

## Introduction to Laboratory Medicine

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## What pathologists do: (clinically)

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

### Tests per year (at CUMC):

Total: 4,900,000

#### “Anatomic pathology”:

Autopsy: 270  
Surgical pathology: 59,000  
Cytopathology: 60,000

### Tests per year (at CUMC):

Total: 4,900,000

“Laboratory medicine”: 4,800,000

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, 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

### 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?

Accession

Analyze: prepare, perform, verify

Report

### Control: efficiency, timeliness, productivity, cost containment

Idea: education

Order/Request: algorithms, repeat testing

Collect: who, time of collection, training

Transport: who, how, timing

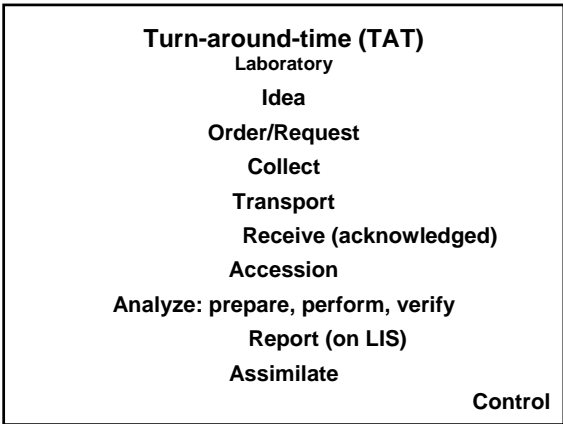
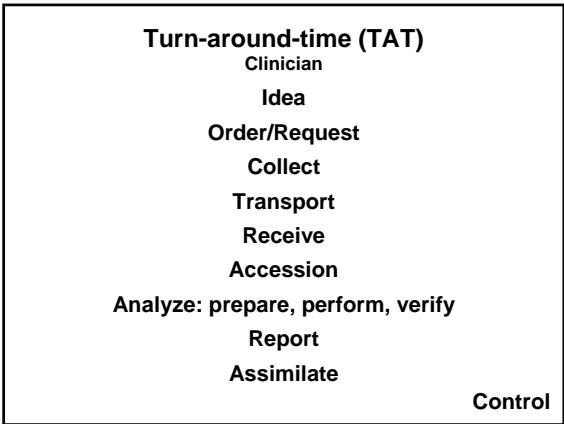
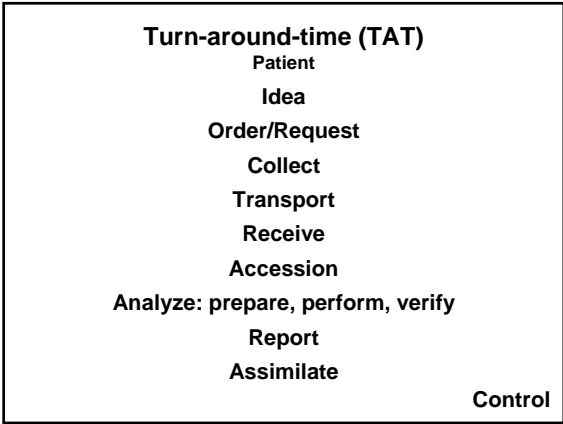
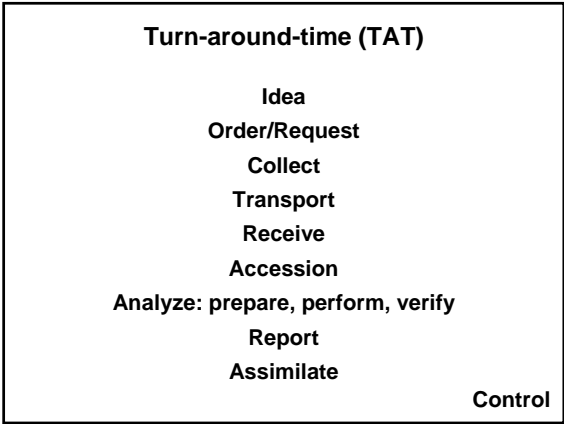
Receive: timing

Accession: timing

Analyze (prepare, perform, verify): timing of each step

Report: timing

Assimilate: ??



- Final Thoughts**
1. Turn-around-time
  2. Specimen labeling
  3. Pathology = Truth
  4. Lab Error
  5. Call us