



An Introduction to Laboratory for TB Nurses

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TB Diagnostic Methods

- **IGRA (Interferon Gamma Release Assay)**
- **AFB Smear**
- **Nucleic Acid Amplification**
- **AFB Culture**

- Clinical Presentation
- TST (Tuberculin Skin Test)
- X-ray







IGRAs

- Which tube do I use?
 - T-spot (heparin – green top tube)
 - QFT – tubes that come with the kit or a heparin – green top (if your lab will let you.....)
- Which lab do I send it to? How do I get it there?
- How quickly do I need to have it to the lab?
- How do I store the tube until transport?



QuantiFERON[®]-TB Gold Plus



| | |
|---|--|
|  | Mitogen – Positive Control Low response may indicate inability to generate IFN- γ |
|  | Nil – Negative Control Adjusts for background IFN- γ |
|  | TB1 – Primarily detects CD4 T cell response |
|  | TB2 – Optimized for detection of CD4 and CD8 T cell responses |



- Essentially 2 tests in one blood draw
- TB1 and TB2 should be close in value

Sputum specimens

- Who should I collect sputum from
 - Patients with respiratory symptoms
 - Patients with an abnormal CXR



Bacteriologic and histologic Examinations

Especially when lung or larynx is site of disease:

- 3 sputum specimens for AFB smear and culture
- Collected 8-24 hours apart with at least 1 early morning specimen



Specimens should be obtained in an isolated, well-ventilated area or sputum collection booth

Bacteriologic and histologic Examinations

- Sputum collection should be directly supervised
- For patients unable to cough up sputum, deep coughing may be induced

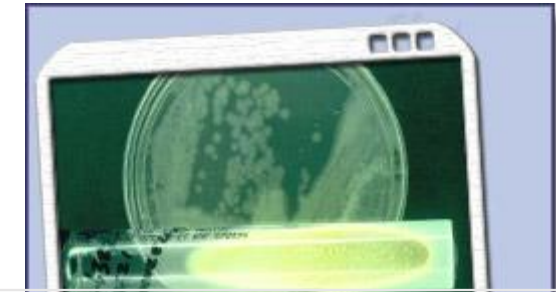


Bacteriologic and histologic Examinations

Extrapulmonary Specimens

- Urine
- Cerebrospinal fluid *
- Pleural fluid *
- Pus
- Biopsy specimens

*recovery poor



**Do NOT collect
specimens in Formalin**



Laboratory Examination

AFB Smear

- First clue
- Presumptive diagnosis only

- Fluorochrome staining preferred method
- Results available in 24 hours
- Many patients have negative AFB smears

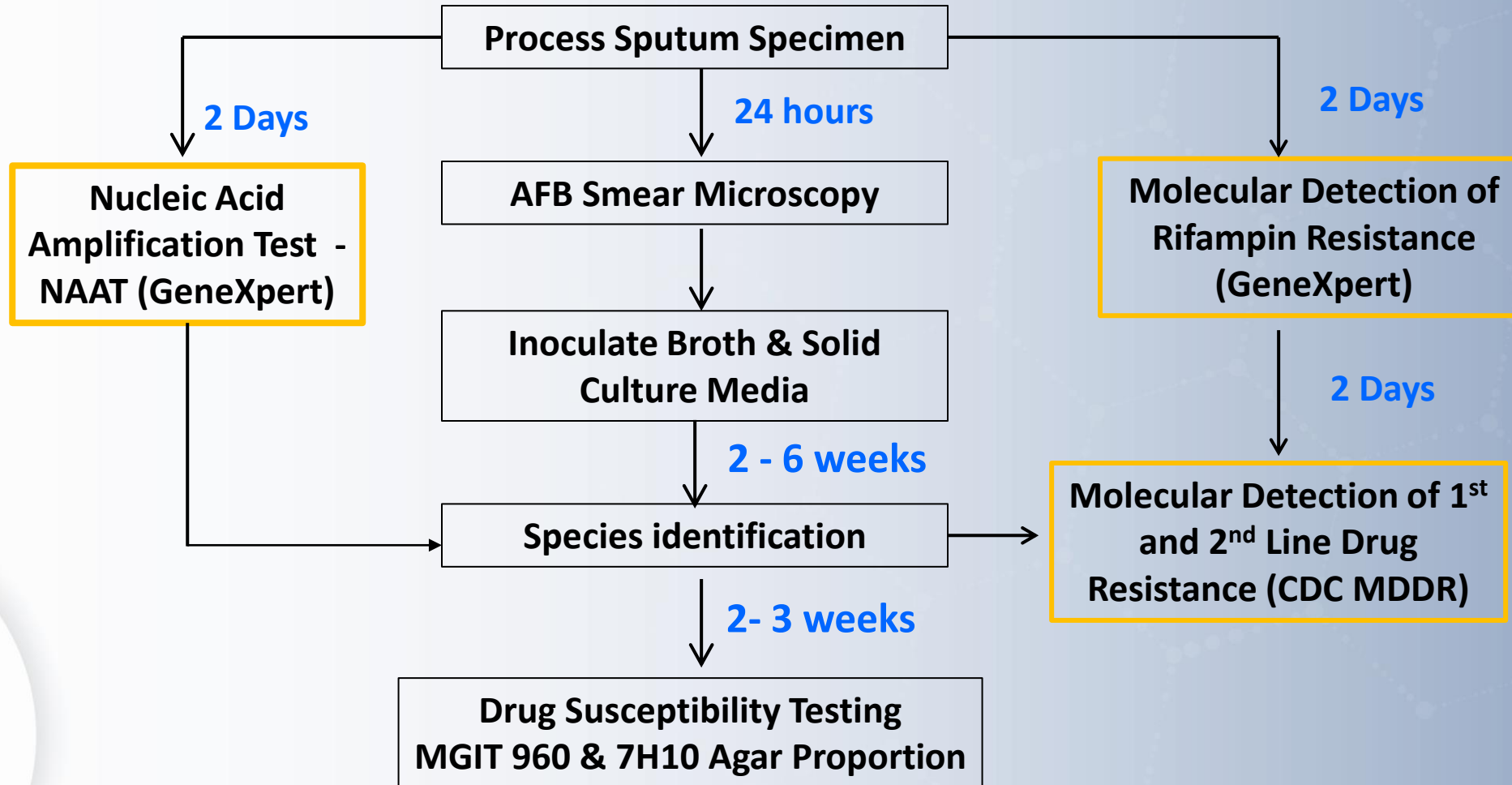


Specimen Quality

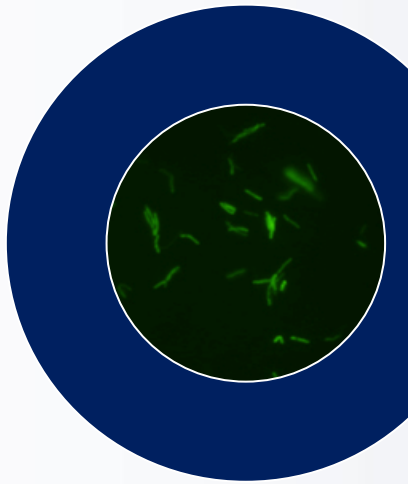
- Accurate laboratory results are directly proportional to the quality of the specimen
- Sputum
 - *Recently* discharged material from the bronchial tree, with minimal amounts of upper respiratory tract secretions
 - Well coached patient, collect at least 3 ml
 - Label tube, form, and indicate test:
 - Initial Dx: Smear, NAAT, & Culture
 - Follow-up: Smear and Culture
 - Release from respiratory isolation?
 - Order Smear only
- Transport to lab cool and quickly



TB Laboratory Testing Algorithm



AFB Smear



one
microscopic
field

| CAP | ATS | Interpretation | AFB/ml sputum | Infectiousness of patient |
|------------------|------------------|---------------------|---------------|---------------------------|
| negative | negative | negative | <5,000 | probably not infectious |
| 1 or 2 per smear | 1 or 2 per smear | weakly positive | ~5,000 | probably infectious |
| <1 per field | 1+ | moderately positive | ~10,000 | probably infectious |
| | 2+ | moderately positive | ~100,000 | probably infectious |
| 1-10 per field | 3+ | strongly positive | ~1,000,000 | probably very infectious |
| >10 per field | 4+ | strongly positive | >1,000,000 | probably very infectious |

Nucleic Acid Amplification Tests (NAAT)

- Tiny amounts of DNA/RNA are amplified (copied) until there is enough for easy detection
- DNA/RNA is examined
 - Identification
 - Detection of Drug Resistance
- Test turnaround time measured in hours



Nucleic Acid Amplification Test (NAAT)

- Detects *M. tuberculosis* complex nucleic acids; **does not distinguish between live and dead bacilli**
 - For initial diagnosis only
 - Not suitable for follow-up specimen or monitoring; cured patients may be NAAT + for years!
- Sensitivity compared to TB culture
 - >95% for AFB smear-positive
 - Only 55-75% for AFB smear-negative
- Does not replace culture for bacteriological Dx



Laboratory Examination

Cultures

Used to confirm diagnosis

- Perform on ALL specimens regardless of AFB smear results
- Results available in 10 to 14 days (on liquid media, e.g. BACTEC)

TB may be diagnosed on the basis of signs and symptoms in the absence of a + culture



AFB Culture

- More sensitive than smear
 - 5,000 to 10,000 AFB/ml for smear
 - ~10 viable AFB/ml for culture
- Positive for only ~85% of Pulmonary TB
 - Requires a quality specimen
 - May be invalid due to contamination
- Used to monitor patient response to treatment (like smear)
- Required for drug susceptibilities & genotype
- Lengthy
 - 1-6 weeks by liquid media
 - 2-8 weeks by solid media



Drug Susceptibility Testing (DST) of *M. tuberculosis* complex

Current Recommendations

- Initial isolate should be tested against first-line drugs (FLD)
 - Isoniazid, Rifampin, Ethambutol, Pyrazinamide
 - Repeat test if patient cult+ after 3 mo. Rx
- For isolates resistant to Rifampin or to any 2 FLDs: **test second-line drug panel**
 - Minimum: Fluoroquinolone, Ethionamide, & Injectable (Amikacin, Capreomycin, Kanamycin)



Molecular Detection of Drug Resistance

- Examining DNA of specific genes for mutations known to be associated with phenotypic resistance
- Rapid - analysis takes less than 1 day
- Can be done on culture isolates or directly on NAAT+ specimens



CDC Molecular Detection of Drug Resistance (MDDR)

• Test Indications

- Known/suspect DR case or contact to DR case
- Previous TB Treatment
- Patient from area with high rate of DR TB
- Large public health impact
- Mixed or nonviable culture



CDC Molecular Detection of Drug Resistance (MDDR)

- Provides 2-3 day DNA sequence analysis for drug resistance prediction
 - 7 classes of anti-TB drugs sequenced
- MDDR complements conventional DST
 - Used alone, MDDR and conventional DST are imperfect
 - Used together, accuracy of drug resistance or susceptibility detection can be improved.
- Conventional DST results are still needed to confirm susceptibility to individual drugs.



Summary

- Make friends with the laboratory that processes your specimens. Often if you can tell them what you are trying to do, they will help you get there
- Like most things we do, quality matters. That goes for the specimens that are sent to the laboratory
- Molecular tests are one of the biggest jumps forward in information informing patient decisions



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Questions?

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