

Introduction to Laboratory Medicine

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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

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

Transfusion medicine

Anatomic Pathology vs. Lab Medicine

Morphology:

gross, light microscopy, special
stains, immunofluorescence, EM

Quantitative and qualitative
Analytical methods

Tests per year (at CUMC):

Total: 4,900,000

“Anatomic pathology”:

Autopsy: 270

Surgical pathology: 59,000

Cytopathology: 60,000

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

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

Control

**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.

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

**The cycle
of
laboratory testing**

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 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

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

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."

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."

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

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.

Accession

Automated: bar code

Computerized

Pen and paper

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

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

Control: efficiency, timeliness, productivity, cost containment

Idea: education

Order/Request: algorithms, repeat testing

Collect: who, time of collection, training

Transport: who, how, timing

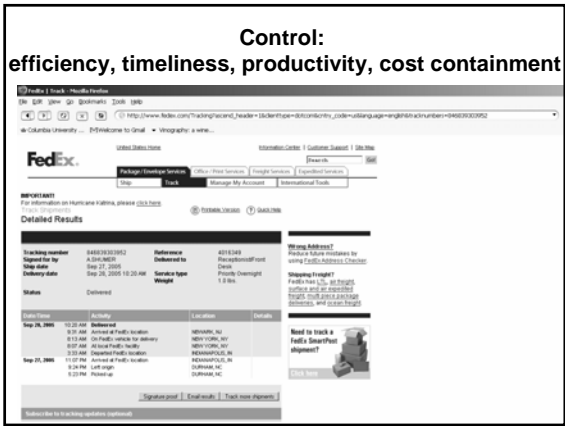
Receive: timing

Accession: timing

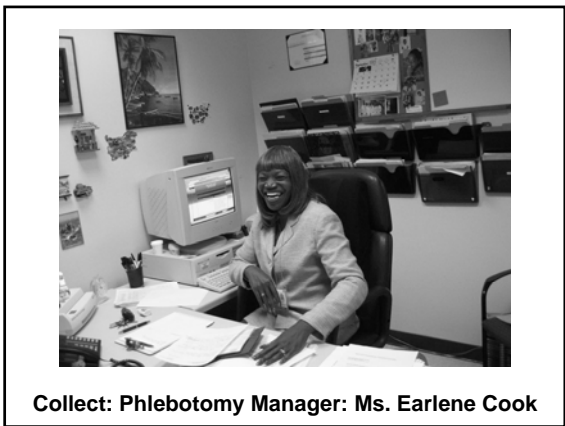
Analyze (prepare, perform, verify): timing of each step

Report: timing

Assimilate: ??



Collect: Print collection list



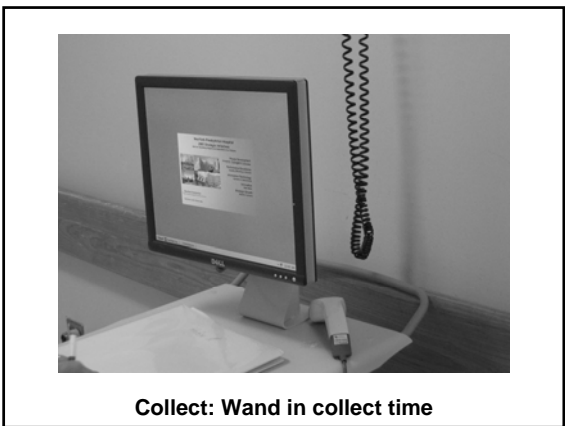
Collect: Phlebotomy Manager: Ms. Earlene Cook



Collect: Draw patient



Collect: Print labels



Collect: Wand in collect time



Transport: Walk to tube station



Receive: Core Laboratory



Transport: Send samples through pneumatic tube



Accession: Core Laboratory



Director of the Core Laboratory: Dr. Daniel Fink



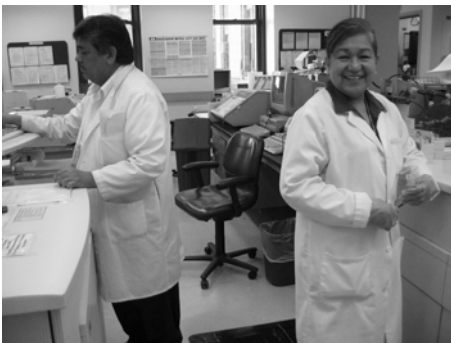
Prepare: Core Laboratory



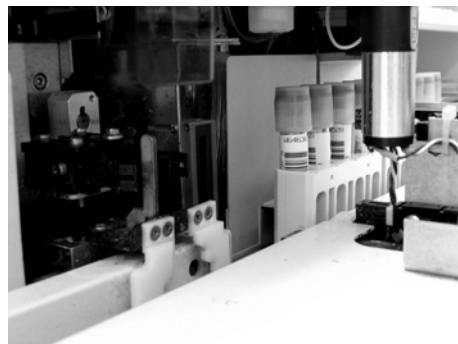
Analyze: Core Laboratory; chemistry



Analyze: Core Laboratory; hematology



Analyze: Core Laboratory; chemistry



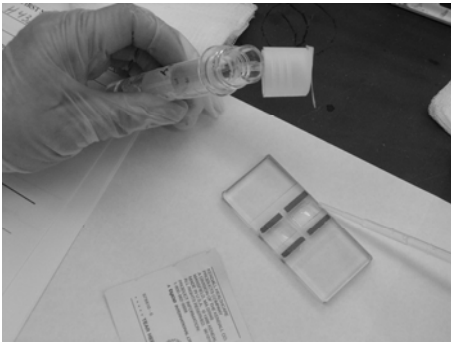
Analyze: Core Laboratory; hematology



Analyze: Core Laboratory; chemistry



Analyze: Core Laboratory; hematology



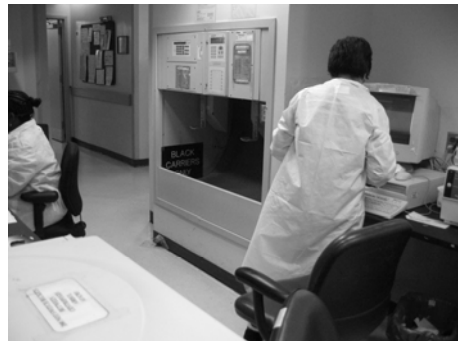
Analyze: Core Laboratory; hematology



Report: Core Laboratory



Analyze: Core Laboratory; hematology



Receive: STAT Laboratory



Analyze: Core Laboratory; hematology



Accession: STAT Laboratory



Accession and analyze: STAT Laboratory



Director of Transfusion Medicine: Dr. Hal Kaplan



Analyze: STAT Laboratory



Receive: Blood Bank



Analyze: STAT Laboratory



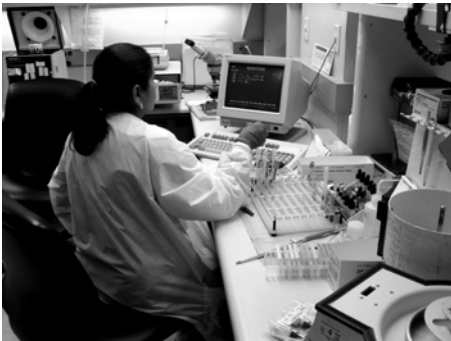
Receive: Blood Bank



Analyze: Blood Bank



Dispense: Blood Bank



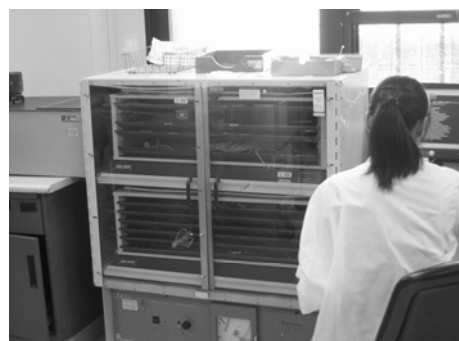
Analyze: Blood Bank



Dispense: Blood Bank



Analyze: Blood Bank



Dispense: Blood Bank



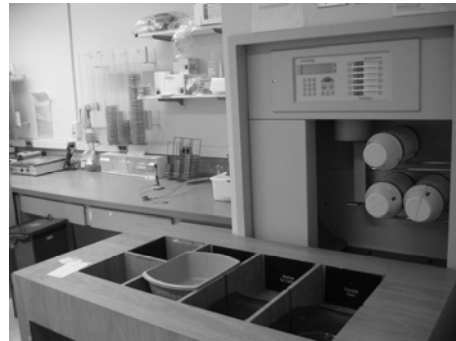
Dispense: Blood Bank



Director of Molecular Microbiology: Dr. Fann Wu



Therapy: Apheresis Unit



Receive: Microbiology



Director of Microbiology: Dr. Phyllis Della-Latta



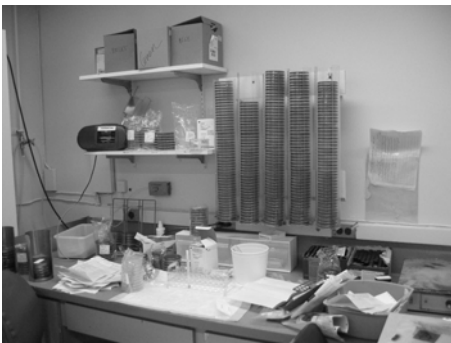
Receive: Microbiology



Prepare: Microbiology



Analyze: Microbiology



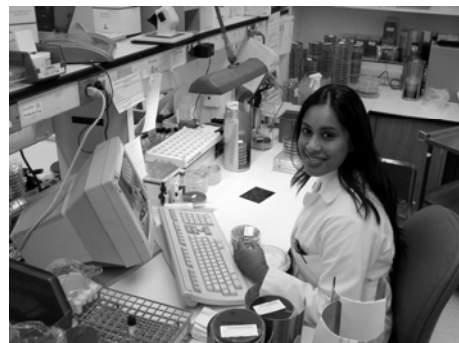
Prepare: Microbiology



Analyze: Microbiology



Prepare: Microbiology



Analyze: Microbiology



Analyze: Microbiology

Turn-around-time (TAT)

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

Control

Turn-around-time (TAT)

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

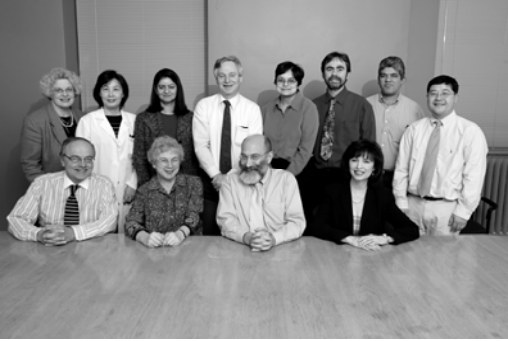
Turn-around-time (TAT)

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

Control

Final Thoughts

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



Lab Medicine Faculty 2004-2005