Clinical Infectious Diseases

IDSA GUIDELINE

A Guide to Utilization of the Microbiology Laboratory for Diagnosis of Infectious Diseases: 2018 Update by the Infectious Diseases Society of America and the American Society for Microbiology[a]

J. Michael Miller,[1] Matthew J. Binnicker,[2] Sheldon Campbell,[3] Karen C. Carroll,[4] Kimberle C. Chapin,[5] Peter H. Gilligan,[6] Mark D. Gonzalez,[7] Robert C. Jerris,[7] Sue C. Kehl,[8] Robin Patel,[2] Bobbi S. Pritt,[2] Sandra S. Richter,[9] Barbara Robinson-Dunn,[10] Joseph D. Schwartzman,[11] James W. Snyder,[12] Sam Telford III,[13] Elitza S. Theel,[2] Richard B. Thomson Jr,[14] Melvin P. Weinstein,[15] and Joseph D. Yao[2]

[1]Microbiology Technical Services, LLC, Dunwoody, Georgia; [2]Division of Clinical Microbiology, Department of Laboratory Medicine and Pathology, Mayo Clinic, Rochester, Minnesota; [3]Yale University School of Medicine, New Haven, Connecticut; [4]Department of Pathology, Johns Hopkins Medical Institutions, Baltimore, Maryland; [5]Department of Pathology, Rhode Island Hospital, Providence; [6]Department of Pathology and Laboratory Medicine, University of North Carolina, Chapel Hill; [7]Department of Pathology, Children's Healthcare of Atlanta, Georgia; [8]Medical College of Wisconsin, Milwaukee; [9]Department of Laboratory Medicine, Cleveland Clinic, Ohio; [10]Department of Pathology and Laboratory Medicine, Beaumont Health, Royal Oak, Michigan; [11]Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire; [12]Department of Pathology and Laboratory Medicine, University of Louisville, Kentucky; [13]Department of Infectious Disease and Global Health, Tufts University, North Grafton, Massachusetts; [14]Department of Pathology and Laboratory Medicine, NorthShore University HealthSystem, Evanston, Illinois; and [15]Departments of Medicine and Pathology & Laboratory Medicine, Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey

Contents

Introduction and Executive Summary
I. Bloodstream Infections and Infections of the Cardiovascular System
II. Central Nervous System Infections
III. Ocular Infections
IV. Soft Tissue Infections of the Head and Neck
V. Upper Respiratory Tract Bacterial and Fungal Infections
VI. Lower Respiratory Tract Infections
VII. Infections of the Gastrointestinal Tract
VIII. Intra-abdominal Infections
IX. Bone and Joint Infections
X. Urinary Tract Infections
XI. Genital Infections
XII. Skin and Soft Tissue Infections
XIII. Arthropod-Borne Infections
XIV. Viral Syndromes
XV. Blood and Tissue Parasite Infections

Received 22 April 2018; editorial decision 23 April 2018; accepted 28 April 2018; published online July 11, 2018.

[a]It is important to realize that this guide cannot account for individual variation among patients. This guide is not intended to supplant physician judgment with respect to particular patients or special clinical situations. The Infectious Diseases Society of America (IDSA) considers adherence to the recommendations in this guide to be voluntary, with the ultimate determination regarding their application to be made by the physician in the light of each patient's individual circumstances. While IDSA makes every effort to present accurate and reliable information, the information provided in this guide is presented "as is" without any warranty of accuracy, reliability, or otherwise, either express or implied. This guide should be applied in a manner consistent with all applicable laws, rules, and regulations. Neither IDSA nor its officers, directors, members, employees, or agents will be liable for any loss, damage, or claim with respect to any liabilities, including direct, special, indirect, or consequential damages, incurred in connection with this guide or reliance on the information presented.

Correspondence: J. M. Miller, Microbiology Technical Services, LLC, PO Box 88212, Dunwoody, GA 30338 (jmm8@comcast.net).

Clinical Infectious Diseases® 2018;67(6):813–6

DOI: 10.1093/cid/ciy584

The critical nature of the microbiology laboratory in infectious disease diagnosis calls for a close, positive working relationship between the physician/advanced practice provider and the microbiologists who provide enormous value to the healthcare team. This document, developed by experts in laboratory and adult and pediatric clinical medicine, provides information on which tests are valuable and in which contexts, and on tests that add little or no value for diagnostic decisions. This document presents a system-based approach rather than specimen-based approach, and includes bloodstream and cardiovascular system infections, central nervous system infections, ocular infections, soft tissue infections of the head and neck, upper and lower respiratory infections, infections of the gastrointestinal tract, intra-abdominal infections, bone and joint infections, urinary tract infections, genital infections, and other skin and soft tissue infections; or into etiologic agent groups, including arthropod-borne infections, viral syndromes, and blood and tissue parasite infections. Each section contains introductory concepts, a summary of key points, and detailed tables that list suspected agents; the most reliable tests to order; the samples (and volumes) to collect in order of preference; specimen transport devices, procedures, times, and temperatures; and detailed notes on specific issues regarding the test methods, such as when tests are likely to require a specialized laboratory or have prolonged turnaround times. In addition, the pediatric needs of specimen management are also emphasized. There is intentional redundancy among the tables and sections, as many agents and assay choices overlap. The document is intended to serve as a guidance for physicians in choosing tests that will aid them to quickly and accurately diagnose infectious diseases in their patients.

Keywords. specimen management; clinical relevance; specimen collection; clinical correlation; microbiology specimens.

EXECUTIVE SUMMARY

Introduction

Unlike other areas of the diagnostic laboratory, clinical microbiology is a science of interpretive judgment that is becoming more complex, not less. Even with the advent of laboratory automation and the integration of genomics and proteomics in microbiology, interpretation of results still depends on the quality of the specimens received for analysis whether one is suspecting a prokaryote or a eukaryote as the etiologic agent, both of which are featured in this document. Microbes tend to be uniquely suited to adapt to environments where antibiotics and host responses apply pressures that encourage their survival. A laboratory instrument may or may not detect those mutations, which can present a challenge to clinical interpretation. Clearly, microbes grow, multiply, and die very quickly. If any of those events occur during the preanalytical specimen management processes, the results of analysis will be compromised and interpretation could be misleading.

Physicians and other advanced practice providers need confidence that the results provided by the microbiology laboratory are accurate, significant, and clinically relevant. Anything less is below the community standard of care for laboratories. To provide that level of quality, however, the laboratory requires that all microbiology specimens be properly selected, collected, and transported to optimize analysis and interpretation. Because result interpretation in microbiology depends entirely on the quality of the specimen submitted for analysis, specimen management cannot be left to chance, and those that collect specimens for microbiologic analysis must be aware of what the physician needs for patient care as well as what the laboratory needs to provide accurate results, including ensuring that specimens arrive at the laboratory for analysis as quickly as possible after collection (Table 1).

At an elementary level, the physician needs answers to 3 very basic questions from the laboratory: Is my patient's illness caused by a microbe? If so, what is it? What is the susceptibility profile of the organism so therapy can be targeted? To meet those needs, the laboratory requires a specimen that has been appropriately selected, collected, and transported to the laboratory for analysis. Caught in the middle, between the physician and laboratory requirements, are the medical personnel who actually 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 physicians, nurses, 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 certified microbiology specialist, particularly a specialist certified as a Diplomate by the American Board of Medical Microbiology, the American Board of Pathology, or the American Board of Medical Laboratory Immunology or their equivalent certified by other organizations. 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 consultation.

Impact of Specimen Management

Microbiology specimen selection and collection are the responsibility of the medical personnel, 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 impacts hospital infection control, patient length of stay, hospital and laboratory costs, it influences antibiotic stewardship,

Table 1. Transport Issues (General Guide)[a]

Specimen Type	Specimen Required	Collection Device, Temperature, and Ideal Transport Time
Aerobic bacterial culture	Tissue, fluid, aspirate, biopsy, etc	Sterile container, RT, immediately
	Swab (second choice); flocked swabs are recommended	Swab transport device, RT, 2 h
Aerobic and anaerobic bacterial culture	Tissue, fluid, aspirate, biopsy, etc	Sterile anaerobic container, RT, immediately
	Swab (second choice); flocked swabs are effective	Anaerobic swab transport device, RT, 2 h
Fungus culture; AFB culture	Tissue, fluid, aspirate, biopsy, etc	Sterile container, RT, 2 h
	Swab (second choice) (for yeast and superficial mycobacterial infections only)	Swab transport device, RT, 2 h
Virus culture	Tissue, fluid, aspirate, biopsy, etc	Viral transport media, on ice, immediately
	Swab; flocked swabs are recommended	Virus swab transport device, RT, 2 h
Suspected agent of bioterrorism	Refer to CDC website for specimen collection and shipping: https://emergency.cdc.gov/labissues/index.asp	
Serology	5 mL serum	Clot tube, RT, 2 h
Antigen test	As described in the laboratory specimen collection manual	Closed container, RT, 2 h
NAAT	5 mL plasma	EDTA tube, RT, 2 h
	Other specimen, ie, viral transport medium	Closed container, RT, 2 h

Abbreviations: AFB, acid-fast bacilli; CDC, Centers for Disease Control and Prevention; EDTA, ethylenediaminetetraacetic acid; NAAT, nucleic acid amplification test; RT, room temperature.
[a]Contact the microbiology laboratory regarding appropriate collection and transport devices and procedures as transport media such as Cary-Blair or parasite preservative transport for stool specimens, boric acid for urines, and specialized containers for *Mycobacterium tuberculosis* are often critical for successful examination. The time from collection to transport listed will optimize results; longer times may compromise results.

and it drives laboratory efficiency. Clinicians and other medical personnel should consult the laboratory to ensure that selection, collection, transport, and storage of patient specimens they collect are managed properly.

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

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.
2. Physicians should not demand that the laboratory report "everything that grows." This can provide irrelevant information that could result in inaccurate diagnosis and inappropriate therapy.
3. "Background noise" of commensal microbiota must be avoided where possible. Many body sites have normal, commensal microbiota that can easily contaminate the inappropriately collected specimen and complicate interpretation. Therefore, specimens from sites such as lower respiratory tract (sputum), nasal sinuses, superficial wounds, fistulae, and others require care in collection.
4. The laboratory requires a specimen, not a swab of a specimen. Actual tissue, aspirates, and fluids are always specimens of choice, especially from surgery. A swab is not the specimen of choice for many specimens because swabs pick up extraneous microbes, hold extremely small volumes of the specimen (0.05 mL), and make it difficult to get bacteria or fungi away from the swab fibers and onto media, and the inoculum from the swab is often not uniform across several different agar plates. Swabs are expected from the nasopharynx and to diagnose most viral respiratory infections. Flocked swabs have become a valuable tool for specimen collection and have been shown to be more effective than Dacron, rayon, and cotton swabs in many situations. The flocked nature of the swab allows for more efficient release of contents for evaluation.
5. The laboratory must follow its procedure manual or face legal challenges. The procedures in the manuals should be supported by the literature, especially evidence-based literature. To request the laboratory to provide testing apart from the procedure manual places everyone at legal risk.
6. A specimen should be collected prior to administration of antibiotics. Once antibiotics have been started, the microbiota changes and etiologic agents are impacted, leading to potentially misleading culture results.
7. Susceptibility testing should be done only on clinically significant isolates, not on all microorganisms recovered in culture.
8. Microbiology laboratory results that are reported should be accurate, significant, and clinically relevant.
9. The laboratory should set technical policy; this is not the purview of the medical staff. Good communication and mutual respect will lead to collaborative policies.
10. Specimens must be labeled accurately and completely so that interpretation of results will be reliable. Labels such as "eye" and "wound" are not helpful to the interpretation of results without more specific site and clinical information (eg, dog bite wound right forefinger).

The microbiology laboratory policy manual should be available at all times for all medical personnel to review or consult and it would be particularly helpful to encourage the nursing staff to review the specimen collection and management portion of the manual. This can facilitate collaboration between the laboratory, with the microbiology expertise, and the specimen collection personnel, who may know very little about microbiology or what the laboratory needs to establish or confirm a diagnosis.

It is important to welcome and actively engage the microbiology laboratory as an integral part of the healthcare team and encourage the hospital or the laboratory facility to have board-certified laboratory specialists on hand or available to optimize infectious disease laboratory diagnosis.

How to Use this Document

This document is organized by body system, although many organisms are capable of causing disease in >1 body system. There may be a redundant mention of some organisms because of their propensity to infect multiple sites. One of the unique features of this document is its ability to assist clinicians who have specific suspicions regarding possible etiologic agents causing a specific type of disease. When the term "clinician" is used throughout the document, it also includes other licensed, advanced practice providers. Another unique feature is that in most chapters, there are targeted recommendations and precautions regarding selecting and collecting specimens for analysis for a disease process. It is very easy to access critical information about a specific body site just by consulting the table of contents. Within each chapter, there is a table describing the specimen needs regarding a variety of etiologic agents that one may suspect as causing the illness. The test methods in the tables are listed in priority order according to the recommendations of the authors and reviewers.

When room temperature is specified for a certain time period, such as 2 hours, it is expected that the sample should be refrigerated after that time unless specified otherwise in that section. Almost all specimens for virus detection should be transported on wet ice and frozen at −80°C if testing is delayed >48 hours, although specimens in viral transport media may be transported at room temperature when rapid (<2 hours) delivery to the laboratory is assured.

Notes

Acknowledgments. We acknowledge the contributions and leadership provided by Dr Ellen Jo Baron in the 2013 version of this document. We appreciate the contributions of the Pediatric Clinical Microbiology Consortium to the document. Participants included Jennifer Dien Bard, Christopher Doern, James Dunn, Karen Sue Kehl, Amy Leber, Alex McAdams, Joel Mortensen, Xuang Qin, Paula Revell, Rangaraj Selvarangan, and Xiotian Zheng. The panel is grateful to Thomas F. Smith, PhD and Donna J. Hata, PhD, for their contributions to the development of this guidance, and to Marilyn August for her assistance with the formatting of the tables. We especially appreciate the careful review and suggestions of members of the American Society for Microbiology (ASM) and the Infectious Diseases Society of America (IDSA).

Potential conflicts of interest. For activities outside the submitted work, J. M. M. has received royalties from ASM for his 1999 book *A Guide to Specimen Management in Clinical Microbiology*, and he serves on the Board of Directors of BioFire Defense. For activities outside the submitted work, M. P. W. has received royalties from UpToDate and payment for consultancies from Rempex, Accelerate Diagnostics, and PDL Biopharma. His institution has received payment for his consultancies with Pfizer and has received grants/pending grants from JMI Labs, BD Diagnostics, Siemens, and bioMérieux that are all outside the submitted work. For activities outside the submitted work, S. S. R. is employed by the Cleveland Clinic and her institution has received grants/grants pending from BD Diagnostics, Nanosphere, bioMérieux, Roche, and ARLG. She has received payment for lectures from the ASM. She has also received payment for travel/accommodations from the College of American Pathologists, the Clinical and Laboratory Standards Institute, and the ASM; all activities are outside of the submitted work. For activities outside the submitted work, P. H. G. has received payment from Mountside Consulting and Diagnostic Microbiology Development Program for consultancies and from SouthEastern Association for Clinical Microbiology, ASM, American Association of Clinical Chemistry, Hospital and Healthcare System Association of Pennsylvania, Eastern Pennsylvania Branch of the American Society for Microbiology, and Illinois Society for Microbiology for lecture honoraria. He has received royalties from ASM. All activities are outside the submitted work. For activities outside the submitted work, R. B. T., has received payment from IDSA for travel to meetings in support of this activity. His institution has received grants/grants pending from Nanosphere, Inc (now Luminex Corp) and Cepheid, both outside the submitted work. For activities outside the submitted work, K. C. serves on the scientific advisory boards of Quidel Biosciences, Inc, and NanoMR, Inc, and her institution has grants/grants pending from Nanosphere, Inc, Biofire, Inc, and AdvanDx. She has received payment for lectures/speakers' bureaus from the New York City Branch of ASM and royalties from McGraw-Hill; all activities are outside the submitted work. For activities outside the submitted work, S. C. K. received payment from Meridian Bioscience for the development of educational presentations. For activities outside the submitted work, B. R. D. is employed by Beaumont Health System and has received payment for lectures/workshops and travel/accommodations from the ASM. For activities outside the submitted work, J. D. S. is employed by Dartmouth Hitchcock Medical Center and Geisel School of Medicine. For activities outside the submitted work, K. C. C. serves on the Board of ThermoFisher; her institution has received grants/grants pending from BD Diagnostics, Biofire, and Hologic; and she has received payment for lectures/speakers bureaus for BD Diagnostics and Hologic. For activities outside the submitted work, J. W. S. has received payment from IDSA for travel to meetings in support of this activity. He has also received support for lectures/speakers bureaus outside the submitted work from Bellarmine University, Becton Dickinson, and Great Basin Corp. He has also received payment for his consultancies to Jewish Hospital (Louisville, Kentucky) and Floyd Memorial Hospital (New Albany, Indiana) and royalties from Taylor Francis, and his institution has received grants/pending grants from the National Institutes of Health (NIH), all outside the submitted work. For activities outside the submitted work, R. P. is employed by Mayo Clinic and her institution has grants/pending grants from the following: Pfizer, Pradama, Pocared, Astellas, Tornier, and the NIH. She and her institution have patents and receive royalties from *Bordetella pertussis/parapertussis* polymerase chain reaction and she has received payments for travel/accommodations from ASM, IDSA, International Symposium on Antimicrobial Agents and Resistance (ISAAR), and Asia-Pacific Congress of Clinical Microbiology and Infection (APCCMI) and for her role as Editor of *The Journal of Clinical Microbiology*. All activities are outside the submitted work. For activities outside the submitted work, B. S. P.'s institution has received payment from the College of American Pathologists for lectures/speakers' bureaus and travel/accommodations. For activities outside the submitted work, S. R. T. is a consultant on the diagnosis of tick-borne infections for Immugen, Inc, Immunetics, Inc, Fuller Laboratories, and Meridian Laboratories. All other authors report no potential conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.