The optimal care of septic patients depends on the successful recovery of clinically relevant microorganisms from blood cultures and the timely reporting of organism identification and antimicrobial susceptibility testing (AST) results. Many preanalytic factors play a critical role in culturing microorganisms, and advancements in blood culture instrument technology have reduced the time to positive results. Additionally, rapid organism identification and AST results directly from positive blood culture broth via new methods help to further shorten the time from empiric to targeted treatment. This article summarizes the current state of blood culture methods, including preanalytic, analytical, and postanalytic factors that are available to clinical microbiology laboratories.
Antimicrobial susceptibility testing (AST) is now, more than ever, a critical role of the microbiology laboratory. Several factors limit its application for patient care and antimicrobial resistance epidemiology, including time to results, requirements for pure cultures, and high starting concentration of bacteria. This review discusses the global status of AST and new phenotypic and genotypic methods in late-stage development or that are new to market.

Recent improvements in next-generation sequencing technologies have enabled clinical laboratories to increasingly pursue pathogen genomics for infectious disease diagnosis. Clinical laboratories can also benefit from whole-genome sequence characterization of cultured isolates, helping to resolve infection prevention questions pertaining to pathogen outbreaks and surveillance. Metagenomic sequencing from primary specimens can also provide laboratories with an unbiased universal test for situations where traditional methods fail to identify infectious etiologies despite, high clinical suspicion. Here, the most useful applications of whole-genome sequence and metagenomic sequencing are summarized, as are the main advantages, limitations, and considerations for building an in-house clinical genomics program.

Endemic species of coronavirus (HCoV-OC43, HCoV-229E, HCoV-NL63, and HCoV-HKU1) are frequent causes of upper respiratory tract infections. Three highly pathogenic coronaviruses have been associated with outbreaks and epidemics and have challenged clinical microbiology laboratories to quickly develop assays for diagnosis. Their initial characterization was achieved by molecular methods. With the great advance in metagenomic whole-genome sequencing directly from clinical specimens, diagnosis of novel coronaviruses could be quickly implemented into the workflow of managing cases of pneumonia of unknown cause, which will markedly affect the time of the initial characterization and accelerate the initiation of outbreak control measures.

Biosafety risks are prevalent in all areas of the clinical laboratories. Clinical laboratory workers have become accustomed to accepting these risks. When an emerging pathogen appears, the concerns become elevated. Since the appearance of Ebola virus in the United States in 2014, biosafety practices have made progress. A recent Association of Public Health
Laboratories survey shows that clinical laboratories are unprepared for current and emerging biosafety challenges. This article focuses on the biosafety program that clinical laboratory leaders should build to meet the needs of clinical laboratories; biosafety challenges of automated laboratory systems, facilities, personnel, and practices; and the relationship with occupational health.

Point-of-Care Testing in Microbiology

Linoj Samuel

Point-of-care (POC) or near patient testing for infectious diseases is a rapidly expanding space that is part of an ongoing effort to bring care closer to the patient. Traditional POC tests were known for their limited utility, but advances in technology have seen significant improvements in performance of these assays. The increasing promise of these tests is also coupled with their increasing complexity, which requires the oversight of qualified laboratory-trained personnel.

Update in Pediatric Diagnostic Microbiology

James J. Dunn and Paula A. Revell

Infants and young children are uniquely susceptible to primary viral and bacterial infections, predisposing them to responses of greater frequency and severity than in adults. Etiologies and manifestations of infections in pediatric patients are often different than those in adults. It can be challenging for clinical laboratories to implement appropriate microbiologic methods for rapid and accurate diagnoses in this population. Laboratorians should be cognizant of the distinctive features of children to provide comprehensive pediatric clinical microbiology services. This article discusses laboratory aspects of several clinically significant pediatric pathogens that cause severe harm to patients and impact public health responses.

Antimicrobial Stewardship: What the Clinical Laboratory Needs to Know

Diana Alame, Bryan Hess, and Claudine El-Beyrouty

Misuse of antibiotics, including unnecessary use or inappropriate selection, may result in side effects and poor outcome in individual patients, as well as contribute to the spread of antimicrobial resistance. Antimicrobial stewardship programs exist to reduce such misuse of antibiotics and ill effect in order to promote patient outcome. The importance of diagnostics, antibiogram data, possible interventions, and impact are reviewed. It is essential for clinical microbiologists and other health care members to understand the field and scope of antimicrobial stewardship, actively participate in, and understand the value they bring to supporting their institution’s efforts.

Fellowship Training for the Future Clinical Microbiology Laboratory Director

Bobbi S. Pritt, Carrie A. Bowler, and Elitza S. Theel

Formal medical and public health microbiology (MPHM) fellowship programs play a key role in preparing future clinical microbiology laboratory
Novel Assays/Applications for Patients Suspected of Mycobacterial Diseases 535

Niaz Banaei, Kimberlee A. Musser, Max Salfinger, Akos Somoskovi, and Adrian M. Zelazny

Although tuberculosis is slowly decreasing, nontuberculous mycobacterial lung disease is significantly increasing. We describe new methods and applications for faster turnaround times in the diagnosis of tuberculosis and nontuberculous mycobacterial lung disease and have included the latest mycobacterial taxonomy. Although the focus is mainly on molecular assays, we also discuss improvements of acid-fast bacilli smear microscopy and stress the need for performing minimal inhibitory concentration determinations especially for tuberculosis. Additionally, important considerations for negative nucleic acid amplification assay results used for releasing tuberculosis suspects from airborne infection isolation rooms saving precious resources for the health care system, are also included.

Food Safety Genomics and Connections to One Health and the Clinical Microbiology Laboratory 553

Marc W. Allard, Jie Zheng, Guojie Cao, Ruth Timme, Eric Stevens, and Eric W. Brown

This article describes the potential for one health surveillance of foodborne pathogens and disease using the revolutionary methodologies of whole genome sequencing. Whole genome sequencing of viral and bacterial pathogens is a natural fit to a one health perspective because these pathogens reside and are shared by humans, animals, and the environment and their genomes are compared easily regardless of where or from what host the pathogen was isolated. A genome provides a huge amount of data that can be analyzed for numerous applications. Sharing data coordinates surveillance efforts across the various disciplines.

Update in Infectious Disease Diagnosis in Anatomic Pathology 565

Alvaro C. Laga

Anatomic pathology is an important resource for detection and exclusion of infectious diseases in tissue specimens. Detection of a microorganism (i.e. bacteria, fungi, parasite) in tissue sections is frequently the beginning of a work-up and occasionally sufficient for definitive microbiologic identification. Close correlation with cultures and ancillary testing in the microbiology laboratory is of paramount importance in arriving at a diagnosis and identify with certitude causative pathogen(s). This review will discuss the adequacy and limitations of histopathology in the diagnosis of infectious diseases, describe potential pitfalls, and discuss the appropriate use of molecular diagnostics in formalin-fixed, paraffin embedded tissues.
Blood Banking and Transfusion Medicine Challenges During the COVID-19 Pandemic

Andy Ngo, Debra Masel, Christine Cahill, Neil Blumberg, and Majed A. Refaai

SARS-CoV-2 (also known as COVID-19) has been an unprecedented challenge in many parts of the medical field with blood banking being no exception. COVID-19 has had a distinctly negative effect on our blood collection nationwide forcing blood banks, blood centers, and the US government to adopt new policies to adapt to a decreased blood supply as well as to protect our donors from COVID-19. These policies can be seen distinctly in patient blood management and blood bank operations. We are also faced with developing policies and procedures for a nontraditional therapy, convalescent plasma; its efficacy and safety is still not completely elucidated as of yet.

Measuring the Serologic Response to Severe Acute Respiratory Syndrome Coronavirus 2: Methods and Meaning

Nicole D. Pecora and Martin S. Zand

The entire spectrum of diagnostic testing, from reagent supply to test performance, has been a major focus during the coronavirus disease 2019 (COVID-19) pandemic. The hope for serologic testing is that it will provide both epidemiologic information about seroprevalence as well as individual information about previous infection. This information is particularly helpful for high-risk individuals who may be outside of the viral shedding window, such as children with suspected multisystem inflammatory syndrome. It is not yet understood whether serologic testing can be interpreted in terms of protective immunity. These concerns must be addressed using highly sensitive and specific tests.