Clinical Infectious Diseases

VIEWPOINTS

Diagnostic Stewardship: Opportunity for a Laboratory–Infectious Diseases Partnership

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Recent advances in microbial diagnostics are providing clinicians with information about microbes causing infections and their resistance to antimicrobial agents more rapidly than ever before. Diagnostic stewardship refers to the appropriate use of laboratory testing to guide patient management, including treatment, in order to optimize clinical outcomes and limit the spread of antimicrobial resistance. Fulfilling the promise of diagnostic stewardship requires a seamless partnership between clinical laboratories, pharmacists, and infectious diseases clinicians, so that appropriate tests are ordered and diagnostic information is translated into appropriate management in real time.

Keywords. diagnostics; stewardship; clinical microbiology; infectious diseases; culture-independent.

Rapid precision diagnostics are revolutionizing clinical microbiology and promise to improve patient outcomes and curb the antimicrobial resistance (AMR) crisis by improving the use of antibiotics. For this potential to be fully realized, infectious diseases (ID) clinicians will play an essential role in a collaborative effort referred to as *diagnostic stewardship* (not to be confused with the cost-effective use of laboratory tests which, though part of diagnostic stewardship, is more limited in scope) [1–4]. Diagnostic stewardship requires a serious reconsideration of current practices, as empiricism gives way to diagnostics-guided therapy.

The goal of new diagnostic methods is to improve human health, but technological advances alone cannot achieve this goal. Decisions must be made about which new diagnostics are needed, how they will be used, and whether they are worth paying for. Laboratory tests currently account for only 4% of healthcare costs [5] but represent the most rapidly growing segment of the healthcare budget, mainly as a result of new molecular assays [6]. Although conventional clinical microbiology diagnostics are relatively inexpensive, some newer and technologically advanced tests can be costly, elevating the need to address value. It is estimated that approximately one-fifth of available tests are overused, with even more being underused [7]. Overuse of tests adds unnecessary costs, and both overuse and underuse can lead to incorrect diagnoses and inappropriate treatment. Moreover, many microbiology tests have become outdated, and optimal testing methods are unavailable in many settings. Appropriate use of testing is becoming more challenging as the number of available diagnostic tests increases. ID specialists can help to determine the appropriate tests for specific patients and situations.

ID clinicians currently partner with laboratory scientists to determine which antimicrobial susceptibility results are routinely reported for specific microorganisms and when additional testing should be performed. This facilitates antimicrobial stewardship by encouraging appropriate antibiotic use. With recent diagnostic advances that allow the identification of microorganisms virtually as soon as they are grown on plates or in blood culture bottles, and sometimes even earlier [8], ID expertise plays an essential role in translating this information into appropriate treatment.

Many studies have shown that rapid diagnostics only improve clinical outcomes if they are coupled with stewardship teams that properly interpret results and apply them to treatment decisions [9–20]. This approach may require expanding the hours of laboratory operation and providing real-time ID consultative support. ID physicians and pharmacists may be asked to work alongside their laboratorians on diagnostic management teams [21], or clinical microbial sequencing boards (modeled after tumor boards) (https://www.genomeweb.com/sequencing/ucsf-lab-readies-launch-metagenomic-ngs-test-infectious-disease) that assist clinicians with the interpretation of complex test results in a specific clinical field.

ID clinicians can assist laboratories in devising appropriate comments to accompany test results in the electronic medical record (EMR), such as "possible contaminant which may not require antibiotic treatment" when coagulase-negative staphylococci are reported from a single blood culture; such comments can be tailored to the needs and unique epidemiology of

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individual institutions [22]. In this way, the EMR can provide a solution to AMR. Integration of laboratories with the EMR, antimicrobial stewardship teams, clinical pharmacists, and clinicians can ensure that treatment decisions are appropriately modified in response to test results in real-time [13]. Likewise, detection of certain drug-resistant organisms can automatically trigger inpatient isolation, preventing the spread of these organisms.

Sophisticated diagnostics can augment antimicrobial stewardship efforts by allowing the replacement of broad-spectrum antimicrobial agents with narrow-spectrum agents that target the microbes specifically responsible for individual patients' infections, facilitating early discontinuation of antimicrobial agents, or abrogating their use in the first place. To support the safety and efficacy of this approach, more studies of the application of precision diagnostics to optimize patient outcomes and reduce AMR (ie, implementation science) will be needed. In the context of AMR, improvements at the patient level promise to provide benefits at the population level.

Test menu selection is another activity in which ID clinicians can partner with their laboratories. An ever-increasing number of powerful but expensive technologies, ranging from point-of-care molecular diagnostics [23, 24] to multiplex panels [25, 26] and next-generation sequencing methods [27], require careful and discerning application. Laboratories can benefit from clinical input to select cost-effective diagnostics that best address patient needs. Similarly, if diagnostics manufacturers market tests directly to ID clinicians, then ID clinicians should work with their clinical microbiologists to ensure that the needs of their patients are optimally served.

As new technologies become available, local laboratory methods and a catalog of send-out tests should continually be reassessed to ensure that patients benefit from the latest diagnostic advances; ID clinicians should help ensure that testing is both available and appropriately ordered (eg, by helping to build smart ordering systems in the EMR). For example, ID clinicians can provide guidance with regard to the appropriate clinical criteria for testing of patients with clinical syndromes, such as acute gastroenteritis [28–30] or suspected *Clostridioides difficile* infections [31, 32].

Finally, by defining important unmet diagnostic needs [33], ID clinicians will play an increasingly important role in defining the future tests that should be developed by industry. For example, the development of syndromic molecular diagnostic panels can benefit from clinical guidance [25, 26]. Molecular diagnostics allow the rapid and sensitive detection of pathogens that were not previously detectable with conventional methods [30], and ID expertise will be required to determine the implications of these diagnoses for specific management.

For example, it is not unusual for multiplex molecular platforms to detect multiple potential pathogens in a single clinical sample [25]. ID physicians can help interpret apparent coinfections with multiple potential pathogens and determine when a pathogen is likely to be responsible for a patient's symptoms, as well as establish appropriate criteria for the use of multiplex tests and assist in the design of such assays so that appropriate target organisms are included [26]. Newer technologies, such as whole-genome sequencing, shotgun metagenomic methods to diagnose infection, and methods to characterize the host microbiome [34, 35] likewise pose both an opportunity and a challenge, and ID clinicians can help establish interpretive criteria and applications.

Achieving a clinician-laboratorian collaboration will not necessarily be simple. The consolidation of laboratory services [36] has created obstacles for direct clinician-laboratory interactions at a time when such interactions are needed more than ever. In addition, new clinical guidelines and testing algorithms will need to keep pace with the development of novel diagnostic methods, which will require the input of both laboratory scientists and ID clinicians (eg, on guidelines panels).

In a recent commentary in *Clinical Infectious Diseases* [37], Arturo Casadevall pointed out that the role of ID specialists has historically been to provide "intellectual input in the form of consultation." Nowadays he suggests that ID specialists should "use (their) expertise to command an important position in the information and decision flows in medicine" but worries that empiricism in the use of antimicrobial agents has "fostered a neglect of new diagnostics." The current diagnostics revolution promises to transform clinical practice to more closely conform with Casadevall's vision of diagnostics-driven therapy for ID.

Developers of new diagnostic technologies will be best served by a team-based approach. ID specialists are ideal partners to develop and implement systems to ensure appropriate diagnostic testing and the seamless translation of laboratory results into personalized treatment. Improved diagnostics may increase the costs of diagnostics, so assessing value will become increasingly important, with regard to both specific tests and approaches to patient care. Diagnostic stewardship means selecting the right test for the right patient at the right time, to optimize clinical care and antimicrobial use [4]. This is a mission for ID specialists and clinical microbiologists to take on together.

Notes

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