Introduction to Laboratory Medicine

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Learning Objective:

Understand the "cycle of laboratory testing" and how it relates to turn-around-time

What pathologists do: (clinically)

We receive <u>any</u> tissue or fluid sample (from an FNA to a whole patient) and use <u>any</u> method (from gross visualization to DNA sequencing) to either make a diagnosis or provide a clinician with diagnostically or prognostically relevant information

Transfusion medicine

Tests per year (at CUMC):

Total:	**5,000,000**
"Anatomic pathology":	
Autopsy:	**250**
Surgical pathology:	**59,000**
Cytopathology:	**60,000**

Tests per year (at CUMC):

Total:	**5,000,000**
"Laboratory medicine":	**4,900,000**

Microbiology	**Clinical chemistry**
Molec. Diagnosis	**Transfusion medicine**
Coagulation	**Toxicology**
Cytogenetics	**Immunology**
Hematology	**Flow cytometry**
Immunogenetics	**Informatics**

Anatomic Pathology vs. Lab Medicine

Morphology:
- **gross, light microscopy, special stains, immunofluorescence, EM**

Quantitative and qualitative Analytical methods

Anatomic Pathology vs. Lab Medicine

Hematopathology:
- **Diagnosis of APL**
  - **Clinical history**
  - **CBC and smear**
  - **Bone marrow aspirate**
  - **Cytochemistry and IHC**
  - **Bone marrow core biopsy**
  - **Molecular Dx: PCR for t15-17**
  - **Cytogenetics: FISH for t15-17**
  - **Flow cytometry**

Border skirmishes:
- **Dermatopathology**
- **Bone marrow aspirates**
- **Oral pathology**
- **Genetic testing**
- **Microbiology**
- **Muscle and nerve biopsies**
- **Tissue typing**

What pathologists do: (research)

Develop molecular, mechanistic understanding of how the pathogenesis of a disease leads to morphological changes and clinical consequences.

The goal is for this increased understanding to suggest new diagnostic approaches and new treatment regimens.

The cycle

of

laboratory testing

Idea

Order/Request

Collect

Transport

Receive

Accession

Analyze: prepare, perform, verify

Report

Assimilate

Control

Idea

What test?

Why?

Necessity?

Turn-around-time (TAT):
- **Seconds (Glucose POCT)**
- **Minutes (STAT BMET)**
- **Hours (Routine ELISA)**
- **Days (Blood culture)**
- **Weeks (TB susceptibilities)**

How good is it? Sensitivity/Specificity

Order/Request

Paper: formal requisition, prescription, FAX

Computerized physician order entry (CPOE)

Verbal: Phone call, yelling, etc.

Documentation:
- **ordering physician**
- **ordering location, phone #, etc.**
- **signatures**

Errors:
- **wrong requisition**
- **wrong box checked**
- **requisition discarded**

Collect

Phlebotomy:
- **Venous**
- **Finger stick**
- **Arterial**
- **Central line**
- **Pediatric**

Urine

CSF

Sputum, wound, oral, eye, etc.

Tissue: bone marrow, lung biopsy, autopsy, etc.

Temperature: RT, 4°C, 37°C, frozen

Potential errors: mislabeling

The Washington Post

"Patient Dies From Blood Mismatch"
Friday, August 29, 2003

A woman who switched beds to be closer to the window died after she was given the wrong type of blood during surgery at Inova Fairfax Hospital. A technician had taken a blood sample from her roommate, hospital officials confirmed this week.
The death came at the end of a chain of events that began when a technician went to the unidentified patient's room to draw blood so the laboratory could determine her blood type for an operation the next day.

Potential errors: mislabeling

But the technician collected the sample from the patient on the wrong side of the curtain in the semiprivate room. The technician may have failed to perform two identification screens that were required: checking the name on the patient's plastic hospital bracelet and asking the patient to state her name aloud, said Russell Seneca, chairman of surgery at the hospital.

"The technician doesn't recall whether she asked the patient her name or not or whether she checked the armband," Seneca said. "I'm not certain what transpired between the technician and the patient whose blood was drawn."

Potential errors: mislabeling

The next day, surgeons performed a bowel resection on the woman, removing an abscess in her colon that perforated an intestinal wall.

The woman received two pints of the wrong blood during the operation, and toward the end, it became apparent that her blood was not clotting properly. In the recovery room, she plunged into an acute hemolytic transfusion reaction.

The medical team tried numerous treatments to reverse the reaction, but the woman died about 5:30 a.m. on July 24.

Potential errors: mislabeling

Saunders said an internal probe has prompted changes; a second person now accompanies a technician to draw blood for cross-matching and typing to guard against misidentification.

"This was a human error," Saunders said. "This individual who made the error failed to follow our procedures for identification."

The worker, who also was unidentified, was so distraught that she resigned, Saunders said. "Because of the grief ... we want to protect her privacy. We would prefer to just let you know this was an exemplary employee who never had a problem like this before."

Transport

Sneakers

Pneumatic tubes

Point-of-care (POC)

Taxi, van, courier, etc.

FedEx, DHL, etc.

Receive

Acknowledge receipt:
- Verbal
- Computer
- Pen
- Wand bar code

Read

Talk

Empty bench

Accession

Automated: bar code

Computerized

Pen and paper

Analyze: prepare, perform, verify

Visually inspect: hemolysis, lipemia, etc.
Chemical analysis: spectrophotometry, etc.
Immunoassays: ELISA, agglutination, flow cytometry, etc.
Microscopy: blood smear, gram stain, FISH, etc.
Culture: bacteria, fungi, viruses, fibroblasts
Molecular: Southern blots, PCR, sequencing, etc.

Controls: positive/negative, high/low
Quality assurance: within-run and between-run variation
Proficiency testing: NYS, CAP
Inspections: JCAHO, CAP, NYS, FDA, AABB, FACT, etc.

Report

To whom?
- Ordering MD
- Primary care MD?
- Consultants?
- Floor?

Paper: mail, FAX, FedEx, etc.

Hospital/Laboratory Information System (HIS/LIS)

Email

Phone: critical values

Blackberry, etc.

Assimilate

When?

How use the information?

Is it correct? Does it fit?

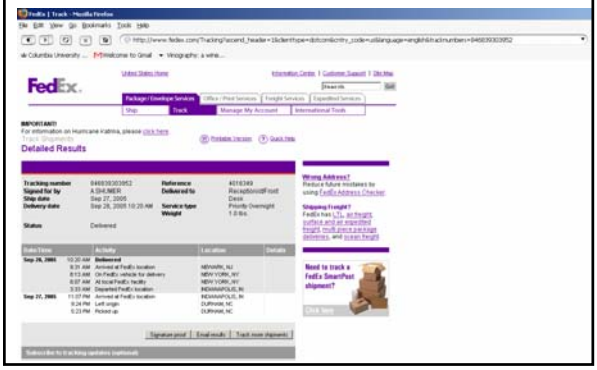
Repeat for confirmation?

Alternative tests for confirmation?

Control:
efficiency, timeliness, productivity, cost containment

- **Idea: education**
- **Order/Request: algorithms, repeat testing**
- **Collect: who, time of collection, training**
- **Transport: who, how, timing**
- **Receive: timing**
- **Accession: timing**
- **Analyze (prepare, perform, verify): timing of each step**
- **Report: timing**
- **Assimilate: ??**

Control:
efficiency, timeliness, productivity, cost containment



Turn-around-time (TAT)

Idea
Order/Request
Collect
Transport
Receive
Accession
Analyze: prepare, perform, verify
Report
Assimilate

Control

Turn-around-time (TAT)
Patient

Idea
Order/Request
Collect
Transport
Receive
Accession
Analyze: prepare, perform, verify
Report
Assimilate

Control

Turn-around-time (TAT)
Clinician

Idea
Order/Request
Collect
Transport
Receive
Accession
Analyze: prepare, perform, verify
Report
Assimilate

Control

Turn-around-time (TAT)
Laboratory

Idea
Order/Request
Collect
Transport
Receive (acknowledged)
Accession
Analyze: prepare, perform, verify
Report (on LIS)
Assimilate

Control

Final Thoughts

1. Turn-around-time (learning objective)
2. Specimen labeling
3. Pathology = Truth
4. Lab Error
5. Call us