Cost Effective Clinical Microbiology
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Cost Effective Clinical Microbiology

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After completing this course the participant will be able to:
1. Discuss the role of laboratory expenditures in the cost of health care.
2. Outline the history of cost-based reimbursement during the fee-for-service era.
3. Explain how the laboratory can control cost.
4. Outline methods to control cost in the microbiology laboratory.
5. Explain laboratory technical operation methods to control cost.
6. State obstacles and methods to deal with test ordering practices.
7. Identify the laboratory management operations methods to help control cost.

I. INTRODUCTION

It has been well known for some time that the United States spends more per capita on health care than other countries. What may be less well known is that the United States has had one of the highest increases in per capita health care spending since 1980 among higher income countries (1). Health care spending around the world generally is rising at a faster rate than overall economic growth, so almost all countries have seen health care spending increase as a percentage of their gross domestic product (GDP). In the United States, which has had both a high level of health spending per capita and a relatively high rate of real growth, the share of GDP devoted to health grew from 8.8% of GDP in 1980 to 16% of GDP today (1). This 7.2% increase in the health share of GDP is larger than increases seen in other high-income countries. Total U.S. spending for health care was $2.16 trillion in 2006, or $7,110 per person. The Centers for Medicare and Medicaid Services (CMS) has projected U.S. health care expenditures to reach $4 trillion in 2015, or 20 percent of GDP. Per person health spending is projected to increase to $12,320 by the end of that period (1).

There are a variety of reasons for the current state of high health care costs in the United States (2, 3). Whether one attributes the high costs to waste and inefficiency, inflated prices, poor management, inappropriate care, or over-consumption, the cost is too high. Many economists and health policy analysts argue that new medical technology (new drugs, devices, treatments, and techniques) is responsible for a substantial portion of the growth in health expenditures. The cost of health care has exceeded what the public is willing to pay, especially in view of the growing realization or perception that increased expenditures have only marginally improved the health in our country. See Table 1, “U.S. Health Care Facts.”

This distance learning course addresses one specific aspect of health care spending: clinical microbiology laboratory tests and the costs associated with them. This course explains how clinical microbiology laboratory costs affect patients, institutions, and the health care system, and offers suggestions for how we in the clinical microbiology laboratory can reduce our costs.
II. HISTORY

Years ago, rapidly increasing medical costs were not of concern to the health care industry. Most medical care providers worked in an environment of cost-based reimbursement—fee for service, a system that offered few incentives for cost-effectiveness and certainly caused over-utilization of diagnostic services. Those were “the good old days” for clinical laboratories. The more tests you did and the more you charged per test, the more revenue you received. Under fee for service, three separate urine cultures or multiple wound or sputum cultures on the same patient in one day, for example, were acceptable. All specimens were accepted regardless of the number and/or quality or the impact to patient care, and the laboratory received payment for all testing performed (2). The hospital administration looked favorably upon laboratory operations during this time because the laboratory was considered a revenue generating center. Often, the laboratory financially supported other non-revenue-generating areas of the hospital, such as dietary and housekeeping. Also, funds generated from multiple testing were used to help subsidize the cost of more expensive lab tests, such as tuberculosis (TB) or fungal cultures, and other lab services in which supply and labor costs were high.

However, times have changed. Now as the health care system moves to prospective reimbursement (payment according to contracted pricing), medical providers must address new issues: the best use of the laboratory’s resources, how to assure quality test results, and which tests to order for optimal patient care, yet at reasonable cost. Today, the more laboratory tests you perform, the more revenue you lose because contracted pricing does not cover the true cost of performing each laboratory test. The laboratory is now considered a cost center and competes for funds with all other cost centers in the hospital. The clinical microbiology laboratory is no longer looked upon so favorably. Whereas its previous role was as a generator of revenue, the clinical microbiology laboratory is now just another consumer of resources, and consequently is one of the major targets for reduction of costs.

Microbiology is an expensive laboratory service because it is labor intensive. Staff salaries generally account for 60 to 70% of the microbiology laboratory’s operating budget. Most microbiology tests cannot be automated easily, so there is a direct relationship between work load and number of Clinical Laboratory Scientists (CLS) needed.

Although many factors contribute to escalating health care costs, an increase in the utilization of health services, especially diagnostic services, is considered to be one of the most important elements. Laboratory and X-ray charges currently account for 30-40% of all hospital costs and are the most rapidly increasing component of the nation’s health bill. Laboratory charges are increasing annually at a rate of about 15% and are considered an important contributor to the general inflation in medical cost (1). It has been estimated that in some acute tertiary-care hospitals, clinical laboratory test charges alone average 24% of the total hospital bill of patients (2).

The magnitude of these cost increases has caused federal agencies considerable concern, prompting them to initiate policies such as the establishment of CLIA ’88 legislation to regulate clinical laboratories and control unnecessary costs associated with laboratory testing. This legislation was intended to restructure laboratories through personnel requirements, testing services, and reimbursement practices to force health service organizations to implement more cost-effective techniques.

Two factors in particular contribute to the rising cost of laboratory services: increased test cost and increased utilization (test ordering). It has been determined that one half of the laboratory cost increase is the result of increased costs to perform the test, and half is due to increased utilization and new services, not due to inflation. Further, authorities believe that 20-60% of laboratory tests may be unnecessary and inappropriate, and do not contribute to improved patient care (3). Therefore, changing test ordering practices without compromising the quality of patient care is an important aspect of cost-effectiveness in clinical laboratories.
Current health care is truly different from what we have known in the past. Some hospitals have managed care (medical insurance plans that control costs); some hospitals need discounts to compete; some medical centers such as Kaiser have protocols to control costs at every stage of interaction with the patient. Some hospitals have a high patient census, while others do not. Some hospitals need to close or change their operations because of financial loss. The switch to managed care and the pressure to control costs have come about rapidly, so it is easy for many laboratory personnel to feel that their control of the laboratory is eroding.

Currently, most laboratory test pricing and revenue is set by government contracts such as Medicare, per diem rates from insurance companies, discounts, special packages, and capitated contracts. In addition, there has been a shift over the last few years from inpatient hospitalization to the outpatient setting, where laboratory revenue may be smaller. Although the test volume, for example, may be high for laboratories performing outpatient testing, the revenue to the laboratory may be low because contracted pricing does not pay the full cost per test. These changes in hospital patient populations will alter the need for personnel, space, and equipment in the clinical laboratory. Economic forces are definitively changing the way medicine is practiced in the United States.

Clinical laboratories must adapt to these economic realities. Laboratory managers and supervisors must develop the skills to manage the laboratory efficiently and cost-effectively, critically analyzing all stages of laboratory operations and making appropriate changes as needed. The challenge is to do this without jeopardizing patient care.

Cost-saving strategies represent change, and change is typically met with resistance. Conflicts will inevitably develop in our changing environment regarding what comprises quality health care, as opposed to cost-efficient health care, and what financial changes are necessary from the hospital administration and from the clinical microbiology laboratory. The laboratory needs to take an important role in developing strategies that focus on desirable patient outcomes, yet limit unnecessary and inappropriate testing; otherwise, changes will be imposed that are not in the best interest of the patient. While it is true that times have changed and health care economics are different from years ago, quality patient care is still the goal, and cost savings in the clinical microbiology laboratory must address that goal.

III. WHERE COST SAVING CAN BE EFFECTED

Cost control in the clinical microbiology laboratory can be achieved most efficiently if you first sort your laboratory costs into discrete categories and then initiate reforms in each category. I suggest you use the three (albeit arbitrary) cost categories described below; each is discussed in greater detail in the sections following.

1. Factors related to patient testing are the events that happen before the specimen is received in the laboratory. This includes utilization (when/how/why tests are ordered), specimen collection, and specimen transport. You should particularly question your laboratory’s utilization practices: What test or tests should be requested, and how often? Are clinicians failing to request tests that actually should be ordered? Are clinicians ordering tests that do not contribute to patient care? Controlling utilization (test ordering practices) is crucial to cost containment.

2. Factors related to laboratory technical operations are the steps performed inside the laboratory after the specimen has been received. Questions to ask: What processing and reporting methods are being used? Does the laboratory assess the quality of the specimen prior to culture? How extensively, how rapidly, and by what methods does the laboratory work up a specimen? Does the workup match the needs of the physician?
3. Lastly, factors related to laboratory management operations are methods used to analyze the laboratory and compare it with others. Are laboratory resources (personnel and equipment) being used properly? Is the skill mix adequate for the laboratory? Does the laboratory know and monitor its labor and supply costs? Does the laboratory use automation properly and effectively? Is laboratory productivity being monitored, compared to a reasonable standard, and compared with other similar medical institutions? Should some laboratory work be referred to an outside laboratory? Should some tests be brought back into the laboratory? Are contracts with suppliers, vendors, and reference laboratories being evaluated for cost?

IV. FACTORS RELATED TO PATIENT TESTING

Patient testing factors are those events that happen before the specimen is received in the laboratory: what test is requested, the frequency of tests requested, what sample is being collected, and how it is being transported. Reviewing patient testing factors can help reduce over-utilization of laboratory services.

Since about half of the overall increase in health care spending is the direct result of increased utilization of medical services by physicians, a decrease in utilization practices will directly reduce laboratory costs. There may be a variety of reasons for the increase in laboratory utilization by physicians (2, 3). For example, physicians may request unnecessary tests because of their insecurity in establishing a diagnosis, or because of poor turn-around time of the laboratory. Another cause for increased utilization may be the practice of standing orders for routine laboratory testing on patients. This practice is for the convenience of the physician and nursing staff, but has been shown to greatly increase laboratory utilization without improvement in patient care. Another cause for increased utilization is the use of check-off boxes on manual laboratory requisition forms which, again, is for convenience of physicians and nurses, but requires little conscious thought about what test is actually needed. Another cause for increased utilization may be the use of reflux testing—the automatic ordering of fungal, TB, or anaerobic cultures on certain specimen types, even though the physician may not have originally ordered or needed this extra test. Reviewing utilization practices for appropriateness is essential for cutting costs in the laboratory.

A good hospital-wide computer system is essential to help reduce the frequency of laboratory testing and to improve utilization. Physicians may be willing to abandon daily test-ordering if they are convinced that updates on the one culture specimen they sent in will be provided early each day, and that all clinically significant changes will be brought to their attention or flagged. The physician may not realize, for example, that multiple samples have been previously submitted, but a good computer system will alert the requestor to previous submissions. Further, the initial requesting process is the ideal place to let the physician and other medical staff know about laboratory policies and guidelines for specimen submission, frequency, and transport. The laboratory’s requesting system must provide clear definitions of what information and exactly what specimen is required. For example, a physician’s request for a generic “wound culture” is not satisfactory. It fails to provide the microbiologist with adequate information for culturing procedures, resulting in inadequate results for the physician to evaluate. What is needed is a notation of the exact specimen source and location—for example, “abdominal surgical drainage”—so that the specimen may be cultured appropriately.

Changing physician ordering practices, however, is one of the most controversial and difficult tasks for the laboratory because many aspects of utilization cannot be controlled directly by the clinical laboratory. Requesting unnecessary testing is a deep-rooted problem stemming from the early training of physicians—the pressure to test for unforeseen problems and the fear of criticism for failure to consider certain unusual diagnoses. Also, unnecessary tests may be ordered because of academic curiosity, defensive medicine, and the fear of litigation. Often, attempting to change a physician’s ordering practices leads to confrontation and unpleasant
situations. It has been suggested that the place to actually start changing physician ordering practices is with the physicians-in-training, rather than with currently practicing physicians. It may be easier to change the behavior of interns, residents, and fellows by performing audits and in-service training when physicians are employed by a medical center than when they have their own practices.

Microbiologists and clinicians may have different perceptions of what constitutes rational and necessary laboratory testing. In the clinician’s view a good microbiology test might be one that provides useful clinical information quickly. The microbiologist may recognize that such a test is labor-intensive, requires huge outlays of equipment or supplies, and is very costly. However, if the clinician believes this is the only way to make a diagnosis, then the test is justified to the physician. The differences between a clinician’s and a microbiologist’s perceptions and attitudes are important factors to consider when attempting changes in microbiology services.

Since all cost-generating procedures originate with a physician’s order, it is important to devise guidelines on protocols for specimen procurement for the medical staff. Some medical centers have established “best practices” or “clinical pathways” for physicians to follow. The teams that develop the clinical pathways are composed of physicians, nurses, and laboratorians. They create policy for specific laboratory testing protocols depending on diagnosis and/or clinical indications. These hospital-wide teams reduce the confrontational component when utilization is changed, as well as ensure that the clinical pathways agree with current medical practice.

Clinical pathway policies include the best test to order, the number of specimens accepted per individual site, and how to properly collect and transport specimens. These policies set limitations on testing and specimen collection frequency, and contain clearly defined rejection criteria for the medical and nursing staff. These policies may also indicate tests the physician overlooked that might facilitate a rapid diagnosis. The goal of clinical pathways is to obtain the correct specimen and request the correct test. Laboratory utilization in some medical centers has been improved by soliciting the support of infectious disease physicians, hospital pharmacists, clinical microbiologists, and the chief of medicine. In the future, these clinical pathways or utilization guidelines for each diagnosis will become the standard of care.

If changing utilization of the laboratory is to succeed, the impetus for this program must be envisioned by all participants as a cooperative educational venture. The educational design should be informational, not punitive. In-service education of the medical staff may be one of the most important mechanisms of implementing effective change in laboratory testing practices and providing specimen guidelines. It is imperative to get physician participation and involvement in the development of laboratory testing algorithms (pathways). If these guidelines are totally dictated by the laboratory they will fail. Physicians who do not understand the testing rationale may cost your staff time and money in explanations, repeated tests, and stressful interactions. Cost containment alone cannot be used as the sole rationale for a cost containment program. Instead, it is important to emphasize the improvement in the quality of care that will occur as a result of reducing over-utilization, under-utilization, and mis-utilization of laboratory tests.

Good laboratory orientation programs and frequent in-service sessions are a must for cost effective clinical microbiology. It is necessary to provide appropriate documentation for the changes you propose—citing, for example: in-house data; Q-Probe data from College of Pathologists; CAP, JCAHO or State of California regulations; or recent publications. I have found it effective to discuss laboratory policies at medical staff meetings. In-service presentation to small groups of physicians also seems to work well. Teaching tools such as PowerPoint presentations are beneficial; physicians are accustomed to this format. See Table 2, “Suggested Limits on Microbiology Specimens,” a valuable list for in-service presentations.
Similarly, in-service training for nursing personnel is crucial. It is important that nurses feel they are part of the solution rather than to feel the laboratory is dictating to them. Nurses often are the ones to order the test, obtain the specimen, and submit the specimen to the clinical laboratory. Their buy-in is essential. Nurses often can represent the lab “de facto” because they interact with the physician more than do the laboratory personnel. Clearly, a new role of the microbiologist is to be a resource to physicians and nurses, and laboratory managers and supervisors can only do this by getting out of the laboratory to interact with other hospital personnel.

One of the greatest wastes of laboratory resources is spending money pursuing tests ordered by the physician that have very little effect on patient care. A few such tests are the following:

- a) bacterial antigen detection as a stand-alone test;
- b) stool cultures or ova and parasites testing on patients hospitalized more than three days;
- c) superficial wound or decubitus specimens obtained by swab;
- d) culture of Foley catheter tips;
- e) throat cultures for other than beta-strep;
- and f) TB and fungal cultures on spinal fluid when glucose, protein, and WBC counts are normal. See Table 3, “Specimens of Limited Value.”

It is easy to suggest these restrictions; harder to implement them. Implement the restrictions slowly. Use computer information flags that appear whenever someone tries to order these tests. Hold in-service sessions with physicians and nurses to ensure everyone is informed. Eliminating unnecessary and inappropriate testing is a good place to start in reducing laboratory costs, and it will reduce clinically misleading test results and improve the quality of patient care as well. See Table 4, “Cost-effective Tips on Factors Related to Patient Testing.”

V. FACTORS RELATED TO LABORATORY TECHNICAL OPERATIONS

Laboratory Technical Operations are those steps that are performed inside the laboratory after the specimen has been received: processing, workup, and identification procedures. Also, laboratory technical operations include how staff is used for the performance of the work. Most often, laboratory technical operations are the steps or methods over which laboratory managers have the most control and can change if appropriate.

Labor is the greatest expense in clinical microbiology laboratory technical operations. Most microbiology procedures are performed manually and certainly are not as automated as procedures in chemistry or hematology. Therefore anything the laboratory can do to reduce labor costs will help. The most conventional approach to cost reduction, especially by non-laboratory personnel such as hospital administrators, is simply cutting some laboratory procedures and personnel. This approach, however, may affect quality and service.

Methods for reducing microbiology labor costs are discussed below. Some of the resultant changes may be unnoticed by the physician user and laboratory staff, while other changes may have a major impact. Each of the following methods for cost reduction, however, should be thoroughly explored by the clinical microbiology laboratory:

A. Evaluate how laboratory personnel are used
B. Screen specimens for quality
C. Review the extent of processing and identification
D. Implement cost effective tips for specific microbiology procedures

A. Evaluate how laboratory personnel are used

A microbiology laboratory may reduce overall personnel expenses by hiring lower-qualified personnel, such as Medical Laboratory Technicians, to perform non-CLS duties, as outlined and limited by the California Laboratory Field Services Regulations. The negative side of reducing microbiology-experienced CLSs is that they are hard to find again when you need them. Therefore, reducing the CLS staffing level is always “a no-win” situation.

Automation in the microbiology laboratory is often suggested as a means of reducing staffing, but in my opinion, automation does not generally reduce staffing to the same extent it may in other departments of the laboratory. Automated identification and susceptibility testing systems and automated blood culture instruments may not reduce laboratory staffing per se, but do not.
provide results faster to the clinician. Recently the use of an automated plate-streaker (inoculator) has been introduced to reduce the time to inoculate specimens directly onto plating media. A complete cost analysis of any labor savings using this instrument, however, has not been published. Further, in many hospitals the direct inoculation of primary media may be performed by laboratory assistants or technicians who generally have a lower salary base so that the overall labor cost savings using an automated plate-streaker to the laboratory may be less than anticipated.

Additional practices that can reduce labor, materials, and overhead costs include reducing the frequency of testing, reducing off-hour testing, reducing stat testing, redistributing work into fewer workstations, and increasing the batch size. Keep in mind, however, that some microbiological tests cannot be delayed or postponed for technical reasons.

**B. Screen specimens for quality**

Physicians often require guidance on the most appropriate specimens: how to collect them, the frequency of their submission, and methods of ensuring specimen quality. Also, physicians are often unaware of the detrimental effect of contamination with indigenous microflora on specimens. Therefore, the microbiologist needs to provide information to the physician. The concept that physicians can submit specimens and laboratories will run the requested tests without question is no longer valid. Specimens that are not collected or transported properly, even when handled optimally within the laboratory, are likely to provide misleading results, causing the physician to act on incorrect, misleading, or irrelevant data. Assessing specimen quality should be thought of as providing a needed service to the physician and to the patient. See Tables 2 and 3.

Once the specimen has arrived in the laboratory, the staff needs to screen the specimen (wounds and sputa for example) by Gram stain to see if the specimen is adequate for culture. Further, the laboratory must ensure the proper storage of the specimen. A urine sample with just a few colony-forming units (CFUs) of bacteria left out at room temperature could easily yield a colony count that may be considered significant. This may necessitate full and expensive identification and susceptibility testing and/or incorrect therapy, adding not only to laboratory costs, but also to overall hospital cost. The inappropriate storage of sputum specimens can result in the normal respiratory microbiota overgrowing potential pathogens and yielding misleading information.

**C. Review the extent of processing and identification**

The extent of workup and identification of microorganisms by the clinical microbiology laboratory must be appropriate to the specimen type, the resources of the laboratory, and to the needs of the physician who ultimately is responsible for the patient. Exhaustive microbiology (workup beyond that which may be relevant for patient care) is not clinically relevant or cost-effective. Exhaustive microbiology produces irrelevant information, which misleads physicians to an erroneous diagnosis and inappropriate therapy, and is much too slow for clinical application. Many clinical situations exist in which rapid, presumptive information is more important than delayed, definitive information. Communication with the physician is essential, either via computer or by phone, to obtain information on what the physician may need for good patient care, and whether more testing is needed.

One of the most cost-effective measures is to use brief schemes to presumptively identify bacteria based on colony morphology and inexpensive biochemical tests rather than always using expensive commercial systems. Laboratories may use an abbreviated algorithm which permits members of Enterobacteriaceae to be presumptively identified to genus level with 97% accuracy to reduce technologist time and reduce reagent costs compared to using conventional biochemical panels. The abbreviated algorithm may include the use of tests such as spot indole, MUG, PYR, butyrate, catalase, oxidase, and lactose fermentation based on colonial morphology on MacConkey agar. An E. coli, for example, can be identified with a specificity of >99% based on growth and lactose fermentation of MacConkey, indole positivity, oxidase negativity, and beta glucuronidase positivity (MUG) within one hour, at an average cost of about twenty cents per isolate (4). Likewise, a swarming Gram-negative bacterium recovered from a urine sample that gives a negative indole reaction can be identified as Proteus mirabilis, while a swelling Gram-negative rod that is indole positive may be identified as Proteus vulgaris. A gram-

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negative, oxidase-positive rod which produces a green pigment, has a characteristic grape-like smell, and grows at 42°C can be reported as Pseudomonas aeruginosa.

Other cost-effective measures that a clinical laboratory may use are special chromogenic culture media designed to simplify traditional culture technique by permitting presumptive identification based upon the color of the colony without the cost of additional biochemical tests. These media, called CHROMagar are available from BD, Hardy, and others. They permit rapid identification of E. coli, Enterococcus, Klebsiella, Enterobacter, Citrobacter, and Proteus sp. Other CHROM agar permit the rapid identification of yeast, Salmonella, VRE, ESBL, and methicillin-resistant Staphylococcus aureus without further biochemical tests.

The intent of this course is not to present all possible brief identification schemes, but to have the reader consider less costly identification methods. I would recommend you consult the Clinical Microbiology Procedures Handbook, 2nd ed. (4) for other rapid identification schemes. Although the laboratory may take pride in its ability to identify an organism to species and subspecies or to its “mother’s maiden name,” there are times when such procedures become academic exercises rather than clinical tools. Have you ever had the experience of working on a culture to identify an unusual organism, only to find that the patient has been discharged?

Some may argue that cutting costs by using brief identification schemes might be “peanuts” in comparison with the whole operational budget of the laboratory, but I believe these schemes measurably reduce both labor and supply costs and provide a faster report to the physician as well.

Use the quantitative aspects of culture results to determine when and if further identification and susceptibility testing is necessary. For example, a single colony growing from a normally sterile source should probably be fully worked up. However, a few colonies of a member of the Enterobacteriaceae family from a sputum specimen do not usually imply clinical significance and does not require further workup. Again, consult the Clinical Microbiology Procedures Handbook, 2nd ed. (4) to see what quantitative thresholds are used for identification and susceptibility testing for various specimen types. See Table 5, “Cost-Reduction Tips for Laboratory Technical Operations.”

Recently there has been an increased availability and use of microbiology methods using various molecular procedures (PCR and others) instead of using conventional biochemical tests. Many of these molecular methods provide rapid detection of antibiotic resistance genes, such as methicillin-resistant Staphylococcus aureus or vancomycin-resistant enterococcus to improve patient care. Other molecular tests can provide rapid detection of pathogens such as Clostridium difficile, Campylobacter jejuni, E. coli 0157:H7, Legionella spp., and Streptococcus pneumoniae, to name just a few organisms. Further, molecular tests are being used more frequently for detection of various difficult to isolate viruses, parasites, and mycology agents of disease. While these tests are very rapid and provide detection of the infectious agent with a high sensitivity and specificity, the molecular tests are very expensive to the laboratory’s operating budget. It is argued that some of the molecular tests are probably not cost-effective to the clinical laboratory when considered by themselves. Many investigators, however, are looking at the these molecular tests in the “big picture” of patient care; for example, there may be significant improvement in patient outcome, a reduction in morbidity and mortality, and a reduction in the transmission of infectious agents to other patients. The usage of many molecular tests will certainly increase in the future and will need to be considered when appropriate for patient care and overall cost to the laboratory.

D. Implement cost effective tips for specific microbiology procedures

The following six microbiology procedures represent about 80% or more of the workload of most clinical microbiology laboratories. Making these procedures as cost effective as possible will help reduce laboratory costs.

Anaerobic cultures

Anaerobes are responsible for many serious infections and are resistant to many commonly used antibiotics. However, anaerobic cultures should be performed only when requested by the physician on appropriate specimens and when collected and transported in appropriate containers.
Specimen quality is essential for good anaerobic bacteriology. Since many anaerobic infections arise from the patient’s existing normal anaerobic flora, the laboratory needs a specimen that is obtained without any contamination. Appropriate specimens include aspirates or fluids obtained by needle and syringe, or tissues obtained during surgery. See Table 6, “Appropriate and Inappropriate Specimens for Anaerobic Culture.”

Swab specimens are frequently submitted to the laboratory because they are easy for the staff to collect; however, they are unsatisfactory for anaerobic culture and should not be processed. Many organisms adhere to the fibers of a swab and are not recovered, and the small specimen volume on a swab reduces the probability of isolating an organism. Further, swab specimens are more likely to be exposed to the toxic effects of oxygen during transportation.

Since many anaerobes are sensitive to the effects of oxygen, specimens should be transported in oxygen-free collection devices. Provide surgery, medicine, and other departments with anaerobic collection devices and provide instructions for transport of fluids and tissues. Reject the specimen if improperly collected and transported, or if the specimen is an inappropriate specimen type. See Table 6.

The extent of anaerobe identification necessary by each clinical laboratory may vary depending on the needs of the physician, the type of patient seen in their facility, and various operational and financial issues in the laboratory. The cost of performing anaerobic cultures can be controlled through the development of protocols on the source of the specimen and the extent of identification required. Communication with the physician about mixed culture specimens and the extent of identification needed is often the best approach.

Use primary, selective, and differential media that is free of oxygen to permit rapid growth and thus allow the initiation of techniques for rapid identification. Using good selective and differential media can also provide early presumptive information on the identity of the organism. Various cost-efficient techniques, such as special potency disks, rapid spot tests, and other rapid tests, can provide rapid presumptive or group identification on many anaerobes, and this may be all that is necessary for some patients. See the Wadsworth-KTL Anaerobic Bacteriology Manual 6th ed. (5) for further tips on anaerobe identification.

Blood Cultures

The culturing of blood for pathogens is among the most important and most expensive procedures performed by the clinical microbiology laboratory. Rapid initiation of appropriate treatment based on blood culture results can save hospitals money and lead to more successful therapy and better patient outcomes. Blood cultures, unfortunately, are often inappropriately ordered, causing great expense to the laboratory. It is essential that the microbiologist provide information on the recommended blood culture bottles to use, the correct method of blood culture collection, the recommended volume of blood, and the frequency of testing.

In most patients with suspected bacteremia, blood from a single venipuncture is inoculated into two separate bottles (one set) of different composition. Three to four blood culture sets per day are sufficient to isolate the organism. A solitary blood culture is rarely useful for the diagnosis of bacteremia because of insufficient volume and difficulty in interpretation, and generally only wastes resources. Multiple sets beyond four rarely contribute to patient care and only add to the laboratory’s cost, as well as increase the likelihood of contamination.

It is essential that blood for culture be collected aseptically. The cost of a contaminant to the laboratory and to the medical facility is significant. In one study, the investigators detailed the cost associated with 94 contaminated blood cultures (6). The contaminated blood cultures resulted in extended hospital stay and room charges, as well as increased pharmacy and laboratory charges, with an overall increased cost of $6,000 per patient per day to the hospital. The laboratory needs to constantly monitor and track blood culture contamination rates as a quality assurance tool, and provide those personnel who obtain blood cultures with their current contamination rates to let them know how they are doing.

The volume of blood obtained for culture is one of the most important variables in the detection of bloodstream infections. The more blood in the sample, the more likely a culture will be positive. Obtaining less blood per patient sample and fewer than 3-4 blood culture sets per CAMLT Distance Learning Course DL-984
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day reduces the probability of detecting an organism. It has been well documented that bloodstream infection in adults may be characterized by fewer than a single microorganism per 10 ml of blood; therefore, guidelines recommend obtaining up to 20 to 30 ml per culture in adults (4).

**Lower Respiratory Specimen Cultures**

Lower respiratory secretions may result in more unnecessary microbiology laboratory effort than any other type of specimen. For example, in only 50-60% of patients with pneumococcal pneumonia can the organism be recovered from expectorated sputum samples, suggesting poor sensitivity of the culture (4). On the other hand, the absence of a pathogen does not exclude the presence of serious pulmonary infection. Therefore, the sputum culture undoubtedly is one of the most misleading of all specimens with regard to true clinical correlation.

Sputum specimens must be freshly collected from a deep cough. If personnel collecting the specimen do not follow this protocol, the specimen may consist mainly of saliva and be contaminated by oral microorganisms. Processing such a specimen adds cost to the laboratory.

It is essential to screen lower respiratory secretion specimens prior to culture. The most practical method is to use the Gram stain to look for epithelial cells (which signify oral contamination). The presence of leukocytes, alveolar macrophages, and bronchial epithelial cells signify that the material was obtained from a deep cough from the lung.

The Gram stain screening method examines 20-40 fields from sputum smears under low power. Unacceptable specimens contain more than 10 squamous epithelial cells per 10 X field. Accept the specimen if leukocytes are 10 times the number of squamous epithelial cells and there is a predominance of a single morphotype of bacteria (4). Some authors suggest using >25 squamous epithelial cells per 10 X field, but generally too few sputa specimens are rejected with this policy. Tracheal aspirates from adults also can be screened by Gram stain. Reject tracheal aspirates if the Gram stain smear contains more than 10 squamous epithelial cells per 10 X field or when no organisms are seen. When rejecting the specimen for culture, report it as “Smear contains more than 10 squamous epithelial cells per low power field, suggestive of poor quality; culture not performed. Please re-collect if clinically indicated.” Other methods to help improve the cost of sputa samples are to reject repeat cultures at intervals of less than every 48 hours, and to reject specimens delayed in transit for more than 2 hours without refrigeration.

Develop guidelines for workup of lower respiratory tract specimens, including identification and susceptibility testing based upon the quantitation of the organisms from primary media. For example, perform identification when the suspected pathogen is isolated from a certain quadrant, such as the second or greater quadrant of the primary plating media, or when it is the predominant pathogen. You may develop protocols to briefly identify at a specific quadrant, for example, and then query the physician to see if further workup and susceptibility testing are required. Such workup guidelines are in the *Clinical Microbiology Procedures Handbook, 2nd ed.* (4).

**Stool Culture**

The rationale for culturing stool specimens for enteric pathogens from patients with gastroenteritis is often misunderstood. Generally, stool samples should be examined for *Campylobacter* spp., *Salmonella* spp., and *Shigella* spp., and because of high recent incidence, *E. coli* O157:H7. However, the laboratory’s routine stool culture procedures should be based on the local prevalence of common pathogens. For example, you may not need to look for *Yersinia enterolitica* routinely in all stool samples. Additional pathogens can be ordered by the physician based on the patient’s food and travel history, and on clinical symptoms. Laboratories may use a variety of differential and selective media. Some laboratories find it cost effective to use CHROM agar for specific pathogens, but it is no longer recommended to include a back-up enrichment broth (i.e., selenite, GN broth) for the processing of stool specimens.

Routine stool cultures on patients hospitalized for more than three days are not warranted, are not cost effective, and should be rejected. Instead, specimens from these patients should be screened for *Clostridium difficile*.

Proper specimen collection and delivery are essential for optimal recovery of enteric pathogens from stool specimens and for ensuring cost effectiveness. Specimens that can be delivered to the laboratory within one hour may be collected in a clean waxed cardboard or plastic container. If a longer delay is expected, the specimen should be placed in a transport CAMLT Distance Learning Course DL-984
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medium, such as Cary-Blair. Store and transport stool in transport medium at 4°C and submit it to the laboratory within 24 hours for best recovery of pathogens. Reject stool specimens if received more than two hours after collection or if not placed in transport medium. If a specimen in transport medium is delayed for more than three days at 4 °C, or delayed for more than 24 hours at room temperature, reject it and request re-collection, since yield will be compromised. Do not process hard, solid stools, and do not process dry swabs.

Methods to control the cost of stool cultures include the following: 1) proper collection and transport in proper containers; 2) reject if patient hospitalized more than three days; 3) pathogen workup: do screening biochemicals and use brief schemes such as TSI, LIA, urea, indole, etc.; 4) if the organism appears to be a pathogen by the screening biochemical results, then use a commercial biochemical identification system.

**Wound Culture Specimens**

Proper collection of wound samples is essential for correct interpretation of test results. Tissue or fluid obtained from a site is always superior to a swab specimen. Wound cultures derived from lesions that are contaminated with intestinal, skin, or oropharyngeal flora result in unnecessary effort and cost, and produce reports that may erroneously imply infection, leading to unnecessary antimicrobial therapy.

Screen specimens for quality by initial microscopic examination by Gram stain smear. Generally, an unacceptable specimen contains many squamous epithelial cells and no polymorphonuclear neutrophils. Develop criteria using the *Clinical Microbiology Procedures Handbook, 2nd ed.* (4) specifying when to perform identification and susceptibility testing based upon the quantitation of the organism from primary media. Use primary media that includes selective and differential media for the most common pathogens. Do not use back-up broth (i.e., thioglycollate, chopped meat) in your primary set up of wounds. Routine inoculation of broth media rarely leads to the recovery of clinically relevant isolates; most of the time organisms recovered in broth are contaminants.

Use brief identification schemes when possible, such as those listed in the *Clinical Microbiology Procedures Handbook, 2nd ed.* (4). Use the original Gram stain to further evaluate the importance of each potential pathogen. Generally, if the organism is seen on the original Gram stain smear, and the more numerous the organism, the more likely the indication of infection. It is not economically feasible to identify every organism present in wounds. This only produces misleading information. Develop screening criteria for wound cultures: the quantity of organisms that must be present before identification is attempted; which results indicate susceptibility testing; how to determine the predominant organism. Contact the physician when the number of organisms seems excessive or unusual.

**Urine Cultures**

For most microbiology laboratories, 25% of the daily workload involves urine samples, particularly if there is a good-sized outpatient service. Processing and workup of urine specimens represents a significant proportion of the daily work performed, so decreasing the time expended on urine specimens greatly helps to cut costs.

Prevention of contamination due to normal vaginal, perineal, and anterior urethral flora is important for collection of urine specimens. It is estimated that as many as 60% to 80% of all urine specimens received for culture may contain no etiological agent or may contain contaminants only (2, 3). Reject and request a repeat urine specimen when there is no evidence of refrigeration and the specimen is > 2 hours old. The sample can be refrigerated up to 24 hours prior to plating on media, or the sample can be placed into transport tubes with preservative. Reject urine specimens obtained with the same collection method within 48 hours of receipt of first specimen. Reject urine from the bag of a catheterized patient.

Screening procedures are available to quickly identify those urine specimens that will be negative on culture, thus reducing costs for media and labor. Most studies indicate that such screening methods may perhaps be useful in an outpatient setting, but probably not in most inpatient populations. The variability in colony counts associated with disease is too great for inpatients, and the poor sensitivity on most screening systems makes the systems impractical for hospitalized patients.

Some medical facilities use an outpatient screening algorithm that uses various rapid enzyme screening tests and a culture, if indicated. Urinalysis is performed; if positive for leukocyte CAMLT Distance Learning Course DL-984

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esterase or nitrate reductase, a urine culture is set up in a reflexive test, but if negative, no culture is done. Such screening works best in symptomatic patients, outpatients, and women older than 60 years.

The most practical approach for inpatients, however, is to develop schemes which incorporate the number of organisms isolated from the primary plates to assess the potential significance of isolates, thereby reducing expenses and helping prevent needless patient treatment. However, even using colony counts as a marker of possible infection and further workup presents problems. Previous studies have shown that bacterial counts of \( \geq 10^5 \) or \( \geq 10^3 \) can be significant. Yet, some recent studies among females with dysuria and acute UTI report that counts of \( \geq 10^7 \) can be significant (4). For other patients, including infants and catheterized patients, even lower colony counts can be significant.

The general microbiology consensus is to:

- perform minimal identification (e.g., lactose-fermenting gram negative rods, or coliform) on single organisms counts <10,000.
- perform identification and susceptibility testing on counts >10,000 (or >1,000CFU in females).
- perform minimal identification on counts <100,000 CFU if two pathogens are present.
- perform identification and susceptibility testing on counts >100,000 CFU if two pathogens are present.
- when three or more organisms present, report as “Multiple bacterial morphotypes present. Suggest re-collection.” See the *Clinical Microbiology Procedures Handbook*, 2nd ed. (4) for further information.

VI. FACTORS RELATED TO LABORATORY MANAGEMENT OPERATIONS

So far this course has outlined patient testing factors (test ordering practices, specimen collection, and specimen transport) and technical operation factors (use of personnel, specimen quality, processing and workup identification issues, and how to streamline six specific tests).

This section will focus on factors dealing with the management of daily operations in the clinical microbiology laboratory: What resources does the laboratory have to control and monitor its own cost to improve efficiency? What management ideas or techniques yield the greatest cost efficiency? How does one find out how other laboratories control costs?

Three areas of potential cost reduction in the clinical microbiology laboratory are discussed in this section:

A. Analysis of laboratory operations
B. Productivity measurement and benchmarking
C. Reviewing contracts with vendors, suppliers and reference laboratories.

A. Analysis of Laboratory Operations

To properly analyze laboratory operations, laboratory managers must know the true cost of each laboratory procedure in order to adequately monitor, compare, and control laboratory costs. Almost all direct costs in microbiology laboratories are within two areas: 1) salaries and benefits, generally about 60-70% of the clinical microbiology budget, and 2) supplies, about 20-25% of the budget. You need to know exactly how much the lab is spending and where, and you need to be able to compare your laboratory to others by using valid data about your expenses.

Unfortunately, there are no good guidelines for estimating the number of personnel needed in a lab according to workload or patient populations. Although some organizations may have developed guidelines based on their own workload and complexity, their guidelines are not workable in labs with different mixes of tests and personnel. There have been a number of attempts to develop staffing guidelines, but they are of limited value. One such program, the College of American Pathology (CAP) Workload Reporting System, attempted to assign weighted workload units based on minutes of technical time. After a number of years, however, this program was abandoned because of great inaccuracies. The Workload Reporting System has been replaced by CAP’s Laboratory Management Index Program, or LMIP, which uses standardized billable test counts. A lab can compare its test numbers and paid-personnel hours with other labs of similar size, but this system does not predict staffing requirements adequately.
Other ideas permitting a comparison of staffing and costs are found in the CAP Q-Probe data. These documents provide examples of best practices and cost savings on a variety of topics, such as Staffing Bench Marks, Trends in Blood Culture Contamination, Solitary Blood Cultures, Urine Contamination, The Use and Abuse of Routine Stool, and Sputum Specimen Adequacy. These are just a few Q-Probe papers to give the laboratory ideas on how to lower costs.

**B. Productivity Measurement and Bench Marking**

There are a variety of tools the laboratory manager can use to calculate costs, monitor laboratory expenses, determine productivity, and provide a baseline to compare one laboratory’s costs with another. One such tool, *Cost Accounting in the Clinical Laboratories*, published by CLSI (formerly NCCLS), provides methods for improving cost control and for identifying significant deviations from standard cost. Another such tool, *The CLMA Guide to Managing a Clinical Laboratory*, published by the Clinical Laboratory Management Association in Wayne, PA, provides methods for evaluating the productivity, cost-effectiveness, and physician utilization of laboratory operations and then permits comparison of your data with laboratories of the same type. Careful analysis of laboratory practices using these guides can usually uncover some unnecessarily costly methods that can be eliminated or modified without compromising patient care. However, there are a number of factors to consider when evaluating laboratory operations for efficiency, such as service demands, culture and patient mix, volume, available instrumentation, and hours of operations.

A step beyond simply measuring a laboratory’s productivity is benchmarking, a technique that allows comparison of the financial and operational performance of many similar hospitals and laboratories with yours. There are companies which provide benchmarking data for a fee, such as the Association for Benchmarking Health Care, Total Benchmark Solutions, and Mecon Associates. Another option that I found of value is to contact laboratory managers at similar institutions and obtain data on their financial and operational activities. This allows the laboratory to identify “best practices” and benchmark areas of opportunity to improve, at least in comparison to other similar institutions. Factors to be compared are utilization, testing cost, staffing mix, productivity, and organizational structure. Examining the financial and operational performance of similar laboratories should be thought of as a starting point. Once the data is compared and analyzed, it is also imperative to re-contact those laboratories whose performance appears best and ask detailed questions about what changes in their operations may have worked favorably to lower their cost.

**C. Reviewing contracts with vendors, suppliers and reference laboratories**

Supply costs represent approximately 20-25% of all direct costs in the laboratory. This expense can be lowered by using group purchasing contracts, improved inventory control, persuasive negotiation with vendors, and volume discounts. Buying economical reagents and supplies and preventing waste can help, but the greatest cost savings in supplies comes about by group discounts—forming consortia with other laboratories. Also, look at service contracts and at ways to better contract with or use reference laboratories. See Table 7, “Cost Reduction Tips for Laboratory Management Operations.”

**VII. CONCLUSIONS**

The need for cost-containment in the clinical microbiology laboratory will increase in years to come. The misuse of laboratory services will not only be reflected in the rising cost of health care, but also will impact the way the laboratory is viewed by administrators and insurance companies. Insurance companies or HMOs will continue to make more of the rules for test ordering and reimbursement. This in turn will alter the extent of services provided by the clinical laboratory. Costs for tests ordered without specific indications or that are not part of the insurance company’s protocol likely will not be reimbursed.

Controlling cost is a more complex issue and a more integrated problem than can be solved by simply asking the laboratory to watch the bottom line. Instead, the laboratory should examine specific items for improvement: utilization practices (why and how often tests are ordered), specimen collection and handling procedures, and rejection criteria for poor quality specimens. The greatest cost-savings will be in the areas of utilization and improvement of specimen quality.
The goal is to lower the labor involved for each test, but still provide clinically significant information within the shortest period of time.

The true role of the clinical microbiology laboratory is to provide data to improve patient care, help control nosocomial infections, and reduce patient length of stay. To accomplish these goals, the clinical microbiology lab must provide accurate, timely, rapid test results to the physician and monitor the spread of disease within the hospital. The cost to the hospital for performing these functions is far less than the cost consequences of not performing them.

A broad view of laboratory costs as they relate to the whole hospital is what is needed. This is an essential link to make, but often is difficult for laboratories to make alone. The hospital administration must view laboratory costs as they relate to the whole hospital—pharmacy, nosocomial infections, shorter patient stays, and reducing overall hospitalization charges—rather than viewing the laboratory as an adversary or an expense in the hospital’s budget. Whether the laboratory can generate revenue is no longer important. What is important in today’s health care climate is that the clinical microbiology laboratory is doing the correct test efficiently.

Some of the cost-effective suggestions offered in this course may not apply to your laboratory. However, the strategy behind them, trying to generate essential laboratory information at a reasonable cost, is universal. As laboratorians we must change many of our approaches and thought processes. Change is uncomfortable. However, to be cost-effective in the new health care environment, change we must.

VIII. REFERENCES
# IX TABLES

## Table 1. U.S. Health Care Facts

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care spending in the U.S.:</td>
<td>$2.1 trillion in 2006; expected to be $2.9 trillion by 2009 and $4 trillion by 2015.</td>
</tr>
<tr>
<td>Health care spending is 4.3 times the amount spent on national defense.</td>
<td></td>
</tr>
<tr>
<td>Although nearly 47 million Americans are not insured, the United States</td>
<td>spends more on health care than other industrialized nations, and those countries provide health insurance to all their citizens.</td>
</tr>
<tr>
<td>In 2006, the United States spent 16 percent of its gross domestic product</td>
<td>It is projected that the percentage will reach 20 percent in the next decade.</td>
</tr>
<tr>
<td>Health care spending in 2006 accounted for 10.9 percent of the GDP.</td>
<td>Switzerland, 10.7 percent in Germany, 9.7 percent in Canada, and 9.5 percent in France.</td>
</tr>
</tbody>
</table>

Source: Centers for Medicare and Medicaid Services, CMS Data, 2007.

## Table 2. Suggested Limits on Microbiology Specimens

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine, expectorated sputum</td>
<td>One per day, not to exceed three per week.</td>
</tr>
<tr>
<td>Wound cultures</td>
<td>From same site once per day, not to exceed three per week.</td>
</tr>
<tr>
<td>Blood</td>
<td>3-4 blood culture sets in 24 hours.</td>
</tr>
<tr>
<td>Stool for routine culture</td>
<td>None for patients hospitalized more than three days. If more than three hospitalized days, \textit{C. difficile} testing recommended. Outpatients limit of three per illness.</td>
</tr>
<tr>
<td>Stool for ova and parasites</td>
<td>None for patients hospitalized more than three days. If more than three hospitalized days, \textit{C. difficile} testing recommended. Outpatients limit of three per illness.</td>
</tr>
<tr>
<td>Specimens for acid-fast bacilli</td>
<td>Three of each type per patient admission.</td>
</tr>
<tr>
<td>Urine or CSF for acid-fast bacilli</td>
<td>Performed following infectious disease or other specialist consults.</td>
</tr>
</tbody>
</table>
Table 3. Specimens of Limited Value

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Superficial wounds or superficial decubiti cultures</td>
</tr>
<tr>
<td>2</td>
<td>Sputa when Gram stain shows oropharyngeal contamination</td>
</tr>
<tr>
<td>3</td>
<td>Multiple wound specimens from the same site per day</td>
</tr>
<tr>
<td>4</td>
<td>Foley catheter tip cultures</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic cultures from vagina, cervix, bowel contents, oral sources</td>
</tr>
<tr>
<td>6</td>
<td>A single blood culture</td>
</tr>
<tr>
<td>7</td>
<td>Stand alone bacterial latex antigen testing</td>
</tr>
<tr>
<td>8</td>
<td>Stool specimen or O&amp;P for patient hospitalized more than 3 days</td>
</tr>
<tr>
<td>9</td>
<td>Workup of urine samples containing more than 3 different organisms</td>
</tr>
</tbody>
</table>

Table 4. Cost Effective Tips on Factors Related to Patient Testing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Set criteria for what tests are allowable and how often.</td>
</tr>
<tr>
<td>2</td>
<td>Eliminate standing orders.</td>
</tr>
<tr>
<td>3</td>
<td>Eliminate check off boxes on manual forms.</td>
</tr>
<tr>
<td>4</td>
<td>Eliminate unnecessary tests that are routinely performed with no benefit to the patient or to the treating physician.</td>
</tr>
<tr>
<td>5</td>
<td>Be on hospital teams that develop clinical (critical pathways) laboratory test ordering practices.</td>
</tr>
<tr>
<td>6</td>
<td>Examine turn around time.</td>
</tr>
<tr>
<td>7</td>
<td>Evaluate your computer system. Is it user friendly? What type of reporting practices do you employ: preliminary reports, interim, final? What type of updates and how frequent? Do you have flags or alerts in your computer system to notify users of significant results or changes?</td>
</tr>
</tbody>
</table>
Table 5. Cost-Reduction Tips for Laboratory Technical Operations

1. Examine how laboratory personnel are being used. What is the skill mix?
2. Assess the quality of clinical specimens.
3. Establish limitations on testing and on specimen frequency. Develop rejection criteria.
4. Develop criteria for extent of specimen workup.
5. Review identification and susceptibility testing practices; do they match clinical need?
6. Use automation and instrumentation when possible.

Table 6. Appropriate and Inappropriate Specimens for Anaerobic Culture

<table>
<thead>
<tr>
<th>Appropriate Specimens</th>
<th>Inappropriate Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgically obtained fluid or tissue</td>
<td>Swabs</td>
</tr>
<tr>
<td>Deep abscess</td>
<td>Expectorated sputum samples</td>
</tr>
<tr>
<td>Aspirates</td>
<td>Bronchial washings</td>
</tr>
<tr>
<td>Sterile body fluids</td>
<td>Small bowel contents</td>
</tr>
<tr>
<td>Biopsy material</td>
<td>Voided or catheterized urine</td>
</tr>
<tr>
<td>Tissues</td>
<td>Female genital tract culture</td>
</tr>
<tr>
<td></td>
<td>Surface swabs</td>
</tr>
</tbody>
</table>
### Table 7. Cost-Reduction Tips for Laboratory Management Operations

| 1. | Calculate accurate direct cost figures for every laboratory procedure. |
| 2. | Monitor labor and supply cost monthly. Plot data against expected budget. Make changes as needed. |
| 3. | Measure laboratory productivity using NCCLS, CLMA, or other tools. |
| 4. | Re-think common laboratory practices, procedures, and costs – things your staff does by rote and tests you seem married to. |
| 5. | Get input from staff, who probably have many cost cutting ideas they would like to suggest and implement. |
| 6. | Consider changes in vendors of supplies and services. Negotiate prices. Make sure your laboratory is in a consortium of buyers. |
| 7. | Review reference laboratory contracts and practices – can you trim costs? |
| 8. | Gather bench marking data for your laboratory and call other laboratories for theirs; ask for details of best practices. |
| 9. | Look at quality assurance and quality control procedures. Are they current with CAP or JCAHO standards? |
REVIEW QUESTIONS
Course # DL-984
Choose the one best answer.

1. Which of the following is not a reason for the high cost of U.S health care spending:
   a. inflated prices
   b. poor management
   c. clinical pathways
   d. waste and inefficiency

2. Which circumstance would likely not have caused over-utilization of diagnostic services under fee for service:
   a. all specimens received were accepted
   b. samples of limited value were processed
   c. quality was not necessarily a consideration
   d. bench marking

3. Under fee for service, the laboratory was looked upon favorably by the hospital administration because:
   a. the lab had a low supply budget
   b. the lab did not require capital budget monies
   c. the lab financially supported other areas of the hospital
   d. the lab was highly automated

4. The impact of prospective reimbursement to the clinical laboratory is:
   a. the laboratory is able to financially support other areas of the hospital
   b. financial resources are limited due to insurance and other contracts
   c. the laboratory must produce cost-accounting quarterly reports
   d. the operational budget of the laboratory has changed jurisdiction

5. It is projected that U.S. health care spending is expected to reach by the year 2015:
   a. $4 trillion, or 20 percent of GDP
   b. $2.16 trillion, or 16 percent of GDP
   c. $4 trillion, or 8 percent of GDP
   d. $2.16 trillion, or 8.8 percent of GDP

6. Labor costs generally account for what percentage of the clinical microbiology laboratory’s operating budget:
   a. 20-25 %
   b. 40-50%
   c. 60-70%
   d. 80-90%

7. It is estimated that laboratory and X-ray charges currently account for what percentage of all hospital costs:
   a. 10-15%
   b. 20-25%
   c. 30-40%
   d. 60-70%
8. What two factors in particular contribute to the rising cost of laboratory services:
   a. increased test cost and increased regulations
   b. increased utilization and increased supply costs
   c. increased utilization and increased management salaries
   d. increased test cost and increased utilization

9. Which is not a reason physicians may request unnecessary laboratory testing:
   a. CLIA regulations
   b. the need to test for unforeseen problems
   c. the fear of litigation
   d. academic curiosity

10. Which specimen type is inappropriate for anaerobic culture:
   a. female genital tract specimen
   b. biopsy material
   c. wound material obtained by needle aspiration
   d. sterile body fluid

11. The best description of the methods lab managers and supervisors must use to manage labs today is:
   a. develop laboratory services and maintain laboratory staff morale
   b. provide laboratory testing that has impact to patient care at lowest cost without compromising quality of testing
   c. develop outpatient lab services and be able to work with administration
   d. wait and see until more data is available

12. Cost savings in a laboratory can best be accomplished by:
   a. examining laboratory technical operations and improving relations with administration
   b. examining factors of patient testing and physician usage
   c. examining factors related to patient testing, lab tech operations, and laboratory management operations
   d. examining laboratory management operations and using automation for identification

13. Of the following statements, which is not likely a reason for the increase in laboratory utilization by physicians:
   a. poor turn-around of the laboratory
   b. standing orders
   c. automatic reflux testing
   d. clinical pathways

14. One advantage of a good hospital-wide computer system for laboratory testing is it:
   a. allows staff to know surgery schedule
   b. notifies staff that multiple specimens have been received
   c. allows staff to automate certain tests via the internet
   d. notifies staff that physician has signed off on test results
15. It has been suggested that the best time to change physician ordering practices is:
   a. after physicians complete internship and residency
   b. while physicians are in training and employed by a medical center
   c. while physicians are attending a medical conference
   d. during medical school training

16. The best description of the term “clinical pathways” is:
   a. standardized ordering and collection guidelines developed by a hospital team of
      various personnel
   b. guidelines formulated by the laboratory for the best tests to order
   c. a series of methods to properly manage the clinical laboratory
   d. standardized guidelines formulated by hospital administration to manage
      laboratory tests

17. Which of the following is not an advantage of clinical pathways:
   a. determines the criteria for reference lab contracts
   b. develops rejection criteria
   c. over-looked but necessary tests are brought to the attention of the requestor
   d. determines the best test to order and provides information on how to collect and
      transport specimen

18. Which of the following is the best reason for a clinical laboratory to provide frequent in-service to nursing personnel:
   a. nurses do not have laboratory training during orientation
   b. tests are complex and nurses need to understand testing protocols
   c. nurses are often the personnel to order the test, obtain the specimen, and submit it to lab
   d. nursing in-service is a benchmarking requirement

19. Which is likely to be a specimen type of limited value:
   d. wound specimen obtained during surgery
   e. routine stool culture or O&P test on patients hospitalized more than 3 days
   f. aspiration material
   g. sputa when a Gram stain shows alveolar macrophages

20. Which is a method to lower labor costs of laboratory personnel:
   a. provide off-hour testing for laboratory services
   b. increase the frequency of testing
   c. hire lower-qualified personnel to perform non-Clinical Laboratory Scientist duties
   d. increase stat testing

21. If you are categorizing the costs in your laboratory, which of the following would not be in the Technical Operations category:
   a. determine how lab personnel are being used
   b. screen specimens for quality
   c. review extent of processing and identification
   d. review contracts from suppliers, vendors, and reference laboratories
22. Screening specimens for quality prior to culture provides:
   a. a reduction in misleading results, preventing physicians from acting on incorrect data
   b. unnecessary quality control
   c. delays in processing specimens
   d. more work than is cost-effective for the microbiology department

23. Which is not a consideration of the extent of processing and identification:
   a. specimen type
   b. resources of laboratory
   c. needs of the physician
   d. NCCLS regulations

24. The extent of identification necessary for clinical isolates is dependent upon:
   a. the State of California regulations
   b. providing complete identification for every isolate to improve patient care
   c. the isolate’s nosocomial importance
   d. the level needed for patient care and the needs of the physician

25. Which of the following is not a cost effective procedure for anaerobic culture:
   a. processing material obtained by needle and syringe
   b. processing swab specimens from superficial wounds
   c. use of primary, selective, and differential media free of oxygen
   d. use of brief identification schemes including special potency disks and rapid spot tests

26. Blood cultures are often inappropriately used by:
   a. collecting 3-4 sets per day
   b. collecting the recommended volume of blood
   c. collecting one set per day
   d. collecting blood samples without contamination

27. One reason that lower respiratory specimen cultures may be misleading and expensive is:
   a. the specimen is obtained by personnel appropriately trained with specimen collection procedures
   b. the specimen is screened for quality prior to culture
   c. the specimen is not screened for quality prior to culture
   d. accepting one specimen per day

28. One method that does not decrease the cost of performing stool cultures is:
   a. providing proper collection and transport instructions
   b. rejecting specimen if patient hospitalized more than three days
   c. using screening biochemicals on potential pathogens
   d. using liquid back up broth
29. Decreasing the cost of performing urine cultures can be accomplished by:
   a. using good transport methods and using a urine preservative if the sample cannot be refrigerated
   b. batch-processing the samples within a 72 hour window
   c. accepting specimens when there is no evidence of refrigeration and the specimen is greater than 2 hours old
   d. the general workup of three or more bacterial isolates from a urine sample

30. It is essential for managers to know the true cost of each procedure because it:
   a. improves utilization
   b. improves the quality of specimens
   c. determines correct turn-around time
   d. allows accurate monitoring and comparison with other medical facilities
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City ____________________________________________
State/Zip ____________________________________________

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Payment Method __Check enclosed  __ Credit Card # ____________  Type - Visa / MC

Exp. Date ______  Signature ____________________________

Please circle the one best answer for each question.

1.  a □ b □ c □ d □  11.  a □ b □ c □ d □

2.  a □ b □ c □ d □  12.  a □ b □ c □ d □

3.  a □ b □ c □ d □  13.  a □ b □ c □ d □

4.  a □ b □ c □ d □  14.  a □ b □ c □ d □

5.  a □ b □ c □ d □  15.  a □ b □ c □ d □

6.  a □ b □ c □ d □  16.  a □ b □ c □ d □

7.  a □ b □ c □ d □  17.  a □ b □ c □ d □

8.  a □ b □ c □ d □  18.  a □ b □ c □ d □

9.  a □ b □ c □ d □  19.  a □ b □ c □ d □

10. a □ b □ c □ d □  20. a □ b □ c □ d □

Distance Learning Evaluation Form

According to state regulations, this evaluation must be completed and returned in order to receive CE hours. Your comments help us to provide you with better continuing education materials in the distance learning format. Please circle the number that agrees with your assessment.

1.  Overall, I was satisfied with the quality of this Distance Learning course.
   (strongly agree)  5  4  3  2  1 (strongly disagree)

2.  The objectives of this Distance Learning course were met.
   (strongly agree)  5  4  3  2  1 (strongly disagree)

3.  The difficulty of this Distance Learning course was consistent with the number of CE hours.
   (strongly agree)  5  4  3  2  1 (strongly disagree)

4.  I will use what I learned from this Distance Learning course.
   (strongly agree)  5  4  3  2  1 (strongly disagree)