Quality Assurance and Proficiency Testing in the Mycobacteriology Laboratory

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Bellevue Hospital - NYU School of Medicine - 1893

- 1902 - municipal hospital on Blackwell's Island
- 1903 - Bellevue TB service
- 1908 - Bellevue ferry boat for care of children
- 1930 - 500 bed Bellevue Chest Pavilion
Changing Principles of TB Therapy

• The first principle: choose drugs to which the organism is susceptible. Fortunately, this presents little difficulty in the US where the vast majority of new cases are caused by Mtb which is susceptible to all major drugs.

• In a patient who has never been treated before, therapy with 2 or 3 drugs may be initiated without awaiting results for susceptibility studies.

Harrison's Principles of Internal Medicine 1977

• Given the high rate of resistance to INH and RIF in NYC, all initial isolates should have drug susceptibility testing performed. Pending results, begin all patients on 4 medications INH, RIF, PZA, EMB.

• Ideally, every patient should receive every dose on a program of directly observed therapy (DOT).

NYC Department of Health, 1992
**TB Cases 1990-2000 Adults age 15 - 44**

*WHO Global TB Program estimates*

<table>
<thead>
<tr>
<th>Region</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>120,000</td>
</tr>
<tr>
<td>Western Europe</td>
<td>420,000</td>
</tr>
<tr>
<td>Latin America, Caribbean</td>
<td>3,200,000</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>1,100,000</td>
</tr>
<tr>
<td>No. Africa, Middle East</td>
<td>4,200,000</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>9,200,000</td>
</tr>
<tr>
<td>East Asia &amp; Pacific</td>
<td>10,400,000</td>
</tr>
<tr>
<td>South &amp; SE Asia</td>
<td>17,900,000</td>
</tr>
<tr>
<td>Australia, NZ</td>
<td>11,000</td>
</tr>
</tbody>
</table>
Increasing Complexity - Increasing Opportunities for Error

NAAT’s
PDCA ("Plan-Do-Check-Act") a four-step problem-solving process typically used in quality engineering is also known as the Deming Cycle, Shewhart cycle, Deming Wheel, or Plan-Do-Study-Act.

1. PLAN Establish the objectives and processes necessary to deliver results in accordance with the specifications
2. DO Implement the processes.
3. CHECK Monitor and evaluate the processes and results against objectives and Specifications and report the outcome.
4. ACT Apply actions to the outcome for necessary improvement. This means reviewing all steps (Plan, Do, Check, Act) and modifying the process to improve it before its next implementation.

- In Six Sigma programs, the PDSA cycle is called "Define, Measure, Analyze, Improve, Control" (DMAIC).
Quality Assurance - QA

• a set of planned and systematic actions necessary to provide appropriate confidence that a product or service will satisfy the requirements for quality. QA is a wide range concept concerning all the matters collectively or individually, which directly affect the quality of product. It controls the quality of a product by doing in-process quality checks, effectively functioning as the brain of an organization.

i.e.

• smear review policy - 2nd observer reviews all positives and 10% of negatives
• SNOP - Smear Negative One Positive
CLIA does not detail specific QA monitors nor remedial action. Any plan should be appropriate to define and resolve patient test management problems.

- **Does your Mycobacteriology Laboratory monitor delivery time to assure that less than 24 hours have elapsed between specimen collection and its arrival at the laboratory?**

- **Reduce TAT** - date and time of collection should be required on the specimen submission form, and the date and time of receipt should be noted by the laboratory. A monthly or weekly recording of these times by sample for a measured number or percent of specimens will provide documentation.

- This documentation can be used to work with provider/clients to reduce the time of specimen delivery to the laboratory. TB specimens should be delivered to the laboratory as soon as possible, but no longer than 24 hours after collection.
EQA specimens

- **Graded analyte:**
  An analyte for which challenges are evaluated and scored - proficiency testing (PT).

- **Alternative assessments:**
  The determination of laboratory testing performance by means other than graded specimens, for example, split sample testing, testing by a different method, etc.
What is proficiency testing and why must I do it?

• It is a form of external quality assurance (EQA).

• Testing unknown specimens from an external source and comparing results among laboratories gives confidence in quality laboratory testing results.

• Although laboratories perform internal QC & QA, External Quality Assurance provides important inter-laboratory comparisons to determine the accuracy and reliability of the testing procedures.

• Proficiency testing (PT) is mandated by CLIA.

CLIA APPROVED PROFICIENCY TESTING PROGRAMS - 2008

Laboratory Practices for Diagnosis of Tuberculosis - US 1994

- CLIA 88 requires mycobacteriology laboratories to enroll in federally approved proficiency testing (PT) programs.

- The PT programs submit samples of unknown content to laboratories for testing in the same manner as actual patient specimens; the laboratories subsequently report methods and test results to the program.

- In 1994, the U.S. Department of Health and Human Services approved six PT programs for mycobacteriology testing: five programs (CAP; states of NJ, NY, WI, & Puerto Rico) provide PT testing for AFB smears, growth detection, organism ID, and DST; and one program (the American Association of Bioanalysts) for AFB smears only.

Essentials of EQA Programs

- Voluntary; i.e. anonymous self-assessment to improve testing & prepare laboratories to satisfy mandatory requirements. Results reported on aggregate data of all participating laboratories.

- Mandatory. i.e. graded, satisfactory performance **required** for accreditation

- Characterized cultures resembling those encountered in clinical testing

- Summary of methods and results by all participant laboratories

- Mechanism for improvement of performance

- Detection of problems with test systems and reagents

- Receipt of reference strains of M. tuberculosis and nontuberculous mycobacteria to be used for future quality control

- Access to sources for technical consultations.
Survey E - AFB smear, culture, ID, DST -

For laboratories performing comprehensive mycobacteriology procedures. Include five simulated clinical isolates for identification (one of which is to be used for antimycobacterial susceptibility testing), plus one specimen for performing an AFB smear.

Survey E1 - AFB smear, culture

For laboratories performing concentration for AFB smears and/or isolating mycobacteria to be referred to another laboratory for identification. Includes five simulated sputum specimens for acid-fast smears and/or for the determination of the presence or absence of AFB by culture.
NYS Mycobacteriology Proficiency Testing Categories

Smears only
Only process and examine smears for AFB - submit all specimens for growth detection and identification to a reference laboratory.

Restricted
Process and examine smears, isolate and identify Mycobacterium tuberculosis complex. Also isolate and identify M. avium complex, M. gordonae, and may isolate mycobacteria other than MTB complex and submit these to a reference lab for ID.

Restricted -S
This category is for labs performing testing in the Restricted category who also perform susceptibility testing. Labs in this category must identify M. tuberculosis.

General
This category is for laboratories that process and examine acid fast smears for Mycobacteria and also isolate and identify any and all Mycobacteria.

General -S
This category is for labs performing testing in the General category description who also perform susceptibility testing. Labs in this category must identify M. tuberculosis.
PT allows comparison of methods between laboratories

**Staining Methodology Breakdown**
**March 2008**

- **Carbol Fuchsin**: 54%
- **Fluorochrome**: 34%
- **Not Reported**: 12%

Of 13 Total errors, laboratories using Carbol Fuchsin reported 8, 5 of which were false positive, and 3 were false negative.

The 5 remaining errors were reported by laboratories using Fluorochrome methods, 4 of which were false positive and 1 false negative.
PT allows comparison of methods between laboratories

Liquid Growth Media
Mycobacteriology PT March 2008

- Bactec Alert 16%
- Bactec9000 MB 1%
- Septicheck 5%
- Versatrek 4%
- 7H9 14%
- Bactec 12B 5%
- MGIT 55%
PT allows comparison of results between laboratories

**Microscopy Grade Distribution**
NYS Proficiency Testing March 2008

<table>
<thead>
<tr>
<th>Grades</th>
<th>NYS Permit Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>107</td>
</tr>
<tr>
<td>80</td>
<td>13</td>
</tr>
<tr>
<td>0</td>
<td>4*</td>
</tr>
<tr>
<td></td>
<td>(N=124)</td>
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</table>

*All zeros were due to improper or lack of entry into EPTRS.

**Growth Detection Score Distribution**
NYS Proficiency Testing March 2008

<table>
<thead>
<tr>
<th>Scores</th>
<th>NYS Permit Laboratories</th>
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</thead>
<tbody>
<tr>
<td>100</td>
<td>63</td>
</tr>
<tr>
<td>90</td>
<td>11</td>
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<tr>
<td>80</td>
<td>3</td>
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<tr>
<td>&lt;80</td>
<td>3</td>
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**Susceptibility Grade Distribution**
NYS Proficiency Testing March 2008

<table>
<thead>
<tr>
<th>Scores</th>
<th>NYS Permit Laboratories</th>
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</thead>
<tbody>
<tr>
<td>100</td>
<td>16</td>
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<tr>
<td>91-95</td>
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</tr>
<tr>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>&lt;80</td>
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**Final Grade Distribution**
NYS Proficiency Testing March 2008

<table>
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<th>Scores</th>
<th>NYS Permit Laboratories</th>
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<td>85-89</td>
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</tr>
<tr>
<td>80</td>
<td>5</td>
</tr>
<tr>
<td>&lt;80</td>
<td>5</td>
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</table>
For complex testing

Critique of results between laboratory categories

### Susceptibility Results

<table>
<thead>
<tr>
<th>Category</th>
<th>SM</th>
<th>INH</th>
<th>Rif</th>
<th>EMB</th>
<th>PZA</th>
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</thead>
<tbody>
<tr>
<td>#0821</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>#0822</td>
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<td>1</td>
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<tr>
<td>#0825</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
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### Source
- SAMPLE #0821: Susceptible to all five first line drugs (AFB0701879)
- SAMPLE #0822: Resistant to Rif (AFB0702823)
- SAMPLE #0823: Resistant to PZA (AFB0701877)
- SAMPLE #0824: Resistant to PZA (AFB0702073)
- SAMPLE #0825: Not M. tuberculosis complex (AFB0702274)

**NOT TB COMPLEX**

- Yellow: False Resistance
- Magenta: False Susceptible

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