Current and Future Opportunities for Rapid Diagnostics in Antimicrobial Stewardship

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KEYWORDS

• Antimicrobial stewardship • Rapid diagnostics • Diagnostic stewardship • Infections

KEY POINTS

- Rapid diagnostic testing has greatly affected the landscape of antimicrobial stewardship programs and, in many instances, is associated with improved patient care.
- Antimicrobial stewardship intervention is required to fully realize the potential clinical impact of rapid testing for bloodstream infections. Whether the same benefits can be achieved for other infectious diseases requires additional research.
- Partnership between the clinical microbiology laboratory and antimicrobial stewardship programs is expected to become increasingly important as new and more complicated tests as well as novel diagnostic approaches become available in the future.

INTRODUCTION

Rapid microbiology diagnostics have consistently been shown to decrease time to organism identification and thus, potentially enable earlier initiation of targeted antimicrobial therapy.[1,2] Optimizing and minimizing unnecessary antimicrobial use is imperative in the age of increasing rates of *Clostridium difficile* infection (CDI), antimicrobial-resistant infections, and antimicrobial-related adverse drug events.

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Significant advances in clinical microbiology diagnostics have been made over the last decade. A wide array of advanced methods with rapid turnaround times and the ability to detect multiple pathogens with high sensitivity have become available. However, many of these new technologies are expensive and few studies have established cost-effectiveness and/or best implementation strategies to maximize value.

Antimicrobial stewardship is a multidisciplinary program of activities that optimizes antimicrobial use to improve clinical outcomes and minimize unintended consequences of antimicrobial misuse. In collaboration with the clinical microbiology laboratory, stewardship teams are playing an increasingly important role in guiding best use of rapid diagnostic testing (RDT). Recent Infectious Diseases Society of America guidelines for implementing an Antimicrobial Stewardship Program (ASP) recommend ASPs advocate for RDT for respiratory infections and bloodstream infections (BSIs) as a means to improve antimicrobial use.[3] The rapid respiratory viral testing has the potential to reduce inappropriate antibiotic use; however, the potential impacts of respiratory viral testing to date have been mixed and the addition of active ASP intervention may improve results. Because the use of RDT for BSIs in the absence of active ASP intervention has not been shown to consistently improve antimicrobial use, guidelines specifically recommend the use of RDT for BSI only if paired with active ASP support and interpretation to providers.[3–6] Active ASP intervention can take on many forms and include activities beyond treatment recommendations; however, proper implementation is labor and resource intensive. With regulatory requirements leading to expansion of ASPs across all health care settings, further understanding of the clinical impact that ASP interventions can have when paired with rapid diagnostic capabilities is imperative for resource allocation.

Although not exhaustive in scope, this review focuses on rapid diagnostic modalities available for bacterial BSIs, candidemia, respiratory tract infections, and gastrointestinal (GI) infections. Specifically, we highlight what is known about the most effective application of these diagnostics in clinical settings, focusing on their clinical utility, cost-effectiveness, and interplay with antimicrobial stewardship efforts.

BLOODSTREAM INFECTIONS

Bacterial

Several US Food and Drug Administration (FDA)–approved RDTs are commercially available for the diagnosis of BSI. Current tests for bacteria are designed to be applied to aliquots from positive blood culture bottles and detect only the most common (>80%) causes of BSI. Available assays are based on peptide nucleic acid fluorescent in situ hybridization (PNA-FISH) with or without digital microscopy, polymerase chain reaction (PCR), or different forms of nanoparticle array technology (**Table 1**). In addition to organism identification, some of the PCR and array-based platforms also provide limited genotypic resistance information. The Accelerate Pheno system (Accelerate Diagnostics, Tucson, AZ, USA) is unique in that it combines organism identification using FISH probes with rapid phenotypic susceptibility results.[7] In addition to RDT applied to blood culture aliquots, 2 matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF) mass spectroscopy platforms are FDA approved for the rapid identification of organisms in pure culture. Faster time to organism identification and information on resistance yields opportunities for clinicians to target antimicrobial therapy in a more rapid manner, which can translate into improved clinical outcomes. However, an important limitation of all current technologies is the inability to accurately analyze polymicrobial cultures and a dearth of assays capable of detecting resistance in Gram-negative organisms.