Preface

Automation and Emerging Technology in Clinical Microbiology

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Editor

This is an exciting time in the field of Clinical Microbiology and the "state of the art" is evolving at a rapid pace. This can be attributed to new technology, rapid development and evolution of antimicrobial resistance, and the discovery of new pathogens. In addition, advances in modern medicine, such as solid organ and stem cell transplantation, have resulted in an explosion of infections with agents that historically have been considered to be of low virulence. This issue of *Clinics in Laboratory Medicine* highlights some of the recent advances in diagnostic microbiology, including high-throughput sequencing methods, matrix-assisted laser desorption ionization-time-of-flight mass spectrometry (MALDI-TOF MS) for organism identification, molecular diagnostics, and the use of biomarkers in the diagnosis of infectious diseases.

This monograph includes articles devoted to contemporary approaches to a number of different types of infection. For example, in the diagnostic virology laboratory, viral culture is becoming almost obsolete; in the article by Dr Buller, advances in molecular diagnostics for respiratory viruses and some of the advantages and limitations of these methods are discussed. In Drs Vassoo and Pritt's article, advances in diagnostic parasitology beyond the traditional "ova and parasite" exam are explored. Next, Drs Dunbar, Zhang, and Tang present novel and advanced techniques for diagnosis of gastrointestinal pathogens.

An area of great interest in medicine is the development and validation of diagnostic biomarkers—noninvasive assays that can predict the presence of a particular disease state accurately. Biomarkers can be especially helpful for diagnosing infections due to slowly growing organisms and high-acuity clinical syndromes or confirming a disease state when an organism is isolated that can both colonize and cause infection. In clinical microbiology, there are a number of circumstances where biomarkers would have diagnostic utility. These have been investigated in detail for the diagnosis of sepsis (reviewed in the first article by Drs Riedel and Carroll) and invasive fungal infections (addressed in the article by Dr Schuetz). While these biomarkers are enticing diagnostic

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tools, to date, most of them fall short for use in the definitive diagnosis of an infectious disease.

Traditionally, the clinical microbiology laboratory has been considered a somewhat "low-tech" area, void of the automation that is becoming commonplace in Chemistry and Hematology laboratories. However, this is rapidly changing with the advancement of microbiology total laboratory automation systems. Widespread use of automation in microbiology will be an enormous change; a description of this technology as well as considerations for cost justification and implementation are detailed in the article by Drs Novak and Marlowe.

Another "chemistry" concept that is poised to supplant traditional phenotypic microbial identification methodology is MALDI-TOF MS. MALDI-TOF MS is a rapid, accurate, and inexpensive identification method that to date has been used primarily for bacterial identification; MALDI-TOF MS for organism identification is reviewed by Drs Dingle and Butler-Wu, and advanced uses of MALDI-TOF MS in microbiology are described by Drs DeMarco and Ford in their article.

So-called "next generation sequencing" (NGS) techniques are producing sequencing data at a rapid pace while the cost of this analysis has been steadily decreasing. However, the role that NGS will play in diagnostic microbiology is still unclear. In the article by Drs Kirkup, Mahlen, and Kallstrom, some of the challenges of integrating this methodology into clinical practice, including bioinformatics and regulatory issues, are described. I think it will be very interesting to see how this technology evolves and is used in the microbiology lab in the future.

All of this exciting new technology is coupled with challenges for the Microbiology laboratory. For example, with the shift toward molecular diagnostics, laboratories will have to be aware of the impact that the constant evolution of organisms will have on the analytical performance characteristics of these assays. There will be an ongoing need to train the workforce in new techniques, the challenge of choosing the technology that is the most appropriate for the patient population that is served by the laboratory, as well as choosing methods that fit the size, clinical needs, and budget of the hospital. In addition, laboratories will have to consider the impact of "active" compared to "passive" reporting of results, and effective communication with the end-user on the utility and performance characteristics of new methods. Some of these challenges are detailed in Dr Doern's article on integration of new technology into clinical practices. In addition to the direct challenges to the diagnostic laboratory, public health considerations are emerging as a result of the shift away from culture-based techniques—strain typing and outbreak investigation may prove difficult in the absence of isolates of microorganisms. A review of the advances in strain typing techniques is found in the article by Dr McCannell.

I have very much enjoyed working on this monograph, and I would like to thank the contributors for all of their efforts in preparing interesting submissions. I hope you will enjoy reading it.

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