Managing Microbiology Specimen Workups: Top 10 list of Do’s and Don’ts

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Abstract
We live in an age when molecular biology is being promoted as the future of microbiology, yet all of us know that neither the automation of the 20th century nor PCR in the 21st century will be able to substitute for the observations and decision making that is done by the bench microbiologist in the workup of cultures. This article is intended to help with that decision making and the subsequent reporting of results to best guide the physician in the evaluation of a patient’s potential infections. The guidelines that I propose represent the most significant in the plethora of experiences I have had as a clinical microbiologist over the last several decades of looking at cultures and discussing their results with physicians and other caregivers.

Introduction
In deciding what is important, I am reminded of what I consider to be the mission of the microbiologist: to contribute to patient care by providing accurate culture reporting that reflects significance and relevance in a timely manner. Careful scientific studies have shown that if results are not timely, costs are increased and data are unavailable for timely intervention in the patient’s disease (1,2). If results are not accurate and relevant, there is a potential for incorrect intervention, and such reports may even contribute to the spread of disease and antimicrobial resistance. It is NOT our goal to finish looking at all the cultures by the end of the day in any order we want to do them and always work up everything we see without regard to significance. Let us start with what to look for and what not to look for in the culture.

Guidelines for Culture Workup
1. Limit workup of mixed microbiota in cultures.
Bartlett has been quoted as saying that the number of organisms in a culture is inversely proportional to patient care value. When the mixed culture includes only the species commonly found in that anatomic site, it is most helpful to report this as mixed microbiota. For example, if a mixture of diphtheroids, coagulase-negative staphylococci, Acinetobacter spp., or Candida (not C. albicans) is found in a non-invasively collected skin wound culture, it should be reported as “Normal skin microbiota,” which means that a culture of intact skin would be likely to contain these species without infection. If a respiratory specimen contains viridans streptococci, Micrococcus, and Neisseria spp., it is easily considered “Normal respiratory microbiota,” which means that a culture of intact skin would be likely to contain these species without infection. If a respiratory specimen contains viridans streptococci, Micrococcus, and Neisseria spp., it is easily considered “Normal respiratory microbiota.” More often than not, in the hospital setting, patients are on broad-spectrum antimicrobial agents and the specimen lacks the usual viridans streptococci, which are replaced with coagulase-negative staphylococci and enterococci. These species are unlikely to be causing disease, but to report them individually leads to confusion for the physician. A report of “Mixed gram-positive bacteria present, specimen lacks usual respiratory microbiota” conveys the message that the antimicrobials have altered the patient’s natural oral defenses.

Escherichia coli, Bacteroides fragilis, Proteus mirabilis, and enterococcus recovered from an abdominal specimen reflect bowel contents. It is helpful to the physician to report this finding as “Mixed aerobic and anaerobic gastrointestinal microbiota,” to indicate that the patient needs to be treated with broad-spectrum antimicrobial coverage for usual bowel microorganisms. Just reporting the organisms found and giving an antibiogram for E. coli, P. mirabilis, and enterococcus will not provide sufficient information to treat this infection accurately, because other species were probably also present in the specimen that were not detected in culture.
It has been reported that Staphylococcus aureus and Pseudomonas aeruginosa are the most important aerobic bacteria in invasive wounds; these species should always be worked up when isolated from such specimens (3). It is less clear, however, whether mixed enteric gram-negative rods with no predominating species are important in wounds, sputum, and urine cultures. A good option is to report these as “Mixed enteric gram-negative rods; contact laboratory if detailed workup is clinically indicated.” While it is generally thought that a midstream urine specimen is contaminated if there are mixed species, this conclusion is much less clear for an indwelling catheter urine. There is good evidence to support the practice of checking the urinalysis result for evidence of pyuria as a guide to doing detailed identifications of mixed gram-negative rods in urine from indwelling catheters. Without pyuria, symptomatic infection is unlikely (4). Before performing a full workup of urines collected from indwelling catheters, another option is to contact the caregiver to verify that the urine was properly collected and transported.

A word of caution: some species of gram-negative rods can exhibit multiple colony morphologies and resemble a mixed culture, but when they are identified, they are revealed as one species with one unique antibiogram. In addition, it is important to hold the plates in case later workup is indicated, especially if the blood cultures become positive with a gram-negative rod.

Some suggestions to get physicians to accept this practice of limited workup of enterics and skin microbiota include the following: (i) ask infectious disease specialists for help; (ii) write a memo to the hospital staff stating that this is the standard of practice, using references to support your plan; (iii) present your policy to the medical review board for their approval.

2. Do not work up an organism present in low numbers just because it is hemolytic.

It is easy to understand how this policy got started, because many significant pathogens are hemolytic, including Bacillus cereus, Clostridium perfringens, Corynebacterium ulcerans, Listeria monocytogenes, P. aeruginosa, Streptococcus pyogenes, S. aureus, and Vibrio spp., to name a few. The problem is that we begin to look for these in mixed cultures. S. aureus in sputum can be part of the normal microbiota and is implicated in pneumonia only if it is found in large numbers associated with a Gram-stained smear indicating inflammation with gram-positive cocci. Low numbers from hospitalized patients can be reported if they are methicillin resistant (MRSA), but otherwise, low numbers of S. aureus bacteria should not be reported (5). In addition, Haemophilus haemolyticus is part of the normal respiratory microbiota and has not been implicated in disease (6). Although hemolytic, it should be ignored in respiratory cultures. Never lose site of the fact that if the laboratory receives a sputum specimen, it should be presumed that it was sent to diagnose the cause of pneumonia. It was not sent to identify all bacteria present in the sample.

Another example of an insignificant hemolytic bacterium is P. aeruginosa present in fecal specimens. P. aeruginosa is not known to be responsible for gastroenteritis, which is presumed to be the disease being considered when a fecal specimen is sent to the laboratory. If P. aeruginosa is found in pure culture in fecal specimens, it is better to indicate on the report what is NOT there, as opposed to what is there. For example, “No normal enteric microbiota found in culture.”

We like to think that P. aeruginosa is always important as a pathogen in a specimen, but that is not the case. An example from my experience may illustrate this point. A sputum sample was submitted from a young postpartum female with a severe cough. White blood cells (WBC) were present, and the laboratory reported “Numerous Pseudomonas aeruginosa.” Since she had been in the hospital for only 2 days, the infectious disease service did not think this agent was the cause of her disease and ordered Bordetella pertussis PCR, which was positive. How fortunate for her newborn that the correct diagnosis was made. It is true that the laboratory had no choice but to report what it found, but this case illustrates that we must always be aware that when we culture a respiratory specimen, we do not routinely inoculate the media needed to grow many of the common agents of community-acquired pneumonia, namely, Mycoplasma pneumoniae, Legionella pneumophila, and Chlamydo-

3. Do not treat all fungal requests the same! Let the source be your guide.

Anatomic site-directed fungal cultures can save considerable laboratory resources. For many anatomic sites, a fungal request is really a request for a yeast culture. Unlike a culture that includes detection of moulds, yeast detection requires a few day’s incubation and is best if only one medium that enhances growth of yeast and inhibits bacteria is used. CHROMagar (BD Diagnostic Systems, Sparks, MD) is advantageous for these purposes, since it also provides definitive identification of Candida albicans and other Candida species (7). Vaginal and urine culture requests should be changed to a yeast
culture when negative. Reports should indicate “no yeast isolated.” When positive, cultures should generally be worked up only for the yeast known to cause infections at these anatomic sites, usually *C. albicans* and *Candida glabrata*. Fecal specimens sent for both yeast and fungal culture should be rejected, since they are of little value in diagnosis of fungal disease.

Fungal culture of blood is another example of a culture that generally is being sent for yeast detection. While it is true that *Histoplasma capsulatum* is a mold that is found in the blood, the laboratory should be alerted to the possible presence of this organism, so that special techniques can be used for its isolation. Most fungal blood culture media bottles detect this fungus poorly (8). Studies of commercial blood culture systems (9) indicate that some aerobic blood culture bottles detect most yeast species consistently, while others are limited and may not detect all species, especially *C. glabrata* (9).

A special fungal broth bottle is required by these manufacturers for the routine detection of all yeast. It is best to check the literature to decide what is the best culture medium to use routinely, based on the needs of your institution.

Cerebrospinal fluid (CSF) is another specimen type in which specific fungi are isolated. Generally, routine culture of CSF for fungi with a 30-day incubation has a poor yield (10), even though it is commonly ordered when meningitis is suspected. The most common pathogenic fungi that infect the central nervous system are *Cryptococcus neoformans* and *Coccidioides immitis*. Both of these organisms prefer chocolate agar for growth, rather than specific fungal media, especially media with inhibitory growth factors. Interestingly, chocolate agar is the same medium that will grow the bacterial pathogens in CSF, namely, *Streptococcus pneumoniae*, *Neisseria meningitidis*, and *Haemophilus influenzae*. Thus, a laboratory can inoculate one plate and, by incubating it for 1 week, grow both the significant fungal pathogens and the bacterial pathogens, whether a fungal culture was ordered or not.

Most fungal CSF cultures fail to grow the pathogen because of low inoculum. To increase the likelihood of fungal detection, placing 1 ml of CSF into Sabouraud dextrose broth will triple the likelihood of detection of the fungal pathogens. In my experience, this broth has grown *C. neoformans*, *C. immitis*, and *H. capsulatum* when there was no growth on several different plate media. The broth is easy to observe for the pellet or puffball of fungal growth, especially because little else will grow in it. I recommend room temperature incubation of the broths for 30 days, with observations at least weekly. Negative reports are more informative if they include a notation that cryptococcal antigen testing or *Coccidioides* serology are more sensitive in detection of disease. An example of such a report is “No fungus isolated, suggest cryptococcal or *Coccidioides* serology for better diagnostic yield.” Although the broths should be held for 30 days, the final negative report should be sent at 1 week to convey important information to the physician in a timely manner. In the rare case of a positive result after completion of the culture, an addendum can be added to the report. In summary, always hold the chocolate agar plates for 1 week for CSF cultures. If a fungal culture is ordered, inoculate a Sabouraud dextrose broth and incubate for 30 days as the only additional medium needed to isolate fungal pathogens.

4. Do not report yeast identifications in lower respiratory aspirate specimens.

Yeasts are normal inhabitants of the upper respiratory tract and rarely, if ever, cause pneumonia (11,12). The single exception might be in a lung transplant patient, where a lung biopsy is the appropriate specimen. Another exception might be *C. neoformans*, but this species is easily ruled out by its mucoid colony morphology and the presence of capsules. Barenfanger et al. (13) have reported that the savings associated with the discontinuation of the practice of reporting yeast by species name has decreased length of stay, decreased use of antifungal therapies, and decreased total cost of the illness. See Table 1 for sample guidelines for reporting yeast in respiratory cultures.

5. Look only for organisms that are considered pathogenic for that body site.

The presumption is that if you report it, you must think it is significant. Many caregivers will think that if you thought it was important enough to report, they need to treat it. They do not realize that you are not aware of how the specimen was collected or what symptoms the patient has.

Examples of clinically irrelevant culture reporting include the following: (i) *S. pneumoniae*-in a throat culture does not indicate pneumonia with that organism (14), (ii) *Gardnerella* in low or moderate numbers in vaginal or cervical cultures is part of the normal microbiota of the female genital tract. Vaginitis results from increased numbers accompanied by a decrease in the normal vaginal lactobacilli, (iii) Enteric rods in vaginal cultures are not a cause of vaginitis or other disease, except in prepubescent girls, where *Shigella* spp. have been found. Such findings can be reported as “enteric rods present with the absence of normal vaginal microbiota,” (iv) Coagulase-negative staphylococci in low numbers in wound cultures, in surgical specimens, or in single blood cultures generally represent contamination of the specimen with skin-colonizing bacteria. Unfortunately, if you report the organism, the physician will often feel compelled to treat the patient, just because there is documentation in the report that it “might” be significant. Whether we like to think it is true or not, laboratory Table 1. Guidelines for reporting yeast, other than *Cryptococcus neoformans*, in respiratory cultures

<table>
<thead>
<tr>
<th>Observation</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>For bacterial culture with few yeast and no oral contamination</td>
<td>“Overgrown with yeast, culture lacks usual respiratory microbiota”</td>
</tr>
<tr>
<td>For fungal culture with few yeast</td>
<td>No pathogenic mould isolated</td>
</tr>
<tr>
<td>For fungal culture with numerous yeast</td>
<td>“Yeast overgrowth, culture terminated”</td>
</tr>
</tbody>
</table>
Table 2. Policy for reporting potential contaminants in blood cultures

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. of Sets Positive</th>
<th>No. of Sets Received</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulase-negative staphylococci or Corynebacterium spp.</td>
<td>2 ≥2</td>
<td></td>
<td>Susceptibility test on each, regardless of morphologies. Identify Corynebacterium to species level. If antibiograms differ by more than one drug, omit susceptibility result and report “Differing antibiograms suggest both isolates are procurement-associated skin organisms.”</td>
</tr>
<tr>
<td></td>
<td>1 ≥2</td>
<td></td>
<td>Susceptibility testing if S. lugdunensis. Otherwise, no testing and report “Probable procurement-associated skin organism.”</td>
</tr>
<tr>
<td></td>
<td>1 1</td>
<td></td>
<td>Susceptibility testing if S. lugdunensis or if patient is less than 2 years old. Otherwise, no testing and report “Cannot differentiate procurement contaminant from true bacteremia; submit two blood culture sets per febrile episode for accurate evaluation of cultures.”</td>
</tr>
<tr>
<td>Viridans streptococci</td>
<td>2 ≥2</td>
<td></td>
<td>Identification and susceptibility test on each. If more than one species identified, omit susceptibility testing.</td>
</tr>
<tr>
<td></td>
<td>1 ≥1</td>
<td></td>
<td>Report “Can be transient microbiota; contact lab for further workup if clinically significant, e.g., evidence of endocarditis.”</td>
</tr>
</tbody>
</table>

*Number of positive bottles is irrelevant (15).

reporting practices can be responsible for much overuse of antimicrobial agents.

In the case of blood cultures, Weinstein et al. (15) found that single positive cultures with coagulase-negative staphylococci, even if more than one bottle was positive, represented contamination 95% of the time. In fact, when multiple cultures were positive, contamination was still likely in 40% of the cases. Since multiple sets are rarely collected from infants and small children, such cultures cannot be evaluated for contamination. Table 2 lists an action plan that can be used to evaluate and report positive blood cultures with coagulase-negative staphylococci and other common contaminants.

While it is not cost-effective to identify most coagulase-negative staphylococci to the species level, one species, Staphylococcus lugdunensis, is usually considered a pathogen and is not a skin colonizer (16). This species can be slide coagulase positive or negative, but unlike most tube coagulase-negative staphylococci, it is pyrroloidyl peptidase (PYR) positive. Such a unique trait can be used to quickly differentiate this species. If the isolate is PYR positive, a positive ornithine decarboxylase test will identify the organism as S. lugdunensis, which should always be reported from blood cultures, even if it is only present in one set (Table 2).

Some laboratories consider coagulase-negative staphylococci growing in the backup broth culture from a sterile body fluid as a contaminant. Since this finding may actually represent a true infection, it is difficult to decide what the appropriate method is to report such findings. The cell count of the body fluid can be helpful, since the presence of WBCs suggests the organism could be the etiologic agent. The laboratory may also suggest a repeat culture to confirm the result. An optional report might read as follows: “Found in low numbers. Cannot distinguish true pathogen from contaminant. Consider re-collection of specimen or call laboratory if considered clinically significant.” Reporting that the culture was positive in “broth only” has little meaning, unless the person reading the report has spent time in the microbiology laboratory. It is better to indicate that low numbers were seen.

6. Do direct tests from blood culture bottles.

Of all the cultures performed in the microbiology laboratory, none are more important than blood cultures, which diagnose the life-threatening diseases. The sooner the isolate is identified and susceptibility test results are available, the better chance the patient has of cure. There are easy ways to identify greater than 90% of blood culture isolates. A few extra tests, if done initially, can allow genus identification in 1 to 4 h and species identification in 18 h from the time of the positive culture. Some of the cultures will need confirmatory testing, but the cost of the initial testing is minimal compared to the savings in patient days, reduced mortality, and ordering of other laboratory tests (1.2).

Over 50% of positive blood cultures contain staphylococci. The genus can be reported as soon as the Gram-stained smear is read. The addition of the descriptor “probable” alerts the physician that the laboratory is not 100% sure but this is the likely genus. If two drops of the blood culture (without centrifugation) are added to 0.5 ml rabbit plasma, the presence of coagulase can be determined. The test culture can be incubated for 18 h at 25°C, but if a person will be in the laboratory for 4 h, the reaction mixture can be incubated initially at 35°C and observed for clot formation each hour up to 4 h. If a clot forms, S. aureus can be reported with certainty, even though the plate growth has not yet been observed. No other organism will do this. If the test is negative, it is difficult to report anything further, but if it is still negative after an additional 18 h at 25°C, this negative result can be confirmed from the colony with a rapid latex or co-agglutination test for coagulase. Thus, 50% of positive culture identifications can be completed in 18 h. In addition to the identification of staphylococci, preliminary susceptibility testing is easily done by adding 10 drops of the blood culture to 5 ml of saline. A swab is dipped into the saline and used to inoculate a Mueller-Hinton.
Table 3. Rapid identification of organisms based on Gram stain of positive blood cultures

<table>
<thead>
<tr>
<th>Gram stain</th>
<th>Test(s)</th>
<th>Preliminary report</th>
<th>Disks for preliminary susceptibility report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram-positive cocci in clusters</td>
<td>2 drops in rabbit plasma – incubate up to 4 h at 35°C, then at 25°C</td>
<td>“Staphylococcus species.” Change to S. aureus if coagulase positive.</td>
<td>Cefoxitin, vancomycin, penicillin</td>
</tr>
<tr>
<td>Gram-positive cocci in chains</td>
<td>2 drops on bile-esculin slant – incubate 35°C, observe at 2, 4, and 24 h</td>
<td>“Streptococcus species.” Change to Enterococcus if bile-esculin positive (black).</td>
<td>Penicillin, vancomycin</td>
</tr>
<tr>
<td>Gram-positive rods</td>
<td>2 drops on bile-esculin slant at 35°C; observe at 2, 4, and 24 h</td>
<td>“Gram-positive rod (add e.g., large, descriptor, tiny, or coryneform).” Change to Listeria if tiny and bile-esculin positive (black). Can confirm with tumbling motility.</td>
<td>Penicillin, vancomycin</td>
</tr>
<tr>
<td>Gram-negative rods</td>
<td>Kit for identification</td>
<td>“Gram-negative rods” or “Gram-negative coccobacilli”</td>
<td>Battery of susceptibility disks on formulary</td>
</tr>
<tr>
<td>Yeast</td>
<td>2 drops on urea slant at 35°C; observe at 4 and 24 h</td>
<td>“Yeast” Change to “probable Cryptococcus” if urease positive (red).</td>
<td>None</td>
</tr>
</tbody>
</table>

7. Do rapid spot test identifications!

The Clinical Laboratory Standards Institute (CLSI) has published a guideline of (M35A) of acceptable tests that can rapidly be performed on colonies to identify most of the clinically significant bacteria and yeast in 1 min to 4 h (6). If the identification fits the conditions described, there is no need to do more testing. Only a few examples are given here, but many others are listed in the document to identify enterococcus, C. glabrata, C. perfringens, H. influenzae, M. catarrhalis, and S. pneumoniae, among others.

If an isolate is growing on MacConkey agar and is lactose positive, a negative oxidase and positive spot indole test will suggest E. coli as the species. This can be confirmed with greater than 99% accuracy if the organism is either hemolytic on blood agar or, if not hemolytic, is PYR negative.

The use of spot tests can prevent errors, regardless of the final identification. A spot indole and oxidase test for all isolates that grow on MacConkey agar can expedite identification of Vibrio, Aeromonas, and Pseudomonas spp. These tests should be a part of every workup and be documented for the person continuing the workup the next day. For gram-negative rods that do not grow on MacConkey, a catalase test should be done in addition to the indole and oxidase tests. Only after these results are obtained should a decision be made as to how to approach the identification. If the isolate does not grow on MacConkey agar, inoculation of the standard gram-negative identification system routinely used in the laboratory will often delay the final report. Either a system for fastidious gram-negative rods or some tube biochemical tests are usually required for accurate species identification of these organisms.

For gram-positive cocci, the identification of typical colonies of S. aureus with a positive coagulase test, group A or B Streptococcus with positive serology, and S. pneumoniae with a positive bile solubility test are accurate, complete identifications. For all other identifications of gram-positive bacteria, a Gram-stained smear and catalase test are essential for accuracy and should not be omitted.

8. Avoid doing repeats of the same identification or susceptibility test system when there is a questionable, unusual, or no result.

This is a very common habit. If the culture is obviously contaminated or the growth was poor, repeating the test system is reasonable. However, if there is no obvious problem, consider better options, such as using a different system, checking the Gram stain, and looking at what tests were positive and what might easily be done to confirm the identification.

agar plate. By placing vancomycin, penicillin, and cefoxitin disks on the plate, preliminary reporting is allowed the next day for the three drugs most likely to be used for treating serious bacteremia with staphylococci. The test can be confirmed with MIC testing, if the isolate is judged significant the following day. Generally, when laboratories have compared the direct test results to the MIC tests performed later, there is no difference. If this is the case, the laboratory has the needed validation to drop the subsequent MIC testing.

If gram-positive cocci in chains are observed, the preliminary report can read “Probable streptococcus.” If the bile-esculin test turns positive in 2 h, this report can be changed to “Enterococcus.” If a tiny gram-positive rod has a positive bile-esculin test, the report of “Probable Listeria” will allow the proper antimicrobial therapy. For gram-negative rods, depending on the system used in the laboratory, the culture can be concentrated for rapid testing. Some laboratories centrifuge the culture and use the pellet for inoculation, others use serum separator tubes. For the API20E, 2 drops from the blood culture broth in 5 ml of saline works well as the inoculum. The citrate test cannot be read by this method, but an accurate identification generally is still possible by the next morning. These and other methods are summarized in Table 3.
Table 4. Examples of meaningful preliminary reports

<table>
<thead>
<tr>
<th>Observation</th>
<th>“Chicken” reporting</th>
<th>Meaningful reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram-positive cocci in clusters in broth (no plate growth yet)</td>
<td>Gram-positive cocci</td>
<td>Probable staphylococci</td>
</tr>
<tr>
<td>Gram-positive cocci in chains in broth (no plate growth yet)</td>
<td>Gram-positive cocci</td>
<td>Probable streptococci</td>
</tr>
<tr>
<td>Gram-negative rods (lactose positive, oxidase negative)</td>
<td>Gram-negative rods</td>
<td>Enteric rods</td>
</tr>
<tr>
<td>Gram-negative rods (lactose negative, oxidase positive)</td>
<td>Gram-negative rods</td>
<td>Pseudomonads</td>
</tr>
<tr>
<td>Gram-negative coccobicilli (on chocolate agar only)</td>
<td>Gram-negative rods</td>
<td>Probable Haemophilus</td>
</tr>
<tr>
<td>Large, gram-positive rods in chains in broth (no plate growth yet)</td>
<td>Gram-positive rods</td>
<td>Probable Bacillus/Clostridium species</td>
</tr>
<tr>
<td>Gram-positive rods in parallel lines (no plate growth yet)</td>
<td>Gram-positive rods</td>
<td>Coryneform rods</td>
</tr>
</tbody>
</table>

9. Do not perform irrelevant susceptibility tests.

Physicians tell me that they feel obligated to treat patients if susceptibility test results are reported on a culture, because they may be sued for having information and not using it. We cannot say that we should perform susceptibility testing on every bacterium in the culture and let the doctor decide if it is important. When the laboratory reports a susceptibility test result, it is telling the doctor it thinks antimicrobial treatment is indicated. Some examples include the report of susceptibilities for coagulase-negative staphylococci in a catheter tip culture. The appropriate treatment is removal of the catheter, which has already been done, since it came to the laboratory. Bacteremia, as evidenced by positive blood cultures or physical evidence of infection, is what should be treated. Without the blood cultures, regardless of the bacterial count on the catheter tip, the diagnosis of catheter-associated bacteremia cannot be made accurately (18).

Conversely, reporting susceptibility tests for organisms for which resistance has never been reported is statistically more likely to result in an erroneous report of resistance due to a laboratory error than in a report of the first known case of true resistance. Examples of unnecessary testing include penicillin testing of *Streptococcus pyogenes*, *L. monocytogenes*, *Streptococcus agalactiae*, and *Neisseria meningitidis*. Resistance in the United States has not been found for any of these species. Cephalosporin resistance of *Haemophilus* is another example. The CLSI document that is published annually (18) provides guidance for the absence of resistance. The document only lists a susceptible breakpoint when resistance has not been documented.

10. Report what you know even if you are not 100% sure; do it now rather than later!

Some of us refer to this as “the microbiologist’s chicken syndrome.” Why is it that we will tell a physician, when asked, that the Gram-stained smear of a positive blood culture looks like staphylococcus, but we say “gram-positive cocci” in the report? Merely documenting in the report that which was verbally stated to the physician when asked for details provides meaningful information to any other physician that reads the report. The use of the name “gram-negative rod” in a report should be qualified as much as possible, in order to guide therapy. Refer to Table 4 for examples.

In my career, I have never had a physician complain that the laboratory changed the report when more tests confirmed a different identification, but a laboratory was criticized for not reporting a *Brucella* for two more days, until it was confirmed serologically. Below, I have illustrated how a knowledgeable microbiologist can quickly provide meaningful information.

Day 1. A positive blood culture smear showed tiny gram-negative coccobicilli. This finding was reported as “Gram positive coccobicilli.” The patient was not started on coverage for pseudomonads, but rather, high doses of cephalosporin therapy. Although this was not the correct treatment, it did him no harm, which may happen with the combination of anti-pseudomonal drugs that would have been commonly used instead.

Day 2. The organism was growing as pinpoint colonies on blood and
chocolate agars, but not MacConkey agar. This finding, by policy, caused the microbiologist to don gloves and work in a biosafety cabinet. A catalase and an oxidase test were positive, but the spot indole test was negative. The Gram stain was repeated and confirmed the isolate as gram-negative coccobacilli. By protocol, a turbid suspension was made in 1 ml of saline and a urea disk (Remel, Inc., Lenexa, KS; or Hardy Diagnostics, Santa Maria, CA) was added to the saline suspension. After 2 h of incubation, the urease test was positive. There are a number of gram-negative rods that fit this profile, but all of them are uncommon in blood cultures. The microbiologist contacted the physician and changed the report to “Probable Brucella.” A courier was called to pick up the plates and take them to the local health laboratory for confirmation of the identification. The patient was placed in isolation and started on appropriate therapy, and an investigation was done to find the source of the infection. In this case, the cause was eating unpasteurized cheese, not a bioterrorist event. In 48 h from the time the specimen was collected, the diagnosis was made. This is the way we should be doing microbiology. Take a chance. You can make a difference.

References