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OPINION PIECE

Communication Between Clinicians and the Hospital-Based Microbiology Laboratory: Strategies for 2018 and Beyond

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Introduction

Treatment of infections in the hospital poses some unique issues in comparison with treatment of other equally sick inpatients without infections. The diversity of potential pathogens for a given infected site (e.g., pneumonia) and the changing spectrum of antimicrobial susceptibilities are variables generally not encountered with other diseases. Infectious diseases may also have distinctly geographical and/or travel-related aspects as shown by inhaled fungal infections such as coccidioidosmycosis from the southwestern United States or Ebola virus disease in West Africa. Communicable diseases due to specific infectious agents (e.g., influenza virus, methicillin-resistant *Staphylococcus aureus* (MRSA), extended spectrum beta-lactamase-producing gram-negative rod bacteria (ESBL-GNR's), and many other examples) also pose challenges in timely diagnosis, infection control, and patient-family-colleague education. In the case of Ebola virus, the presence of only a few infected individuals in the United States in 2014 caused nationwide concern among healthcare workers and the public. Clinicians, infection control staff and the hospital-based microbiology laboratory all received many inquiries about potential routes of transmission, diagnostic testing, and personal protective strategies.

Antimicrobial therapies, while often remarkably effective, also carry the potential for specific adverse events, some infectious. These include *Clostridium difficile* enterocolitis or fungal overgrowth when broad spectrum agents are used. The high cost of some agents and serious potential organ toxicities are additional limiting factors, especially in the absence of a firm diagnosis. Finally, inappropriate utilization of antimicrobial agents—including unnecessary use, selection of an overly broad spectrum of activity, too long a course, and too high or too low a dose—can drive increasing microbial resistance to these drugs [1].

Having practiced infectious diseases in the hospital setting for over 30 years, I have seen the changing role of the clinical microbiology laboratory in patient management. More recently, as director of an antimicrobial stewardship program [2] in a community teaching hospital, I have also seen firsthand some of the pressures and resource limitations affecting our laboratory.

Everyone, it seems, is being asked to do more with less, and to have it done by "yesterday." Fortunately, my health system's clinical microbiology laboratory has had very experienced leadership and many technicians have over a decade of experience in the field. This helps the hospital and entire health system run more smoothly in the face of some of the challenges previously detailed. However, the need to function quickly and efficiently will continue to be a priority and warrant careful thought and planning in many areas [3, 4, 5].

Timeliness of testing and reporting

Hospitals are now becoming 24/7 operations as there is steady pressure to reduce duration of hospitalization. I have seen patients discharged after very short stays, though this is sometimes at patient/family insistence rather than as a clinical plan. However, every decision to discharge represents a balance between having enough clinical information for diagnosis and selecting effective therapy (e.g., an antibiotic) versus how sick a patient is and the prognosis for improvement. Much of this pressure is financial and clinicians have in many cases been able to both shorten hospitalization and maintain quality of care. Examples are higher dose shorter duration oral fluoroquinolone regimens and overall shorter durations of intravenous therapy for pneumonia than used in the past. These approaches have safely reduced the percentage of pneumonia patients requiring admission and facilitated earlier discharge of others. Unfortunately, this trend has led to microbiology laboratory test results sometimes becoming the rate-limiting step in the discharge process. For example, consultants may be asked to recommend oral therapy for discharge BEFORE pathogens have been identified or susceptibilities determined. While patients who have defervesced and whose signs and symptoms of infection are resolving would seem to be good candidates for discharge on oral antimicrobials, there are enough cases of bacteria resistant to common oral agents of choice to make this risky clinically and medicolegally.

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The best approach from the microbiology bench would therefore be to emphasize rapidity of turnaround time on gram stains, cultures, and serologies WITHIN REASON. Rapid diagnostic testing is one answer, as in the case of influenza A/B, respiratory syncytial virus, and other pathogens for which a timely diagnosis may open up outpatient management options and allow very specific antimicrobial treatment or simply supportive care. Streamlining specimen handling may be another approach. My five-hospital health system utilizes a central microbiology lab so that specimen transit time has to be considered for most of the hospitals. Local specialized "stat lab" testing is one response, depending on cost and efficiency studies. On the other hand, investing in very expensive equipment to speed identification of an organism or generate susceptibilities a few hours earlier may not be the best investment. Review of the flow of clinical specimens from collection to transport to processing to reporting of results indicated getting final results at 3 am rather than 6 am probably doesn't improve efficiency very much. Whatever the methods for getting results quickly, the clinical benefit is considerably enhanced by interpreting them correctly and communicating results effectively [6].

Insuring expertise in interpreting results

Two of the trends cited previously also impact the usefulness of data coming from the microbiology laboratory. One is the need for prompt reporting of results to clinical services to facilitate patient care. The other is the move to off-site laboratories as groups of hospitals consolidate services to contain costs. The days when clinicians dropped by the microbiology lab to chat about a case or teams from clinical services routinely rounded through the laboratory to exchange information are now less common. Despite this, as laboratory testing becomes more specialized and faster, the need to accurately interpret test results is ever more important.

For example, a new generation of rapid diagnostic tests using polymerase-chain assays or gene probes can yield results on clinical microbiology specimens within hours [6]. However, the results may be preliminary and/or incomplete as when a specimen is reported as an ESBL-producer without specific susceptibilities or as one of a group of similar pathogens without definitive identification. Given the amount of medical knowledge that health care providers must keep track of these days, it is not surprising that few practitioners can stay current on all the advantages and limitations of new microbiologic diagnostic studies. The microbiology laboratory staff is therefore increasingly responsible for getting the latest information to the right personnel to act on it [7].

In many hospital systems, the availability of rapid diagnostic testing has triggered a debate about when results should be communicated and who should be responsible for the subsequent decision-making. This includes automated results becoming available in the middle of the night. In many cases these can just be reported via the electronic health record for interpretation at rounds in the morning. However, for some potentially life-threatening or communicable infectious diseases (e.g., bacteremias, positive CSF cultures, some sputum tests, etc.) it has been argued that the information should be acted on as soon as possible. The chain of reporting of "stat" results may involve nursing, pharmacy, and emergency department/ infectious diseases/pulmonary/other consultants, as well as the responsible primary service and microbiology laboratory staff. Decisions may involve laboratory personnel explaining results versus waiting for a supervisor in the morning. This is an issue of laboratory training and policy [3]. When critical information is communicated to hospital clinical staff for decision-making such as selection or modification of an antibiotic regimen, who must be involved? In most cases, the decision is easily made by the primary service. However, late at night, especially when coverage physicians not familiar with the case are involved or the decision rests on incomplete pathogen identification or antibiotic susceptibility results, who does the work? Current approaches include programs to educate healthcare providers about new diagnostic tests, antibiotic options, and when to contact a specialist not currently involved in the case. Unresolved issues are how to spread out the on-call burden and whether there should be institutional compensation for this additional call responsibility.

Communicating effectively

Further, great patient care relies on communication -- from the patient and family to the diagnosing clinicians to the treating staff and back again. Much information is now being communicated online, e.g., the electronic health record (EHR) and local viewing of radiographic data on personal computers. Availability of data almost as quickly as it is generated is certainly a great improvement over the old paper report slips or once daily printouts of results [8]. However, someone must look up the data in the EHR and for certain information such as positive blood cultures or sputum acid-fast bacilli smears, rapid and accurate reporting to someone in a position to act on the results is critical. Thus, having experienced laboratory staff that understand this and get the information to the appropriate health care provider(s) can have a positive effect [8].

Even routine reports can provide guidance that improves timeliness of patient care. A gram stain report on sputum can provide much information to distinguish oral contamination from true infection. Also, describing growth in "chains" versus "clusters" for gram-positive cocci, especially in blood or other usually sterile fluids, can get appropriate clinical management going earlier. It goes without saying that this data has to be generated by technicians confident in their readings and that changes should be flagged, timed and dated. There have been occasional inexperienced laboratory staff that have changed readings as from gram-positive to gram-negative or from culture-positive to -negative without leaving documentation of the change. This can be very harmful to patient care and clinician confidence in the laboratory. This leads to a related topic. Clinicians need to have an understanding what a clinical microbiology technician does (e.g., how many minutes' search does it take to declare a sputum acid-fast bacterial smear negative) to best use their services. A microbiology lab staffer needs to have an idea why a clinician wants to know ASAP if the staphylococcus is coagulase-negative or –positive or whether the gram-negative rod is a non-lactose fermenter and how it affects clinical decision-making. Participation of laboratory personnel and clinicians in rounds, conferences, or other activities **to** discuss patient management should be encouraged, perhaps in more formal settings if casual interactions are no longer feasible due to distance, etc.

Emphasize education

As a result of the previous considerations, everyone in health care is (or should be) an educator. In the case of the clinical microbiology laboratory, there is a very important role in educating other hospital staff about microbiology findings [9]. In some cases, this is one-on-one over the telephone about a specific patient's data or in response to a general question about how to interpret an antibiogram. When communicating culture results, explaining current institutional pathogen resistance profiles, or fielding a request for specialized testing, the challenge is to communicate the answer clearly AND GAUGE HOW WELL IT IS UNDERSTOOD [7]. Read back of critical results is one way to insure the information was correctly communicated and errors avoided. While laboratory staff in academic teaching hospitals are probably used to hearing from medical students not quite sure what they are asking about, this is not an infrequent occurrence at any hospital. The classic mistake seen by infectious diseases physicians is to be called about "the best treatment" for an enterococcal infection. A little research, which fortunately no longer necessitates a trip to the patient's chart or a call to the microbiology lab, reveals that the organism is an *Enterobacter* species. The proliferation of health care extenders (physicians' assistants, nurse practitioners, etc.) mean that staff in the microbiology laboratory should be comfortable discussing the significance of a culture with polymicrobial growth, multidrug-resistant pathogens (such as ESBL-GNR's), and coagulase-negative staphylococci versus *Staphylococcus aureus*, with individuals of differing levels of clinical expertise and experience. Knowing when to refer questions to a laboratory supervisor or specialist service, is also key. This is often the case in which as caller is asking about the significance of microbiology results vis-à-vis isolation for specific communicable diseases, management of patients with unusual pathogens, or serologic testing for exotic diseases. The further these questions fall outside of the microbiology lab routine, the more an accurate referral (ideally with specific contact information) will save time and angst for all concerned.

Think multidisciplinary; embrace technology

Just as hospitals are being forced to run continuously, the "silo mentality" in which different hospital groups keep to themselves is being set aside. Anyone treating patients with infections in the hospital now has to be ready to interact with the primary clinicians (both outpatient and hospitalist), specialist consultants, infection control practitioners, pharmacy, formulary committee, nursing leadership, education committee, quality assurance committee, and information technology service at a minimum. Thinking this through ahead of time can avoid confusion and more work later on. For example, information on antibiotic susceptibilities, especially current trends, could be of interest to not just clinicians, but also infection control programs, the pharmacy, and quality assurance programs.

Computer software may offer some solutions, such as in flagging specific communicable diseases for attention, suppressing certain antimicrobial susceptibility results with the guidance of the formulary committee, and collecting pathogen frequency and resistance trends. This may allow valuable epidemiologic studies to guide future decision-making. Point of service education is also becoming feasible, guiding practitioners on antimicrobial costs, reasons for restrictions on specific agents, and reporting requirements as they enter orders via the computer. Publishing antibiograms regularly is also useful, as much for infection control and formulary committee purposes, as for guiding individual practitioners in antimicrobial selection. While this can be a time-consuming task, software can be a major help in the endeavor.

It has been argued that only death and taxes are certain, but I suspect that increasingly rapid changes in the way everyone manages data will be a common theme now and in the future. Clinical microbiology information is key to treating many patients in and out of the hospital, and getting the data to the right groups in a timely fashion in as useful a form as possible will be more and more critical. Current efforts support faster and more specific diagnosis of infections, when not to use antibiotics, earlier use of appropriate antimicrobials, and narrowing and stopping therapy as soon as possible. If done prudently, hopefully this will help control and reverse the trend toward more resistant pathogens which have fewer options for treatment [10].

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