

readers to the following sources for current taxonomy: Bacteria: www.bacterio.net/-alintro.html; Fungi: www.mycobank.org; Viruses: <http://ictvonline.org>; Parasites: www.cdc.gov/dpdx. Other sources are also available.

At an elementary level, the physician needs answers to 3 very basic questions from the laboratory: (1) Is my patient's illness caused by a microorganism? (2) If so, what is it? (3) What is the susceptibility profile of the organism so therapy can be targeted? To meet those needs, the laboratory requires very different information. The microbiology laboratory needs a specimen that has been appropriately selected, collected, and transported to the laboratory for analysis. Caught in the middle, between the physician and laboratory, are the medical staff who have received orders to select and collect the specimen and who may not know or understand what the physician or the laboratory needs to do their work. Enhancing the quality of the specimen is everyone's job, so communication between the patient-facing healthcare provider and laboratory staff should be encouraged and open with no punitive motive or consequences.

The diagnosis of infectious disease is best achieved by applying in-depth knowledge of both medical and laboratory science along with principles of epidemiology and pharmacokinetics of antibiotics and by integrating a strategic view of host-parasite interactions. Clearly, the best outcomes for patients are the result of strong partnerships between the clinician and the microbiology specialist. This document illustrates and promotes this partnership and emphasizes the importance of appropriate specimen management to clinical relevance of the results. One of the most valuable laboratory partners in infectious disease diagnosis is the microbiology specialist certified as a Diplomate by the American Board of Medical Microbiology (ABMM), the American Board of Pathology (ABP), or the American Board of Medical Laboratory Immunology (ABMLI) or their equivalent certified by other organizations. These Board-Certified microbiology specialists are engaged with the medical staff to communicate clinically significant results, interpret complex laboratory findings, and consult on testing and diagnostics on a daily basis. Clinicians should recommend and medical institutions should provide this kind of leadership for the microbiology laboratory or provide formal access to this level of laboratory expertise through expert consultation.

Impact of Specimen Management

Microbiology specimen selection and collection are the responsibility of the medical staff, not usually the laboratory, although the certified specialist may be called upon for consultation or assistance. The impact of proper specimen management on patient care is enormous. It is the key to accurate laboratory diagnosis and confirmation, it directly affects patient care and patient outcomes, it influences therapeutic decisions, it helps

drive hospital infection control, it influences patient length of stay, hospital costs, and laboratory costs, it impacts antibiotic stewardship, and it influences laboratory efficiency. Clinicians and medical staff should consult the laboratory to ensure that selection, collection, transport, and storage of the patient specimens they collect are managed properly.

Antibiotic stewardship and diagnostic stewardship are interdependent, and the laboratory plays a pivotal role in each of those activities. Diagnostic stewardship leads to the appropriate use of laboratory testing to guide clinical intervention and therapeutics in order to optimize patient outcomes and limit the spread of antimicrobial resistance (which is addressed by antibiotic stewardship) [1]. The importance and interdependence of antibiotic and diagnostic stewardship are shown in Figure 1. This document focuses on diagnostic stewardship and how best to optimize the use of the microbiology laboratory for infectious disease diagnosis.

Tenets of Specimen Management

Throughout the text, there will be caveats that are relevant to specific specimens and diagnostic protocols for infectious disease diagnosis. However, there are some strategic tenets of specimen management and testing in microbiology that stand as community standards of care and that set microbiology apart from other laboratory departments such as chemistry or hematology. Ten points of importance are:

1. Specimens of poor quality must be rejected. Microbiologists act correctly and responsibly when they call physicians to clarify and resolve problems with specimen submissions that do not meet the requirements specified in the lab procedure manual.
2. Full identification of multiple organisms (>3) within a mixed culture is not recommended. This can provide irrelevant information that could result in inaccurate diagnosis and inappropriate therapy and place the laboratory at legal risk for providing such information.
3. "Background noise" of commensal microbiota unrelated to the disease process must be avoided where possible during specimen collection. Many body sites have normal microbiota that can easily contaminate the specimen and complicate interpretation. Therefore, specimens from sites such as lower respiratory tract (sputum), nasal sinuses, superficial wounds, fistulae, and others that contain large numbers of normal microbiota require care in collection and interpretation.
4. The laboratory needs a specimen, not a swab of a specimen. Actual tissue, aspirates, and fluids are always preferred over swabs, especially from surgery. A swab is not the specimen of choice for many specimens because swabs pick up extraneous microbes as opposed to needle aspirates into a targeted area, hold extremely small volumes of the specimen