# Antimicrobial Stewardship Approaches in the Intensive Care Unit

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**KEYWORDS**

- Antimicrobial stewardship • Antibacterial resistance • Rapid diagnostics
- *Clostridium difficile* infection • Prospective audit and feedback
- Formulary restriction • Computerized decision support

**KEY POINTS**

- Antibiotic resistance is a major and growing problem, and antimicrobials are a limited resource. Antimicrobial stewardship is an approach to improving and monitoring the use of existing antimicrobials.
- The intensive care unit (ICU) is a unique and high-stakes setting for antimicrobial use that presents distinct challenges for antimicrobial stewardship programs. This article outlines approaches to antimicrobial stewardship with a focus on the ICU setting.
- Opportunities for antimicrobial stewardship exist during the diagnosis, empirical treatment, and definitive antimicrobial choice. General approaches and ICU-specific application are discussed.
- Both process and outcome measures should be monitored as antimicrobial stewardship initiatives are implemented in the ICU to demonstrate effectiveness and ensure safety.

## CASE PRESENTATIONS

- A 75-year-old man who underwent a Whipple procedure for pancreatic cancer 1 month prior with a rocky postoperative course, including respiratory failure, shock, upper gastrointestinal bleed, and surgical site infection, develops a new fever, need for reintubation, and pressor requirement. Blood and urine cultures are negative and chest radiograph demonstrates bilateral infiltrates, stable

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from prior. How should this patient's antibiotics be managed initially? What tests are useful to help direct therapy? What antibiotic stewardship strategies are helpful in this situation?
- A 19-year-old trauma patient is admitted with multiple fractures and a subarachnoid hemorrhage, now has a fever 4 days after admission. How does one determine whether this patient has an infectious cause for fever? Does this patient need antibiotics?
- A 60-year-old lung transplant recipient is admitted from the community with septic shock. How can one rapidly determine the cause? When is it safe to deescalate antibiotics? When can antibiotics be stopped?

## BACKGROUND

More than 2 million illnesses and 23,000 deaths occur each year in the United States due to infections caused by antimicrobial-resistant pathogens, a large burden of which occur in the intensive care unit (ICU) setting.[1,2] Since the discovery of penicillin, there has been a clear temporal relationship between the introduction of antibiotics into clinical practice and development of resistance.[3] Though the antibiotic pipeline has improved in recent years, new drugs have not kept pace with threatening antibiotic-resistant organisms.[4–6] Antimicrobial stewardship has emerged as a strategy to preserve existing drugs, as well as newly developed drugs, so that these remain effective.

Antimicrobial stewardship refers to an organized program designed to monitor, improve, and measure the responsible use of antibiotics.[7] Though there are many approaches to antimicrobial stewardship, fundamental strategies include development and implementation of facility-specific treatment guidelines, restriction of certain types of high-risk antibiotics, and review of antibiotic therapy by an infectious disease (ID) expert (physician or pharmacist) with feedback to providers.[8] These programs are often led by an interdisciplinary team composed of an ID and/or stewardship-trained physician and pharmacist, who oversee the core actions, monitor antibiotic use, and provide education for their facility in conjunction with key stakeholders, including clinicians, the microbiology laboratory, hospital infection control, information technology (IT), quality groups, and executive leadership. First described as far back as the 1970s, antimicrobial stewardship has grown immensely in past years due to a combination of increasing attention to patient safety, increasing reports of antibiotic resistance, and regulatory mandates.[9–12] The underlying goal for stewardship programs is to improve clinical outcomes in individual patients, through improved treatment of infection and prevention of adverse events, while limiting selective pressure for antimicrobial resistance for the population as a whole and, to the extent possible, decreasing costs.

The ICU is a unique and high-stakes setting for antimicrobial use. Antimicrobial resistance rates are high, resulting in poor clinical outcomes and high cost.[2,13] Inadequate initial antimicrobial therapy in the ICU setting is associated with worse outcomes, which given the prevalence of antimicrobial resistance often results in use of very broad-spectrum agents in critically ill patients, even when risk factors for resistance are not present.[14–17] On the flip side, inappropriate antimicrobial therapy accounts for approximately 30% of prescriptions in the ICU setting, most frequently for treatment of colonization or contamination, treatment of noninfectious or viral infections, or too-long or too-broad treatment.[18,19] The combination of the acuity of illness in the ICU setting mixed with the high stakes of inadequate initial therapy can push providers to use antibiotics in inappropriate ways, such as treatment of community-acquired infections or organisms with very low likelihood of resistance with overly broad-spectrum agents.[20]