The Importance of Quality Control (QC) for Antimicrobial Susceptibility Testing (AST)

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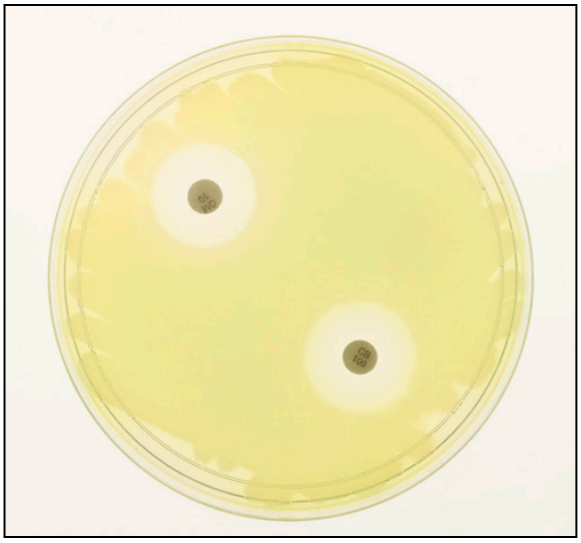

AST QC is a critical component of a Quality Control Plan (QCP) to ensure reliable patient results. Appropriately performed QC procedures monitor a test system's precision (i.e., repeatability and reproducibility), accuracy, and the performance of test reagents; as well as the performance of the laboratory personnel who test and report the results.[1,2]

Manufacturers of AST systems have a responsibility to follow good manufacturing processes that assure the integrity of the product and account for antimicrobial potency, stability and labeling. Laboratories (users) of the AST system have a different set of responsibilities, including:

- Storage of AST Minimal Inhibitory Concentration (MIC) panels, disks, and reagents under the environmental conditions recommended by the manufacturer
- Proficiency (e.g., training and regular competency assessment) of the laboratory personnel performing and reporting the results
- Use of current Clinical and Laboratory Standards Institute (CLSI) standards and/or manufacturer's instructions.[1,2,3]
- Following established procedures for AST
- Following requirements of local and national regulatory and accreditation agencies

When AST QC is not performed, or is performed incorrectly or inadequately, erroneous test results may be reported that are potentially harmful to the patient. Common examples of inadequate or improper QC measures include: 1) improper maintenance of QC organisms, 2) failure to perform QC on new lots or shipments of MIC panels or disks before reporting patient results, 3) incorrect inoculum preparation, and 4) incomplete training of laboratory personnel or failure to conduct

regular competency assessment of employees, especially when laboratory assignments do not allow frequent rotation into AST work areas. The following scenario demonstrates the potential ramifications of improper AST QC.

Day 1: A Suspected Outbreak

Several Enterobacteriaceae isolates with intermediate imipenem MICs are reported. Worried there is an outbreak of Carbapenem-Resistant-Enterobacteriaceae, the Infection Control department calls the lab for more information. The day-shift laboratory technologist quickly ascertains the elevated imipenem results are only from the new shipment lot of panels. Corrective action is implemented: 1) QC testing of the new lot is initiated, 2) all patient isolates tested on the new shipment lot are repeated on the current lot in use, and 3) Infection Control and the clinicians caring for the patients are immediately notified of a possible problem with a lot of materials affecting imipenem results.

Day 2: The Investigation

The imipenem MIC for QC strain *Pseudomonas aeruginosa* is out-of-range (8 mcg/ml) for the new shipment lot. All repeated patient imipenem results are susceptible when tested on the current lot. Tech support for the manufacturer is notified of the QC problem and the tech support representative reports no other out-of-range imipenem results with the new lot have been reported by other users. The lab stores and maintains QC strains correctly (see CLSI M07 Appendix E. QC Strain Maintenance)[2], therefore that common source of error is ruled out. The tech support representative suggests investigation of storage conditions because imipenem is particularly susceptible to degradation when environmental conditions are not optimal (see CLSI M100, Table 5G. MIC: Troubleshooting Guide).[3] QC testing of the new shipment lot is repeated.

Day 3: Answers

The imipenem MIC for QC strain *Pseudomonas aeruginosa* is again out-of-range (8 mcg/ml) for the new shipment lot. An investigation determines the probable cause of the error to be that the new shipment of MIC panels was allowed to sit in the loading dock area at temperatures exceeding 100°F for an extended period. When the shipment was finally delivered to the laboratory, no one in the lab was informed about the delay on the dock. To compound matters, MIC panels from the new shipment were inadvertently used for patient isolates on the evening shift, prior to QC testing which was scheduled for the next day.

Later: The Follow Up

The damaged shipment lot is discarded. Follow-up to the investigation is provided to Infection Control and all shifts of laboratory personnel. The laboratory QCP is modified to include: 1) documentation indicating time of delivery of MIC panels to the hospital and time of receipt in lab, including notations if environmental conditions are outside the range specified by the manufacturer, and 2) labeling of new shipments of AST MIC panels to indicate whether QC testing has been completed satisfactorily and panels are cleared for use.

QC AND RISK MANAGEMENT

AST QC is part of a larger QCP to provide consistent quality results and recognize risks and hazards. Besides QC testing, a well developed QCP includes monitoring, corrective action, maintenance/calibration, recordkeeping, and training and competency assessment. CLSI guidance document EP23-A, Laboratory Quality Control Based on Risk Management [4] provides instructions to laboratories for developing a customized QCP for their own laboratory setting. The document further details processes for risk assessment to determine weaknesses in the QCP and risk mitigation to reduce the potential for errors that could cause harm to patients. An effective QCP that includes risk management will enhance the overall quality of the test result.

Biography:

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Susan Munro is currently employed as a Technical Specialist Consultant to the Clinical Microbiology Laboratory at VA Palo Alto Health Care System. She recently retired from the Clinical Microbiology Laboratory at Stanford University Medical Center in Palo Alto, California.

Ms. Munro has served as an advisor or reviewer for the CLSI Subcommittee for Antimicrobial Susceptibility Testing for many years, and she is a member of two CLSI Working Groups: Text and Table Revision, and Quality Control. In 2011, she was selected to chair a new CLSI User QC Ad Hoc Working Group to improve QC recommendations.

At the national ASM level, Ms. Munro was honored to be the recipient of the ASM 2011 Scherago-Rubin Award, in recognition of excellence in clinical microbiology at the bench-level. She is the author of the Disk Diffusion chapter of ASM Clinical Microbiology Procedures Handbook, 4th Edition (in press). She was a member of ASM's Clinical Microbiology Task Force, Working Group for Evidence-Based Practice Guidelines.

Ms. Munro has been an active member of the Program Planning Committee, Northern California Branch ASM for several years, and was recently elected to serve as Alternate Councilor.

References:

CLSI. M02-A11, Performance Standards for Antimicrobial Disk Susceptibility Tests; Approved Standard--11th ed. Clinical and Laboratory Standards Institute. Wayne, PA ----------. 2012

CLSI. M07-A9, Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria that Grow Aerobically; Approved Standard--9th ed. Clinical and Laboratory Standards Institute. Wayne, PA ----------. 2012

CLSI. M100-S24, Performance Standards for Antimicrobial Susceptibility Testing; 24th Informational Supplement. Clinical and Laboratory Standards Institute. Wayne, PA ----------. 2014

CLSI. EP23-A, Laboratory Quality Control Based on Risk Management; Approved Guideline. Clinical and Laboratory Standards Institute. Wayne, PA ----------. 2011