

## TENETS OF SPECIMEN MANAGEMENT IN DIAGNOSTIC MICROBIOLOGY

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### ABSTRACT

The interpretation of microbiological results depends, to a large extent, on the quality of the samples received for investigations. Even with the advancements in laboratory automation and integration of molecular diagnosis in microbiology, interpretation of results still depends on the quality of specimens received. Therefore, an appropriate management of the samples is necessary to achieve an optimal diagnosis in microbiology laboratory. Recently, clinical microbiologists have begun to promote specimen management as a process critical to diagnostic success. Microbiology laboratory results that are accurate, significant and clinically relevant depend almost entirely on specimen management process. This article review the specimen management process, special skills and precise concepts required to collect the specimens for effective methods in diagnosis.

### KEYWORDS

Clinicians, Clinical microbiologist, Microbiology laboratory, Specimen management.

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## INTRODUCTION

Specimen management in diagnostic microbiology constitutes policies and procedures that guide collection, identification, storage, handling, safe transportation, processing and disposal of microbiology specimens, sufficiently stable to provide accurate and precise results suitable for clinical interpretation.<sup>1</sup> All microorganisms grow, multiply, and die very quickly. If any of those events occur during specimen collection, transport, or storage, the results of microbiologic analysis will be compromised and could be misleading. Therefore, attention to pre-analytical specimen management in microbiology is critical to accuracy, and diagnostic success.<sup>2</sup> Because result interpretation in microbiology depends entirely on the quality of the specimen submitted for analysis, specimen management cannot be left to chance, and those that collect specimens for microbiologic analysis must be aware of what the physician needs as well as what the laboratory needs, including ensuring that specimens arrive at the laboratory for analysis as quickly as possible after collection.<sup>3</sup>

### The Clinician and the Microbiology Laboratory

The critical role of the microbiology laboratory in infectious disease diagnosis calls for a close, positive working relationship between the physician and the microbiologist. The diagnosis of an infectious disease is best achieved by applying in-depth knowledge of both medical and laboratory science along with principles of epidemiology and pharmacokinetics of antibiotics and by integrating a strategic view of host-parasite interactions. Clearly, the best outcomes for patients are the result of strong partnerships between the clinician and the microbiologist.<sup>4,5</sup>

Clinicians should consult the clinical microbiologist to ensure that the selection, collection, transport, and storage of patient specimens are performed properly. At an elementary level, the physician needs answers to three very basic questions from the laboratory. Is my patient's illness caused by a microorganism? If so what is it? What is the drug susceptibility profile of the organism so therapy can be targeted? To meet these needs, the laboratory needs a specimen that has been appropriately selected, collected and transported to the laboratory for analysis. Caught in the middle, between the physician and laboratory, are those who select and collect the specimen and who may not know or understand what work the physician or the laboratory needs. Enhancing the quality of the specimen is everyone's job, so the interaction and communication between the physicians, nurses, and laboratory staff, and a clinical microbiologist should be encouraged openly.<sup>6,7</sup>

**Table 1. The responsibilities of microbiologist and clinician<sup>2</sup>**

The microbiologist responsibilities
• Provide a menu of the offered tests
• Provide cutoff times for receipt of specimens, and turnaround time for test results
• Provide guidelines for specimen collection and transport
• Maintain an effective computerized system for acknowledging receipt of specimens, and reporting of results
• Periodic publication of antimicrobial susceptibility patterns for the most commonly isolated bacteria in the institution
• Maintain a program of quality control that ensures the accuracy of all offered tests

### The clinician responsibilities

- Maintain knowledge of the laboratory test menu and specimen collection and transport guidelines
- Alert the laboratory when a specific organism is sought
- Prioritize test requests when a limited quantity of specimen can be collected
- Establish an open communication with microbiologist

### The Impact of Specimen Management

Specimen management in diagnostic microbiology is a new concept in the changing world of microbiology accreditation. Appropriate specimen management is critical to ensuring laboratory effectiveness and an acceptable turnaround time. Inaccuracies can affect laboratory efficiency, leading to repeat testing with resultant waste of personnel time, supplies, and reagents. The impact of proper specimen management on patient care is enormous.<sup>8,9</sup>

- It is the key to accurate laboratory diagnosis and confirmation
- Directly affects patient care and patient outcomes
- Influences therapeutic decisions
- Impacts hospital infection control
- Impacts patient's length of stay, hospital costs, and laboratory costs
- Influences laboratory efficiency

### Principles of Specimen Management

Microbiology specimen selection and collection are the responsibility of the clinicians, not usually the laboratory, although clinical microbiologist may be called upon for consultation. Clinicians and other medical personnel should consult clinical microbiologist to ensure that selection, collection, transport, and storage of patient specimens they collect are managed properly. Specific actions for handling various types of specimens may differ; however, the management process is essentially the same.<sup>10,11</sup>

The laboratory requires a true clinical specimen, not a swab of a specimen. Actual tissues, aspirates, and fluids are always specimens of choice, especially from surgery. A swab is not the specimen of choice for many specimens because swabs pick up extraneous microorganisms, hold extremely small volumes of the specimen (0.05 mL), make it difficult to get bacteria or fungi away from the swab fibers and onto media and the inoculum from the swab is often not uniform across several different agar plates (culture plates). Swabs are expected and ideal from nasopharyngeal and viral respiratory infections. Flocked swabs have become a valuable tool for specimen collection and have been shown to be more effective than dacron, rayon, and cotton swabs in many situations. The flocked nature of the swab allows for more efficient release of contents for evaluation. The laboratory must receive a specimen that is the representative of the disease process. Specimens submitted for the diagnosis of otitis media should not be sent on swabs since the flora on the swab will likely be that of the external ear canal. The specimen of choice is an aspirate from tympanocentesis. *Bordetella pertussis* and many respiratory viruses are primarily found in the nasopharynx, so a properly collected nasopharyngeal swab is preferred and essential for detection and diagnosis, rather than a nasal swab.<sup>2,9,11</sup>

The most important criteria of sample collection continue to be a specimen should be collected prior to administration of antibiotics. Once antibiotics have been started, the flora changes, leading to potentially misleading culture results. Specimens for anaerobic culture should be submitted under conditions that allow recovery of anaerobes.

Specimens must be labeled accurately and completely so that interpretation of results will be reliable. Labels such as “eye” and “wound specimens” are not helpful to the interpretation of results without more specific site and clinical information. (e.g. surgical site infection after laparotomy). Modern laboratories are advancing with bar coding. Thus, Microbiology laboratories need precise concepts, and special skills to collect the specimens for effective methods in diagnosis.<sup>12,13</sup>

The microbiology laboratory should be allowed to set technical policy with specific guidelines to create the optimal and standard operative procedures. A microbiology laboratory policy manual should be available at all times for all medical staff to review or consult and it would be particularly helpful to encourage the nursing staff to review the specimen collection and management portion of the manual. This can facilitate collaboration between the laboratory with the microbiology expertise, and the specimen collection personnel, who may know very little about microbiology or what the laboratory needs in order to establish or confirm a diagnosis. For a good laboratory practice, train all personnel responsible for collecting, handling, storage, transport and disposal of specimens. All the technical staff should follow the standard universal precautions while handling and disposing the microbiology specimens.<sup>1,2</sup>

Everything that grows on a culture plate is not a pathogen. Many body sites have normal microflora that can easily contaminate the specimen. Many junior staff and technical staff start reporting commensal and oral flora as pathogens thus providing irrelevant information that could result in inaccurate diagnosis and inappropriate therapy. Therefore, specimens from sites such as lower respiratory tract (sputum), nasal sinuses, superficial wounds, fistulae, and others require care in collection.<sup>14,15</sup>

**Table 2. Sites of infection where the specimen is likely to become contaminated during collection<sup>10</sup>**

Sites of infection	Contamination during collection
Middle ear	External ear canal
Lower respiratory tract	Oropharynx
Nasal sinus	Nasopharynx
Urinary bladder	Urethra and perineum
Endometrium	Vagina
Superficial wounds	Skin and mucus membranes
Fistulae	GI tract

Optimal specimen collection increases the capabilities of diagnostic reporting. Specimen collection and aseptic precautions in collection is a major concern to valid microbiology reporting. Disinfection of the site, if applicable, must be carefully considered during specimen collection. For example, it is imperative to disinfect the skin prior to collection of blood. Otherwise, skin flora may result in a false-positive culture. Severe life threatening septic complications including blood cultures in bacterial infections are contaminated due to lapses in specimen collection.<sup>16</sup> A frequently contaminated blood culture reports losses the confidence of physicians on microbiology departments. Blood culture and urine cultures contaminated with skin flora during collection are common problem encountered in diagnostic microbiology laboratories.<sup>16,17</sup>

**Table 3. Instructions and precautions for collection of mid-stream sample of urine<sup>11-13</sup>**

Female patients	Sterile specimen container	Male patients
Spread labia	Begin passing urine	Retract prepuce
Using plain soap or antiseptic wipe front to back	Stop flow in midstream	Clean glans penis using plain soap or antiseptic
Dry with tissue paper	Pass several mL into container without touching rim	Dry with tissue paper
	Recap container	
	Pass remaining urine into lavatory	
	Send specimen to laboratory immediately (refrigerate if prolonged transport time)	

Microbiology laboratory results that are reported should be accurate, significant, and clinically relevant, do not report *Streptococcus pneumoniae* from throat swabs. Drug susceptibility testing should be performed on clinically significant isolates, not on all microorganisms recovered in culture. Appropriate microbiology skills reduce super bugs. Refer peer reviewed diagnostic microbiology text books or else you are communicating the commensals and contaminants as pathogens and with misuse of antibiotic.<sup>18,19</sup> Specimen rejection criteria are essential in order to avoid providing inaccurate results. Specimens of poor quality must be rejected. Rejection of specimens must be done with wisdom and experience and be prepared to say “no” responsibly. Microbiologists should act correctly and responsibly when they call physicians to clarify and resolve problems with specimen submissions.<sup>10,16,17</sup>

**Storage of Specimens**

Most samples should be stored at 4°C, if the processing is not done within two hours after collection. The CSF sample for bacteriological examination should never be refrigerated as delicate pathogens such as Haemophilus influenzae may die; if delay is expected, it may be kept in an incubator at 37°C. For virus isolation, CSF may be kept inside the freezer. CSF being the most precious specimen should be examined immediately. Specimens for virus detection should be transported on wet ice and frozen at -80°C if testing is delayed for more than two hours; although specimens in viral transport media may be transported at room temperature when rapid delivery to the laboratory within two hours is assured.<sup>20,21</sup>

Diagnostic microbiology laboratory results that are reported should be accurate, significant, and clinically relevant. Unfortunately, clinical microbiologist services are not utilized to their fullest potential for patient care and welfare, Since most of the hospitals and medical institutions are under the administrative control of non-medical personnel, and diagnostic microbiology laboratories are kept under the control of technical staff who does not have a sound knowledge of clinical microbiology, and of course, due to corruption, which has become an order of the day in developing countries.<sup>19,21</sup>

**CONCLUSION**

Clinical microbiologists are responsible for all major issues and all phases of testing, specimen management, and educating clinicians using microbiology services. Therefore, diagnostic microbiology laboratories in medical institutions and hospitals must be placed under the supervision and direction of clinical microbiologists. Clinical microbiologists must made aware of purchase of instruments, reagents,

and chemicals, and allowed to discuss with suppliers because the specifications, technical know-how, and maintenance of the instruments and the quality and performance of reagents and chemicals play an important role in diagnostic testing and accuracy of the test results. Welcome and engage the microbiology laboratory as an integral part of the health-care team and encourage the hospital or the laboratory facility to optimize infectious disease laboratory.

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