving antibiotic stewardship does not always require major changes to hospital infrastructure. Many meaningful improvements can begin with consistent communication and structured clinical review.

One practical approach is to include antibiotic reassessment as a routine part of daily ICU rounds. Rather than discussing antimicrobial treatment only when a problem arises, the team can review whether each patient still requires antibiotics, whether the selected agents remain appropriate, and whether treatment can be narrowed or discontinued.

A second approach involves strengthening collaboration between clinical pharmacists and prescribing physicians. Pharmacists should have opportunities to review antimicrobial regimens and communicate recommendations about dosing, monitoring, and treatment duration.

Respiratory therapists should also be included in discussions involving suspected respiratory infections, particularly when changes in ventilator requirements or respiratory findings influence treatment decisions.

Education is another important component. Training programs that bring physicians, pharmacists, and respiratory therapists together can improve understanding of each profession's responsibilities and encourage more effective communication.

Hospitals can further support stewardship through local antibiotic guidelines, microbiological surveillance, electronic

The 2016 IDSA/ATS guidelines for hospital-acquired and ventilator-associated pneumonia recommend considering local resistance patterns when selecting empirical antibiotics. They also support antimicrobial de-escalation and recommend approximately seven days of treatment for most patients with VAP, with adjustments according to clinical circumstances 5.

Physicians, pharmacists, and respiratory therapists each contribute to implementing these recommendations.

Physicians evaluate the likelihood of pneumonia and determine treatment strategies. Pharmacists help optimize antimicrobial dosing and identify opportunities for narrower therapy. Respiratory therapists contribute respiratory assessments, specimen collection, and ventilator-related information.

The shared objective is not simply to reduce antibiotic use, but to ensure that patients with genuine bacterial infections receive effective treatment while avoiding unnecessary exposure in those without infection.

8. Antibiotic-Related Harm and Patient Safety

Antibiotics are often viewed primarily as treatments for infection, but their potential adverse effects deserve equal attention.

Critically ill patients may be particularly vulnerable to medication-related complications because of organ dysfunction, multiple prescribed medications, and prolonged hospitalization.

Some antibiotics can cause nephrotoxicity, while others may contribute to hepatotoxicity, allergic reactions, cardiac adverse effects, or gastrointestinal disturbances. Broad-spectrum antibiotic exposure can also disrupt normal microbial flora and increase the risk of Clostridioides difficile infection.

These complications may be difficult to recognize in critically ill patients because symptoms can overlap with manifestations of the underlying illness.

For this reason, medication safety monitoring should be part of routine antimicrobial management.

participants in antibiotic stewardship programs. Although their involvement in respiratory assessment and ventilator management is well established, further studies are needed to determine whether their formal inclusion in stewardship activities produces measurable improvements in antibiotic use or patient outcomes.

Future research could compare ICUs using traditional physician-pharmacist stewardship models with units that formally integrate respiratory therapists into respiratory infection assessment and antimicrobial review processes.

Such studies could examine antibiotic days of therapy, diagnostic accuracy, adverse drug events, treatment appropriateness, ventilator-associated complications, and patient-centered outcomes.

11. Limitations

This narrative review is based on selected clinical guidelines and published literature rather than a systematic search and formal appraisal of all available studies. Therefore, it may not capture every relevant publication, and its conclusions should not be interpreted as pooled estimates of intervention effectiveness.

The available literature also differs in study design, patient populations, and stewardship interventions, making direct comparisons difficult.

In addition, evidence concerning the independent contribution of respiratory therapists to antibiotic stewardship remains limited. Their proposed role in this review is based mainly on established respiratory care responsibilities and their potential contribution to multidisciplinary clinical decisions.

Further prospective research is needed to evaluate the clinical effectiveness of structured stewardship models involving physicians, pharmacists, and respiratory therapists.

12. Conclusion

Antibiotic stewardship is an important part of providing safe and effective care in intensive care units. Critically ill patients often require urgent antimicrobial treatment, but unnecessary or inappropriate antibiotic exposure can lead to avoidable complications and contribute to antimicrobial resistance.

prescribing alerts, and regular evaluation of antimicrobial use.

However, these interventions should be adapted to the resources and clinical needs of each ICU. A strategy that works well in a large tertiary hospital may require modification before implementation in a smaller facility.

10. Discussion

The management of antibiotics in critically ill patients is a complex process that requires balancing urgent treatment needs against the risks associated with unnecessary antimicrobial exposure.

Existing antimicrobial stewardship guidelines provide a strong foundation for improving prescribing practices. However, implementing these recommendations in everyday ICU practice depends on how effectively healthcare professionals work together.

Physicians remain responsible for diagnosis and treatment decisions, but their work is supported by the expertise of clinical pharmacists and respiratory therapists. Pharmacists contribute specialized knowledge of antimicrobial pharmacotherapy, while respiratory therapists provide clinical information that is particularly valuable in mechanically ventilated patients.

An important consideration is that the benefits of interprofessional collaboration may not always be reflected in conventional clinical outcomes such as mortality or ICU length of stay.

For example, a multidisciplinary intervention may improve antibiotic dose accuracy or reduce unnecessary treatment without producing a measurable reduction in mortality. This does not mean that the intervention lacks clinical value. Preventing medication-related harm and improving prescribing appropriateness are meaningful patient safety outcomes.

At the same time, it would be inappropriate to assume that all forms of collaboration automatically improve clinical outcomes. The effectiveness of interprofessional stewardship depends on clear responsibilities, appropriate training, consistent communication, and access to reliable clinical information.

Another important issue is the limited research specifically examining respiratory therapists as

Managing these competing concerns requires regular clinical reassessment and collaboration among healthcare professionals.

Physicians contribute diagnostic judgment and treatment planning, pharmacists help optimize antimicrobial therapy and prevent medication-related harm, and respiratory therapists provide important information about respiratory function, ventilator management, and suspected pulmonary infections.

When these roles are brought together through effective communication and multidisciplinary rounds, healthcare teams are better positioned to make informed decisions about antibiotic treatment.

Although additional research is needed to determine the impact of specific interprofessional models on clinical outcomes, integrating physicians, pharmacists, and respiratory therapists into antibiotic stewardship activities offers a practical approach to strengthening patient safety in intensive care.

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