Fundamentals of the Clinical Laboratory

I. Fundamentals of the Clinical Laboratory
   A. Organization and Structure of the Laboratory
      1. Overview
         Health care organizations have reorganized and downsized to provide better services in a more patient-oriented manner. Advanced laboratory technology has enabled laboratory testing to be performed closer to the point of care (patient’s bed side).

         Laboratory analyses of a variety of specimens are used for three important purposes:
         - Diagnostic testing
         - Therapeutic assessments
         - Monitoring of a patient’s health status

         Communication is essential not only for teaching and interacting with patients but also for everyday effectiveness in all areas of the workplace. Communication can be broken down into three components:
         - Verbal communication
         - Nonverbal communication
         - Active listening

         Health care organizations have evolved into the following four different levels of care:

         a. Primary care is given to maintain and monitor normal health and to prevent diseases by means of laboratory screening tests and immunizations.
         b. Secondary care refers to specialized care involving a physician who is an expert on a particular group of diseases, a group of organ systems, or an organ.
         c. Tertiary care could be offered in a hospital and involves sophisticated instrumentation and technology or invasive procedures, such as open-heart surgery. Acute care hospitals are characterized by hospital stays of less than 30 days.
         d. Long-term care refers to care needed longer than 30 days. Hospitalized patients are often referred to as inpatients. Patients that are not hospitalized are often referred to as outpatients.

         A lot of our population is aging and hospitals have expanded their services to provide a more continuous system of care from birth to death.

         - Medicare
         - Medicaid
2. Laboratory

A typical hospital-based clinical laboratory can have two components: **clinical pathology** and **anatomic pathology**.

Large clinical laboratories may cluster testing according to the following:

**Clinical Laboratory:**

- **Clinical Chemistry**
  Primary concern is to assess and measure the chemical composition of blood, including analyses of drug levels, hormones, organ profiles, etc.

- **Hematology and Coagulation**
  Study of formed (cellular) elements of blood. Specialize in evaluating the number, shape, size, and function of blood cells. Assesses body’s ability to stop bleeding (hemostasis) and to coagulate blood. Valuable for anti-coagulant therapy.

- **Microbiology**
  Principle task is to culture and identify bacterial pathogens and their toxins. Evaluates bacterial susceptibility to particular antibiotics. Also evaluates for presence of parasites and fungi.

- **Immunohematology (blood bank) or transfusion medicine**
  Major task is to provide blood products to patients. Patients’ blood groups and types are assessed. Antibody/antigen reactions are detected and patient progress is monitored. Transfusion reactions are evaluated.

- **Immunology/serology**
  Major task is to determine antigen/antibody reactions as part of the body’s immune system, and identify related diseases.

- **Urinalysis & other body fluids**
  Primary concern is to assess and evaluate chemical and physical properties of urine and other body fluids.
  (Sometimes this is part of hematology.)

**Anatomic Pathology:**

- **Histology**
  Study of tissues taken from surgery to determine a diagnosis.

- **Cytology**
  Study of cells in various body fluids to evaluate for cancer.
3. Other departments found in most healthcare facilities:

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<tr>
<th>Professional Services</th>
<th>Nursing Services</th>
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<tbody>
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<td>Coronary Care Unit</td>
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<td>Radiation Therapy</td>
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<td>Occupational Therapy</td>
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<td>Pharmacy</td>
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<td>Clinical Laboratory</td>
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<tr>
<th>Support Services</th>
<th>Fiscal Services &amp; Misc.</th>
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<td>Maintenance</td>
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<td>Purchasing</td>
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<td>Security</td>
<td>Data Processing</td>
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<td>Etc.</td>
<td>Medical Records</td>
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B. Duties and Desirable Characteristics of a Phlebotomist

Duties and responsibilities –

Traditional –

1. ID correctly
2. Collect appropriate amount
3. Select appropriate containers
4. Label specimens correctly
5. Transport appropriately and timely
6. Interact with others effectively
7. Process specimens appropriately
8. Operate computer, keep pertinent records
9. Observe all safety regulations
10. Attend CE programs

Additional may include –

1. Train others in phlebotomy
2. Monitor specimen quality
3. Evaluation specimen protocols
4. Perform POCT
5. Perform ECG (old EKG)
6. Perform vital signs
7. Collect arterial specimens

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Desirable Characteristics – (we’ll also look at some later in the course)

General –
- Dependability
- Compassion
- Honesty
- Integrity
- Flexibility
- Appearance

Specific –
- Good communication skills –
  - Verbal
  - Listening
  - Non-verbal; such as eye contact, walk, body language, etc.
- Telephone skills

C. Accreditation and Regulations

The federal government regulates all clinical laboratories through the Clinical Laboratory Improvement Amendments of 1988 (CLIA 1988).

CLIA categorizes laboratory tests into three groups:

- **Waived tests** are those tests that are the easiest to perform, the least susceptible to error, and the least risky to patients.

- **Moderate complexity tests** are those tests that are simple to perform but may involve more risk to the patient if results are inaccurate.

- **High complexity tests** are those tests that are complex to perform and may allow for reasonable risk of harm to the patient if results are inaccurate.

Three primary agencies that accredit hospital laboratories:
- The Joint Commission (TJC)
- College of American Pathologists (CAP)
- Commission on Office Laboratory Accreditation (COLA)

Other organizations are also involved.

D. Alternate/Additional Sites of Testing

- Centralized labs or core labs
- Satellite labs
- Off-site drawing stations
- POC testing
E. Personnel

Clerical, nontechnical

Phlebotomist

Medical Laboratory Technologist (AS degree)

Medical Technologist (BS degree)

Specialists (BS with 5 yrs. experience in one area, certified)

Some have Master’s Degree (some management)

Pathologists (MD, longest of any residency)

F. Medical-Legal Issues (brief)

Informed consent

Confidentiality

Chain of custody

Others – negligence, tort (act that injures someone), etc.

G. Various Terms - these are not complete or all-inclusive

The term **phlebotomy** is derived from the Greek words;

- *phleb* (blood vessel), which relates to veins, and
- *otomy* (incision into), which relates to cutting.

Major task is to perform venipuncture and to obtain blood specimens necessary to determine disease and to assess patient progress. Also instruct patients on the collection of other types of specimens needed for collection. Also involved in processing and distributing all specimens to various laboratory departments.

1. **Patient age:**
   - geriatric - old
   - neonate - premie

2. **Categories of patient disease/condition:**
   - cardiology
   - dermatology
   - endocrinology
   - gastroenterology
   - gynecology
   - hematology
   - nephrology
   - obstetric
   - oncology
   - urology
   - orthopedic
   - psychiatric
   - renal
   - urology

3. **Food/liquid/medication intake status of patient:**
   - NPO – nothing by mouth (nothing per oral)
   - pp (post-prandial) – after a meal or glucose dose
fasting – no food or drink for specified hours (usually 8-12), can have water
q.n.s. (quantum non satis) – quantity not sufficient (not satisfied)
q.s. (quantum satis) – quantity sufficient or enough (not satisfied), as much as needed

others

4. Anatomic locations from which fluids are obtained:
   - amniotic
   - ascitic
   - cerebrospinal (CSF)
   - pericardial
   - pleural
   - synovial
   - thoracic
   - -centesis - process of obtaining fluids (paracentesis, thoracentesis, etc.)

5. Commonly ordered laboratory tests:
   - ABG
   - AFB
   - CBC
   - C & S
   - GTT
   - Hb/Hgb
   - Hct/Pcv
   - RBC
   - WBC
   - FBS
   - Electrolytes (Lytess)
   - Panels (comprehensive, hepatic, lipid, basic metabolic, etc.)
   - Others

6. Hematology and other departmental terms:
   - leukocytes
   - erythrocytes/RBCs
   - monocytes
   - platelets/thrombocytes
   - lymphocytes
   - eosinophils
   - granulocytes
   - hemoglobin/anemia
   - morphology
   - neutrophils/polymorphonucleated cells/PMNs
   - plasma
   - cyanosis
   - serum
   - fibrinogen/anticoagulant
   - differential
   - hemophilia
   - hemorrhage/hemostasis
   - hematoma
   - petechiae
   - veins/arteries/capillaries
   - phlebitis
   - oxygenated/deoxygenated
   - sclerosed
   - septicemia
   - hemolysis
   - nosocomial
   - dilate/constrict
   - icteric/xanthochromic
   - lipemic
   - syncope
7. Measurement:
   liquid measurement
   liter (L)
   deciliter (dL) = 1/10 L or 100 mL
   milliliter (mL) = 1/1000 L
   dry measurement
   gram = 1/1000 kg
   kilogram (kg) = 1000 g
   milligram (mg) = $10^{-3}$ or 1/1000 g
   length measurement
   meter (m) = 39.37 inches
   centimeter = 1/100 m (2.54 cm/in)
   millimeter (mm) = $10^{-3}$ or 1/1000 m
   concentration
   ng/dL
   mg/dL
   IU/mL

8. Procedural terms:
   phlebotomy     asepsis
   invasive       sepsis
   disinfectant   anaerobic
   germicide      aerobic
   bactericidal