# PHLEBOTOMY TECHNICIAN

## STUDY GUIDE

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CHAPTER I
THE PHLEBOTOMIST

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1. JOB DUTIES AND RESPONSIBILITIES

The primary duty for the phlebotomist is the collection of blood samples via venipuncture or micro techniques, but may also include the collection of tissue samples or other fluids. Blood samples may also be collected by the phlebotomist for blood donations, transfusions, and/or research.

A type and cross-match process takes place for transfusions to determine if a patient will react after a transfusion.

The process of collecting a specimen for further laboratory testing (such as clinical pathology, which focuses on the study of diseases by laboratory testing of bodily fluids such as blood or urine, or anatomic pathology that focuses on testing specimens such as biopsy tissue) is also known as the preanalytical phase.

Phlebotomists working in the neonatology department are collecting blood from newborns that are only a few hours to a few days old.

If blood is collected for testing drug levels, the primary consultant for timing guidelines is the pharmacy or pharmacy department.

Therapeutic phlebotomy (removal of large amount of blood) is often used as treatment for hemochromatosis, porphyria cutanea tarda, and/or polycythemia.

A phlebotomy technician must work accurately and well, even under pressure. They must be able to communicate well, have a basic knowledge of the health care system, and always treat patient-related information with discretion and confidentiality.

The work of a phlebotomy technician requires daily interaction with medical staff as well as patients, ranging from infants to geriatrics. Having knowledge of patient psychology and being able to calm patients down is therefore important.

It is also important to practice cultural sensitivity as well as learning other values, beliefs, and traditions/practices.

Job tasks may include:

- assembling equipment (needles, collection devices, etc.)
- keeping track of supplies
- following safety rules at all times
- verifying and recording patient information
- assisting patients before, during, and after the procedure
- disinfecting areas being punctured
- drawing blood and/or other specimens
- labeling and storing blood collection devices
- reporting possible hazards

The work duties of the phlebotomy technician can be categorized into four major groups:

- Equipment
- Procedure
- Patient Care
- Records and Patient Information
**Equipment:**  
- phlebotomists must ensure that all equipment and areas used are sterile  
- equipment includes needles, bandages, gauzes, tubes, other collection devices, as well as labels for tubes  
- tracking supplies to ensure that proper amounts are always present  
- disposal of needles and other used supplies

**Procedure:**  
- correct puncture or incision of patient's skin  
- collecting the correct amount of blood or other fluids  
- correct labeling of collection tubes/devices  
- completing and submitting documents needed to lab

**Patient Care:**  
- reassuring patients, as some may have fear of needles  
- being able to answer questions that patients may have  
- verifying patient information to ensure accuracy of tests or procedure  
- monitoring patient during procedure to prevent movement or fainting

**Patient Information:**  
- patients’ rights must be respected  
- keeping patients’ medical records confidential  
- accurate documentation of collection, ordered tests, and test results  
- providing accurate documentation to the laboratory to ensure performance of tests ordered by physician

**QUALITY IMPROVEMENT METHODS**

Quality improvement methods may include the use of data-based methods in order to reach improvement. Such methods may include charts, like flowcharts or pareto charts.

**Flowchart:** - used to break out components into diagrams in order to understand a process

**Pareto Chart:** - bar charts are made that show the frequency of problems

Quality Improvement for specimen collection usually involves the technique of the Phlebotomist, the frequency of hematomas, and the recollection rates.

Quality Control Records should include the following information:

- expiration dates  
- proper use  
- stability information  
- precision of testing supplies/reagents  
- storage information  
- accuracy of testing supplies/reagents
2. WORK ENVIRONMENT

Phlebotomy technicians can work in a variety of medical settings, such as hospitals, clinics, doctors’ offices, laboratories, blood banks, research firms, and/or pharmaceutical firms.

Hospital:
– institution which provides medical and surgical treatment

Clinic:
– institution or hospital department focusing on diagnosis and care of outpatients

Doctor’s Office:
– suite/office where doctors receive and treat patients

Laboratory:
– building or room where tests are performed to evaluate specimens in order to diagnose medical conditions

Blood Bank:
– institution where blood is collected from donors, and then stored and prepared for transfusion

Research Firm:
– institution equipped for scientific/medical research that may specialize in basic research or on specific areas

Pharmaceutical Firm:
– institution that develops and markets drugs for use as medications
3. SAFETY CONSIDERATIONS

Phlebotomy technicians must be aware of the risks and dangers involved with specimen collection.

Organizations such as the CDC have put out strict guidelines for health care professionals to follow to ensure their own safety, and therefore increase safety for patients and other workers. Universal precautions require that all used needles must be discarded intact. The purpose of infection control is to prevent the spreading of infection within a medical setting, such as a hospital. Although certain bodily materials such as feces, urine, and blood can be a potential source of infection, in a protective isolation setting it is the phlebotomist who is a potential threat to the patient. Therefore, it is necessary to wear masks, gloves, and coats or gowns when coming in contact with patients that are in protective isolation.

If patients develop infections while in the hospital that were not present before hospitalization, the infection is classified as nosocomial.

The chain of infection usually includes the source, a susceptible host, and poor isolation technique.

**Hygiene**

- wash hands with soap and water if they are visibly dirty
- good hand-hygiene techniques reduce number of outbreaks of infections
- hand washing is the single most important way to prevent spread of infection

**Equipment**

- gloves, masks, goggles, gowns, or coats
- autoclaves (instruments for sterilizing under pressure)

**Emergency Needle Stick Information**

- if exposed to blood due to a needle stick or other sharp object, wash needle stick and cut with soap and water
- flush mouth, eyes, and skin with water
- report the incident to a supervisor
- seek medical treatment
# CHAPTER II

## BLOOD CELLS AND VESSELS

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1. VITAL SIGN – BLOOD PRESSURE

Blood Pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels.

Without further specification, “blood pressure” usually refers to the arterial pressure of systemic circulation. During each heartbeat, blood pressure varies between a systolic (maximum) pressure and a diastolic (minimum) pressure.

Due to pumping by the heart and resistance to flow in blood vessels, blood pressure decreases as the circulating blood moves away from the heart through arteries.

Blood pressure drops most rapidly along the small arteries and arterioles, and continually decreases as blood moves through the capillaries and back through the veins to the heart. Valves in veins, gravity, and pumping from contracting of skeletal muscles can also influence blood pressure at different places in the body.

Blood pressure measurement without specification usually refers to the systemic arterial pressure that is measured on the inside of an elbow (at the brachial artery) at a person's upper arm. The measurement is usually expressed as the systolic pressure over the diastolic pressure. For example, a normal blood pressure reading is 120/80 mmHg, with systolic pressure being the higher number, and diastolic pressure being the lower number.

**DEFINITION SYSTOLIC AND DIASTOLIC**

**Systolic:** This is the blood pressure at the time when the heart is contracting, specifically the maximum arterial pressure during contraction of the left ventricle of the heart. This time, at which ventricular contraction takes place, is called systole.

A systolic sound is a heart sound that is heard during systole, the time the heart contracts, between the normal first and second heart sound.

**Diastolic:** This is the blood pressure at the time when the heart is in a relaxation and dilatation (expansion) period, specifically the minimum arterial pressure during relaxation and dilatation of the ventricles when they fill with blood.

A diastolic sound is a heart sound that is heard during diastole, the time the heart relaxes.
2. VITAL SIGN – PULSE

The pulse, also known as heart rate, is the rhythmical expansion of arteries due to contractions of the heart, and is recorded as beats per minute (bpm). A person’s heart rate can change during activity where the body needs to take in oxygen and discharge carbon dioxide, such as exercising or sleeping. A person’s pulse can be felt at any place that will allow an artery to be compressed against a bone, such as the wrist (radial artery), the neck (carotid artery), the inside of the elbow (brachial artery), behind the knee (popliteal artery), and around the ankle joint (posterior tibial artery). The pulse can be measured by simply placing the index finger and middle finger on the pulse site. Once the pulse is located, the beats per one minute should be counted. When measuring the pulse though, it is important not to use the thumb, as the thumb has a pulse of its own and may lead to inaccurate results.

The pulse can be used to determine a person’s overall level of health. In general, a lower pulse rate is better; although a condition called bradycardia (heart rate drops below 60 bpm) can be dangerous.

Normal pulse rates are considered to be:

- newborn: 120 – 160 beats per minute
- 1 month – 12 months: 80 – 140 beats per minute
- 1 – 2 years of age: 80 – 130 beats per minute
- 2 – 6 years of age: 75 – 120 beats per minute
- 6 – 12 years of age: 75 – 110 beats per minute
- 13 years and older: 60 – 100 beats per minute
- adult athletes: 40 – 60 beats per minute

Abnormal or irregular heart rates can be caused by many factors, including:

- anxiety
- stress
- caffeine
- nicotine
- certain medications
- overactive thyroid
- exercise
- hyperventilation
- fever
- diet pills
- cocaine
- low oxygen levels in bloodstream
- heart valve disease
3. BLOOD CELLS

Blood cells are also called hematocytes. As blood is removed from the body, the blood clots and the fluid portion are also called serum.

Blood is a fluid needed to maintain life (a steady or stable state, also known as homeostasis) as it circulates through the:

- arteries
- arterioles
- veins
- venules
- capillaries

Blood is made in the bone marrow, which is a soft material in the center of bones. Bone marrow produces about 95% of blood cells, and other organs such as the liver, spleen, and lymph nodes help in the regulation of blood cells. The formation of blood cells begins in the bone marrow as stem cells, which is the initial stage of blood cells. As these stem cells mature, they evolve into red blood cells, white blood cells, and platelets.

In the human body, there are three different types of blood cells: red blood cells (erythrocytes), white blood cells (leukocytes), and platelets (thrombocytes). These three types of blood cells make up 45% of blood tissue, and plasma (liquid) makes up the remaining 55%. In the average adult, blood makes up about 8% of the body weight. The blood volume in an average adult is about 5 liters.

Blood also has a pH level, which is the measurement of hydrogen ion concentration. The higher the pH (above 7.45), the more alkaline blood is. The lower the pH (below 7.35), the more acidic blood is. The pH of blood is regulated and stays within 7.35 to 7.45, and is therefore somewhat alkaline.

The function of blood is to carry materials to the bodily tissues. These materials are:

- hormones
- vitamins
- oxygen
- antibodies
- heat
- electrolytes
- nourishment

Blood also has the function of carrying materials away from the bodily tissues, such as:

- carbon dioxide
- waste
**RED BLOOD CELLS**

Red blood cells are also known as erythrocytes, and are the most numerous blood cells in the body. Their shape is similar to a biconcave lens and they contain no nucleus (control center containing chromosomes). Red blood cells are the body's major way of delivering oxygen to the body tissue due to blood flow in the circulatory system.

Erythrocytes contain hemoglobin, an iron-containing pigment which gives red blood cells their color. Hemoglobin is able to bind oxygen. People with a lower number of red blood cells, or not enough hemoglobin, are considered to be anemic. Red blood cells form in the bone marrow and have a life span of about 100 to 120 days.

**LIFE CYCLE OF ERYTHROCYTES**

There are three stages to the life cycle of red blood cells – the development, the functional stage, and the senescent (aged) stage.

*Erythropoiesis:*  
- process of development in which new red blood cells are produced  
- cells mature in about 7 days  
- about 2 million red blood cells per second are continuously produced in the bone marrow  
- developing cells are also known as reticulocytes, and make up around 1% of the red blood cells in the circulatory system

*Functional Lifetime:*  
- red blood cells live between 100 and 120 days  
- during this stage, red blood cells move continuously  
- blood flow pushes erythrocytes in arteries, pulls erythrocytes in veins, and squeezes erythrocytes through capillaries and other small vessels

*Senescence:*  
- as erythrocytes, they go through changes in their plasma membrane  
- these changes make the cells more recognizable for removal of old and defective cells, a process called eryptosis  
- eryptosis takes place at the same rate as production of cells, therefore keeping a balance in the amount of red blood cells
**WHITE BLOOD CELLS**

White blood cells are also known as leukocytes.

Leukocytes are cells of the immune system and help the body defend against diseases and foreign materials.

There are several different types of white blood cells, all developing from a cell in the bone marrow called a hematopoietic stem cell. Unlike red blood cells, white blood cells all have a nucleus, a type of control center that contains chromosomes. Each white blood cell and all other human cells, except for red blood cells, contain 46 chromosomes in their nucleus.

White blood cells can be classified into two different groups: granulocytes and lymphoid cells. Granulocytes have a presence of granules in the cytoplasm, and different granules are found in different types of granulocytes.

Neutrophil, eosinophil (or acidophil), and basophil are granulocytes; lymphocytes and monocytes are lymphoid cells.

The proportions of their presence in blood differ with each type of cell:

- neutrophil 50 – 70 %
- lymphocyte 20 – 40 %
- monocyte 3 – 8 %
- eosinophil 2 – 4 %
- basophil 0.5 – 1 %

**Neutrophils:**
- defend against fungal or bacterial infection
- unable to renew the lysosomes used in the defense against infection, these cells die and, in large numbers, form pus

**Lymphocytes:**
- although present in blood, lymphocytes are common in the lymphatic system
- produce antibodies that bind to pathogens
- grouped into B cells, T cells, and NK cells

**Monocytes:**
- forerunners of macrophages
- larger cells that enter the circulatory system for about 24 – 36 hours before becoming macrophages

**Eosinophils:**
- main function is the defense against parasites

**Basophils:**
- responsible for antigen and allergic response by releasing histamine
PLATELETS

Platelets are also known as thrombocytes.

Their function is to stop blood loss due to wounds (maintaining homeostasis). In order to do so, platelets release factors to promote blood coagulation (blood clotting). Platelets are irregularly-shaped small cells.

The average life span of platelets is about 5 – 9 days.

If a person has an insufficient amount of platelets, it may lead to excessive bleeding. If a person has too many platelets it may result in formation of blood clots that can hinder blood vessels and cause a stroke or other medical conditions.

For a normal blood specimen, it usually takes 30 – 60 minutes for the blood to clot.

Platelets develop in bone marrow by forming off from megakaryocyte cells. This process is regulated by a hormone called thrombopoietin, which is produced in the liver and kidneys. A megakaryocytic cell can produce anywhere from 5,000 – 10,000 platelets.

Once platelets reach the end of their life cycle, the destruction of platelets takes place by phagocytosis in the spleen, and by Kupffer cells within the liver. However, there are reserve platelets that are stored within the spleen and are released as needed due to splenic contraction.

By preventing excessive blood loss by forming blood clots, platelets help maintain homeostasis. They do so by using fibrinogen and vWF (von Willebrand factor) as connecting agents to clump together. Once activated, platelets will attach to the exposed collagen and both processes, clumping and attachment, will form the clot to stop the bleeding. Furthermore, clumped platelets help the healing process (vessel repair) by secreting chemicals to urge fibroblasts into the wound for healing.
4. BLOOD VESSELS

There are three major types of blood vessels in the human body: arteries, which carry blood from the heart; veins, which carry blood back to the heart; and capillaries, which are responsible for the exchange of chemicals and water between blood and tissue.

Blood vessels also play an important role of measuring vital signs, blood pressure, and pulse.

The structures are different between arteries and veins: veins have two layers and arteries have three layers.

There are several different types of blood vessels:

- arteries
- veins
- arterioles
- venules
- capillaries
- sinusoids (small vessels located in the liver, spleen, and bone marrow)

Blood vessels can also be grouped into arterial vessels and venous vessels. Arterial vessels carry blood away from the heart, and venous vessels carry blood towards the heart. The exception to this is the pulmonary vein, which carries blood that is oxygen-enriched; and the pulmonary artery, which carries venous blood.

Arterial and venous systems develop from different areas. The arterial system mainly develops from aortic arches, whereas the venous system develops from three bilateral veins between 4 and 8 weeks of the human development.

A distinction as to which system carries oxygen-richer blood cannot be made, as neither one carries blood that is richer in oxygen than the other.
Arterial Development

- the arterial system develops from the aortic arches as well as the dorsal aorta at 4 weeks of human development
- aortic arch 1 mostly moves back and forms the maxillary arteries
- aortic arch 2 mostly moves back and forms the stapedial arteries
- aortic arch 5 completely moves back
- the formation of the arterial system comes from aortic arches 3, 4, and 6
- the dorsal aorta first is bilateral and later fuses to form the definitive dorsal aorta
- there are about 30 poster lateral branches that branch off the aorta and form the intercostal arteries, the lumbar arteries, the upper and lower extremity arteries, and the lateral sacral arteries
- the lateral branches from the aorta form the suprarenal arteries, gonadal arteries, and renal arteries
- the ventral branches from the aorta are the vitelline and the umbilical arteries
- the vitelline arteries form the superior arteries, inferior mesenteric arteries, and the celiac arteries of the GI (gastrointestinal) tract
- the umbilical arteries form the internal iliac arteries after birth

Venous Development

- the venous system mainly develops from the umbilical veins, the cardinal veins, and the vitelline veins
- umbilical veins, vitelline veins, and cardinal veins empty into the sinus venous
ARTERIES

- carry oxygen-rich blood away from the heart with exception of the pulmonary and umbilical arteries
- blood pressure can be measured due to arterial pressure variations between heart contraction and relaxation
- the pressure difference of the arteries creates a pulse which reflects the activity of the heart

Main arteries of the human body:

- ascending aorta
  - left coronary artery
  - right coronary artery
- arch of aorta
  - brachiocephalic artery
  - right common carotid artery
  - left common carotid artery
- external carotid artery
- internal carotid artery
- subclavian artery
  - vertebral artery
  - internal thoracic artery
  - thyrocervical trunk
  - deep cervical trunk
  - cost cervical trunk
- axillary artery
- brachial artery
- thoracic aorta
- abdominal aorta
  - inferior phrenic
  - celiac
  - superior mesenteric
  - middle suprarenal
  - renal
    - anterior and posterior
      - interloper artery
- gonadal
- lumbar
- inferior mesenteric
- median sacral
- common iliac
- external iliac artery
  - popliteal artery
  - internal iliac artery
    - anterior division
    - posterior division
VEINS

- carry oxygen-deprived blood from tissues back towards the heart with the exception of the pulmonary and umbilical veins that carry oxygen-rich blood to the heart
- veins are less muscular than arteries and are generally closer to the skin
- veins contain valves which help in keeping blood flowing to the heart
- veins can become obstructed (occluded) due to blood clots
- veins have two layers which are tunica adventitia (connective tissue) and tunica media (bands of smooth muscle); the inside of veins is tunica intima (endothelial cells)
- fragile veins are usually found in the elderly (geriatrics)

PULMONARY VEINS

Pulmonary Veins:
- right superior pulmonary vein
- left superior pulmonary vein
- right inferior pulmonary vein
- left inferior pulmonary vein

SYSTEMIC VEINS

Cardiac Veins:
- great cardiac vein
- oblique vein of the left atrium
- left marginal vein
- small cardiac vein
- middle cardiac vein
- posterior vein of the left ventricle

Head/Neck Veins:
(exterior)
- frontal vein
- supraorbital vein
- angular vein
- anterior facial vein
- posterior facial vein
- occipital vein
- superficial temporal vein
- posterior auricular vein
- internal maxillary vein
Neck Veins:
- anterior jugular vein
- posterior external jugular vein
- internal jugular vein
- external jugular vein
- vertebral vein

Diploic Veins:
- anterior temporal vein
- posterior temporal vein
- frontal vein
- occipital vein

Veins of the Brain:
- superior cerebral vein
- inferior cerebral vein
- middle cerebral vein
- basal vein
- terminal vein
- choroid vein
- great cerebral vein
- superior cerebral vein
- inferior cerebral vein

Eye/Skull Veins:
- superior ophthalmic vein
- inferior ophthalmic vein
- two transverse sinuses
- occipital sinus
- straight sinus
- superior sagittal sinus
- inferior sagittal sinus

Upper Extremity Veins:
- dorsal digital vein
- volar digital vein
- dorsal metacarpal vein
- intercapitular vein
- cephalic vein
- accessory cephalic vein
- basilic vein
- median antibrachial vein
- axillary vein
- subclavian vein
Veins of the Thorax:

- right innominate vein
- left innominate vein
- internal mammary vein
- superior phrenic vein
- inferior thyroid vein
- highest intercostal vein
- superior vena cava
- hemiazygos vein
- accessory hemiazygos vein
- bronchial vein
- external vertebral venous plexus
- internal vertebral venous plexus
- postvertebral vein
- invertebral vein
- vein of the medulla spinalis

Portal System Veins:

- portal vein
- lineal vein
- short gastric vein
- left gastroepiploic vein
- right gastroepiploic vein
- pancreatic vein
- inferior mesenteric vein
- hemorrhoidal vein
- sigmoid vein
- left colic vein
- superior mesenteric vein
- pancreatic duodenal vein
- coronary vein
- pyloric vein
- cystic vein
- parumbilical vein
Lower Extremity Veins:
- great saphenous vein
- small saphenous vein
- accessory saphenous vein
- dorsal digital vein
- intercapitular vein
- medial marginal vein
- lateral marginal vein
- plantar digital vein
- metatarsal vein
- posterior tibial vein
- anterior tibial vein
- peroneal vein
- popliteal vein
- femoral vein
- deep femoral vein
- external iliac vein
- inferior epigastric vein
- hypogastric vein
- deep iliac circumflex vein
- pubic vein
- superior gluteal vein
- inferior gluteal vein
- internal pudendal vein
- obturator vein
- lateral sacral vein
- middle hemorrhoidal vein
- dorsal veins of the penis (superficial and deep vein)
- spermatic veins
- vaginal veins
- ovarian veins
- lumbar vein
- renal vein
- suprarenal vein
- inferior phrenic vein
- hepatic vein
ARTERIOLES

- small blood vessels in microcirculation
- extend and branch out from arteries and lead to capillaries
- like arteries, arterioles carry blood away from the heart to tissues
- arterioles play an important role in blood pressure regulation
- arterioles generally have one to two layers of smooth muscle

VENULES

- small blood vessel in microcirculation
- carry oxygen-deprived blood from the capillaries back to the veins
- venules have three layers
  - the endothelium (inner layer) is made up of squamous endothelial cells that act as a membrane
  - the middle layer is made up of elastic tissue
  - the outer layer is made up of fibrous connective tissue

CAPILLARIES

- smallest of the blood vessels in microcirculation
- connect arterioles and venules
- enable the exchange of oxygen, water, carbon dioxide, waste, and other nutrients between blood and body tissues
- capillaries don't function on their own but as a “supply cell”
- there are two main capillary types: continuous capillaries and fenestrated capillaries

**Continuous Capillaries:**
- endothelial cells provide continuing lining, therefore allowing only small molecules to spread through junctions of intercellular clefts (unjoined membrane)

**Fenestrated Capillaries:**
- pores in the endothelial cells are present
- these pores allow small molecules and restricted amounts of protein to spread through
# METHODS OF SPECIMEN COLLECTION

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![Newer Safety Collection Tube](image-url)
METHODS OF SPECIMEN COLLECTION

The collection of a specimen is a vital part in testing. It is required that the procedure is done properly in order to ensure accuracy of results and safety for patients and the phlebotomist. Positioning the patient in a safe and secure manner is important to avoid complications such as fainting. In general, the patient may be seated in a chair, but in some cases, such as when patient is bound to the bed, the patient may also be lying down. In phlebotomy, the positions where the patient is lying down may be described as supine and prone, and these are important to the phlebotomist.

Supine Position: - patient is laying face-up on their back
Prone Position: - patient is laying face-down on their stomach

When drawing blood from the back of the patient's hand, the prone position may also refer to the hand of the patient with the palm facing down. When collecting samples for glucose or cholesterol testing, it is necessary for the patient to fast (no food or liquids) for at least 12 hours before the procedure. If the patient ate a meal before the procedure, it could interfere with laboratory testing. Glucose level is the most commonly requested timed specimen. A breakdown of glucose is referred to as glycolytic action. There are three general methods for the collection of a specimen; venipuncture, capillary puncture, and arterial puncture.

1. VENIPUNCTURE

Venipuncture refers to the collection of blood from veins through the use of a needle and syringe. This procedure is usually chosen when a large amount of blood is required for testing such as cholesterol, glucose, and other blood chemistry determinations. If blood is collected to determine the level of medications, the blood should be collected just before the next dose of medication. When explaining the procedure as what arm is to be used, always refer to the patient's right or left arm.

Equipment: - gloves (put on in front of patient to reassure safety)
- evacuated collection tubes (designed to fill with predetermined amount)
- needles (available for evacuated systems or for use with syringes)
- holder/adapter (for use with evacuated systems)
- syringes
- tourniquet (causes blood to pool)
- alcohol wipes
- gauze sponges (for application when needle is withdrawn)
- bandages and tape
- needle disposal unit
Site Selection: - in general, the median cubital veins of the arm are most preferred, located in the antecubital area (slightly below elbow) - if arm veins can't be used, the basilic vein and dorsal hand veins are accepted for puncture - areas to avoid are those with hematoma or scars of previous mastectomy - to find a vein, palpate and trace path of veins with index finger - arteries are mostly elastic and pulsate; thrombosed veins lack resilience - if no superficial veins are apparent, blood may be forced into veins by massaging arm from wrist to elbow, tapping the site with fingers, applying warm cloth, or lowering the extremity over the bedside

Procedure: - approach patients in a friendly manner and make them feel comfortable - identify patient, verify condition, and check for allergies - fill out requisition forms accurately - position patient in chair or bed - apply tourniquet 3-4 inches above selected puncture site - instruct patient to make a fist - prepare patient's arm with alcohol prep - alcohol should dry 30 – 60 seconds before puncture - anchor selected vein - needle should form an angle of 15 – 30° - insert needle through the skin and into the vein with the bevel side up - remove tourniquet as blood begins to flow - remove needle using a backward motion - once needle is removed, press down on gauze to avoid hematoma - check that bleeding has stopped - dispose of materials - mix and label tubes - deliver the collected specimen to the laboratory

Requisition Form: - each sample must have a requisition form to be submitted to the laboratory - elements of a requisition form are: - patient's first, middle, and surname, and patient's ID number - date of birth and sex of patient - name of physician requesting procedure - source of specimen (if analysis and reporting is site specific) - date and time of collection and initials of phlebotomist - indication of tests requested

Labels: - labeling samples is essential and must be accurate - elements of labels are: - patient's first, middle and surname (must match requisition form) - patient's ID number (must match requisition form) - date and time of collection - initials of phlebotomist
2. CAPILLARY PUNCTURE

Capillary puncture is also known as a dermal puncture and/or finger stick.

This method of specimen collection is usually chosen if small amounts of blood are needed, or if the patient is an infant or anemic.

When collecting blood from newborns, the penetration depth of lancets should be less than 2.0 mm. Capillary punctures are often performed in order to test white blood cell differentials.

Although several different sites may be used for capillary puncture, the most accessible, and therefore most commonly used, site is the palmer or lateral surface of the finger. Alternative sites for capillary puncture are ear lobes, big toes, and the heel (in infants).

The Monoject Monoletter is a safety device for capillary blood collection.

Blood collected via capillary puncture is composed of blood from capillaries, arterioles, and venules, as well as tissue fluids (interstitial fluid). When performing a skin puncture it is important to wipe off the first drop of blood as it contaminated with tissue fluids.

Equipment:
- gauze pads
- blood lancet
- glass slides or capillary tubes
- alcohol pads

Procedure:
- prepare supplies and have them within reach
- identify patient information and verify condition
- select site for puncture (usually ring finger)
- sterilize the puncture site
- puncture the site in a smooth manner
- cut should be orientated across fingerprint lines
- wipe off first drop of blood and then collect specimen
- apply pressure to wound for several minutes to stop the bleeding
- dispose of materials
- mix and label tubes
- deliver the collected specimen to the laboratory
Requisition Form: - each sample must have a requisition form to be submitted to laboratory
- elements of a requisition form are:
  - patient's first, middle, and surname
  - patient's ID number
  - date of birth and sex of patient
  - name of physician requesting procedure
  - source of specimen (if analysis and reporting is site specific)
  - date and time of collection
  - initials of phlebotomist
  - indication of tests requested

Labels: - labeling samples is essential and must be accurate
- elements of labels are:
  - patient's first, middle and surname (must match requisition form)
  - patient's ID number (must match requisition form)
  - date and time of collection
  - initials of phlebotomist
- automated systems may have labels that use bar codes (more reliable)

BLOOD SMEAR

The capillary puncture procedure may also be used to perform blood smears.

When collecting blood to perform a blood smear, it is important for the phlebotomist to know the criteria in order to provide a readable slide.

A blood smear is performed right after wiping away the first drop of blood. A spreader slide (two glass slides) is then positioned, and a small drop of blood is placed on the slide. The top glass side is pulled back into the blood drop for the blood to spread along the back side of the glass. The best angle for spreading is 30°. The slide then needs to be pushed to the left quickly, and the blood smear needs to be allowed to dry.

Improper blood smears can cause inaccurate results; it is therefore important that the blood smear is done correctly.
3. ARTERIAL PUNCTURE

Arterial puncture is another method of blood collection and is usually performed for further analysis of blood gas.

The procedure is similar to venipuncture with the exception that the arterial puncture should be done with no exposure to air; this prevents the escape of gas from the fluid.

Equipment:
- syringe
- dry and wet sterile cotton
- rack for test tubes
- test tubes

Procedure:
- put on gloves
- check supplies and put them within reach
- identify patient and condition
- select puncture site (radial artery, femoral artery, or brachial artery)
- puncture artery at a 90° angle
- remove needle once requested amount of blood is collected
- apply pressure and sterile cotton
- check that bleeding has stopped (last step in every procedure)
- dispose of all used materials

Requisition Form:
- each sample must have a requisition form to be submitted to laboratory
- elements of a requisition form are:
  - patient's first, middle, and surname
  - patient's ID number
  - date of birth and sex of patient
  - name of physician requesting procedure
  - source of specimen (if analysis and reporting is site specific)
  - date and time of collection
  - initials of phlebotomist
  - indication of tests requested

Labels:
- labeling samples is essential and must be accurate
- elements of labels are:
  - patient's first, middle and surname (must match requisition form)
  - patient's ID number (must match requisition form)
  - date and time of collection
  - initials of phlebotomist
- automated systems may have labels that use bar codes (more reliable)
CHAPTER IV

SPECIMEN COLLECTION AND TRANSPORT

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1. EQUIPMENT

The following equipment is commonly used in phlebotomy:

Gloves:  - disposable gloves used in phlebotomy to help prevent contamination  
- can be made of latex, nitrile rubber, neoprene, or vinyl  
- there are two types of gloves: exam gloves and surgical gloves  
- surgical gloves are better sized and made to a higher standard

Goggles:  - although not commonly used, goggles are frequently recommended for use  
- protect eyes from exposure due to splashing of blood-borne pathogens

Antiseptics:  - antimicrobial substances used to clean puncture sites before procedure in order to reduce the risk of possible infection  
- most common antiseptic is alcohol

Tourniquets:  - compressing device that is used to control blood circulation  
- usually resembling a rubber tube, it is wrapped around the arm during the procedure  
- more modern devices are available with contour cuffs attached to wire

Collection Tubes:  - made of glass or plastic (plastic being preferred in use)  
- tubes are attached to a needle and a hub  
- tubes contain vacuum so that they fill automatically to a certain level  
- some tubes contain anticoagulants (additives)  
  - anticoagulants are substances that prevent blood clotting  
  - heparin is the preferred anticoagulant in clinical chemistry  
  - lithium heparin is the general anticoagulant to study glucose levels  
  - acid-citrate dextrose is an anticoagulant used in blood donations  
- in tubes with anticoagulants, it is important to fill the tube with the correct amount of blood to provide an accurate blood-additive ratio

Syringes:  - medical syringes are usually fitted with needles  
- consists of a plunger and a tube (plunger fits exactly into tube)  
- design makes it possible for fluid to be pulled in and pushed out of the syringe
Needles:
- needle sizes vary, as do the gauges (openings) of needles
- larger gauge sizes refer to smaller openings (diameters) of needles
- the butterfly needle refers to a winged needle (infusion) set
- butterfly needles are used when conventional methods are too difficult
- needles have a color coding system which indicates the gauge size
  - 19 gauge – white top
  - 20 gauge – yellow top
  - 21 gauge – green top
  - 21 gauge butterfly needle – green top – often used in pediatrics
  - 22 gauge – black top
  - 23 gauge – blue top
  - 23 gauge butterfly needle – blue top
  - 24 gauge – purple top
  - 25 gauge – orange top
  - 25 gauge butterfly needle – orange top

Disposal Unit:  
- also known as a Sharps Container
- needles and other sharp objects/instruments are disposed into it
- there are two different types of disposal units:
  - single use (container will be disposed with contents inside)
  - reusable (automatically emptied and sterilized for safe reuse)

Centrifuge:
- device/machine with fast rotating container which applies radial force
- used to separate fluids of different densities (as in spinning blood)
- if blood has a separation device, it should be centrifuged once

Labels:
- small piece of paper or plastic attached to the collection tubes/containers
- labeling collected specimen/tubes must be accurate
- elements of labels are:
  - patient's first, middle and surname (must match requisition form)
  - patient's ID number (must match requisition form)
  - date and time of collection
  - initials of phlebotomist
- automated systems may have labels that use bar codes (more reliable)
Bar Codes: - codes that are machine-readable
- usually consists of numbers and patterns of lines printed on labels
- may be used for:
  - patient’s names, ID number, and date of birth
  - specimen accession numbers
  - test codes
  - product numbers
  - expiration dates of inventory
- handwritten information can't be converted into bar codes

Identification Tags: - small tag, usually worn on bracelets, with information on medical conditions
- tags allow for fast medical attention in emergencies
- newer forms of ID tags are USB alert tags, capable of holding more information
- other forms of ID tags are RFID tags (using silicon chips and wireless receiver)

Requisition Forms: - forms to properly identify blood samples
- each specimen collected needs to be accompanied by a requisition form
- elements of requisition form are:
  - patient's name, ID number, date of birth, and gender
  - name of physician requesting procedure and tests requested
  - source of specimen (if analysis and reporting is site specific)
  - date and time of collection and initials of phlebotomist
- report forms (clinical chemistry) may also include reference ranges
2. ORDER OF DRAW

In order to avoid cross-contamination, blood collection tubes must be drawn in a specific order.

Alkaline phosphates should never be collected in gray top tubes. Blood that needs to be tested for lead levels should be collected in tan top tubes. Blood collected for testing of blood copper should be collected in dark (royal) blue top tubes (no anticoagulants). Blood collected for blood cell count should be collected in purple top tubes. Blood collected for cytogenetic analysis should be collected in green top tubes.

*Order of Draw*

<table>
<thead>
<tr>
<th>Tube Color</th>
<th>Blood Collection</th>
<th>Mix Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Top Tube</td>
<td>Blood Cultures (SPS)</td>
<td>mix by inverting 8 – 10 times (sodium polyanethol sulfonate)</td>
</tr>
<tr>
<td>Light Blue Top Tube</td>
<td>Citrate Tube</td>
<td>mix by inverting 3 – 4 times</td>
</tr>
<tr>
<td>Gold Top Tube</td>
<td>Gel Separator Tube</td>
<td>mix by inverting 5 times</td>
</tr>
<tr>
<td>Red Top Tube</td>
<td>Serum Tube</td>
<td>mix by inverting 5 times (plastic)</td>
</tr>
<tr>
<td>Orange Top Tube</td>
<td>Rapid Serum Tube</td>
<td>mix by inverting 5 – 6 times</td>
</tr>
<tr>
<td>Green Top Tube</td>
<td>Heparin Tube</td>
<td>mix by inverting 8 – 10 times</td>
</tr>
<tr>
<td>Purple Top Tube</td>
<td>EDTA Tube</td>
<td>mix by inverting 8 – 10 times</td>
</tr>
<tr>
<td>White Top Tube</td>
<td>Separator Tube with Gel</td>
<td>mix by inverting 8 – 10 times</td>
</tr>
<tr>
<td>Gray Top Tube</td>
<td>Fluoride (glucose) Tube</td>
<td>mix by inverting 8 – 10 times</td>
</tr>
</tbody>
</table>
### USES OF COLLECTION TUBES

**Yellow Top Tubes**
- Additive: ACD (acid-citrate-dextrose)
- Mode of Action: complement inactivation
- Uses: paternity testing, DNA studies, HLA tissue typing

**Light Blue Top Tubes**
- Additive: Sodium citrate
- Mode of Action: forms calcium salts to remove calcium
- Uses: coagulation tests; full draw required

**Dark Blue Top Tubes**
- Additive: Sodium EDTA
- Mode of Action: tube is specially designed to contain no contaminating metals
- Uses: trace element (lead, zinc, etc.) testing and toxicology

**Red Top Tubes**
- Additive: none
- Mode of Action: blood clots
- serum is separated via centrifugation

**Gold Top Tubes**
- Additive: none
- Mode of Action: Serum separator tube
- contains gel at the bottom to separate blood from serum via centrifugation
- Uses: immunology, serology, chemistries

**Light Green Top Tubes**
- Additive: Plasma Separating Tube with lithium heparin
- Mode of Action: anticoagulants with lithium heparin; plasma is separated
- Uses: chemistries

**Dark Green Top Tubes**
- Additive: Sodium heparin or lithium heparin
- Mode of Action: inactivates thrombin and thromboplastin
- Uses: for ammonia level use sodium or lithium heparin; for lithium level use sodium heparin
**Purple Top Tubes**  
- Additive: EDTA liquid  
- Mode of Action: forms calcium salts to remove calcium  
- Uses: blood bank (cross match) and hematology (CBC); requires full draw

**White Top Tubes**  
- Additive: Potassium EDTA  
- Mode of Action: forms calcium salts  
- Uses: molecular/PCR and bDNA testing

**Gray Top Tubes**  
- Additive: Potassium oxalate and sodium fluoride  
- Mode of Action: antiglycolytic agent; preserves glucose levels for up to 5 days  
- Uses: gluoses require full draw; short draw may lead to hemolysis

**Pink Top Tubes**  
- Additive: Potassium EDTA  
- Mode of Action: forms calcium salts  
- Uses: immunohematology

**Light Brown Top Tubes**  
- Additive: Sodium heparin  
- Mode of Action: inactivates thrombin and thromboplastin; contains virtually no lead  
- Uses: serum leads determination

**Black Top Tubes**  
- Additive: buffered sodium citrate  
- Mode of Action: forms calcium salts to remove calcium  
- Uses: sedimentation rate; requires full draw

**Yellow/Black Top Tubes**  
- Additive: broth mixture  
- Mode of Action: preserves viability of microorganisms  
- Uses: microbiology
3. SPECIMEN TRANSPORT

Specimens that are collected need to be transported to laboratories for further testing.

Certain regulations that apply:

- all specimens must be placed in leak-proof containers (tubes)
- tubes must be bagged in special biohazard specimen bags
- requisition slip must be placed on outside pocket of bag

One of the safest and most efficient methods of transport is the pneumatic tube system.

Transport for tube specimen:

- tube specimen can be sent using the pneumatic tube system
  - pneumatic tube system:
    - place tubes in biohazard bag and seal
    - attach requisition slip
    - place biohazard bag in pouch
    - completely seal pouch
    - load pouch into pneumatic tube and send to lab

Certain specimens must be transported to the lab more quickly in order to get accurate test results. Blood and urine samples must be transported quickly in order to increase the chance of pathogen detection. Serum specimens should be transported to the lab within two hours in order to avoid erroneous results. A delay or improper transport may cause a hemolyzed specimen, which can compromise laboratory testing and/or assays.

Other specimens need to be preserved before testing/analysis and should therefore be kept cold. A common way of keeping a specimen cold during transport is by using icy water.

Assays requiring a cold/chilled specimen are blood gasses, gastrin, ammonia, lactic acid, catecholamine, renin, and parathyroid hormone determinations

In the case of a light-sensitive specimen, it is best to wrap the collection tube in aluminum foil to prevent exposure to light. Common light-sensitive analytes are bilirubin, beta-carotene, and erythrocyte protoporphyrin.
4. PROCEDURAL COMPLICATIONS

Allergic Reaction

- some patients may be allergic to supplies used during puncture, such as latex gloves
- patient records should always be checked for known allergies
- if patient has allergic reactions that were unknown, be prepared to provide or call for medical attention

Bleeding Does Not Stop

- in some cases, such as patients with bleeding disorders, the bleeding does not stop
- if this occurs, the patient should be instructed to lift the arm above the shoulder and apply pressure
- if bleeding does not stop after 10 minutes, contact the supervisor
- patients whose bleeding does not stop should not be left alone until bleeding has stopped

Fainting

- if the patient is known to faint, the patient should be laid down for the procedure
- if patient faints, the procedure should be stopped immediately
- patient's head should be lowered to their knees
- keep patient in sight for 15 minutes before releasing them
- contact supervisor or physician if patient is unresponsive

Hematoma

- occurs as blood that pools in tissue around veins is collected
- may result in bruising and may be painful
- to prevent hematoma, surface veins should be chosen and puncture should be at the accurate angle

Hemolysis

- complication that occurs in the collected blood sample
- if sample is not collected or handled properly, blood cells may start to break apart
- to prevent this, the phlebotomist should collect and handle samples with care
- tubes that contain additives should be inverted
**Hemoconcentration**

- increased amount of large molecules and formed elements
- causes may be prolonged tourniquet application or occluded veins

**Indwelling Lines or Catheters**

- this can be a source for potential errors
- to prevent complications, samples should be discarded three times the amount of the line before the specimen is collected for further testing or analysis

**Infection**

- when performing phlebotomy, the skin barrier is broken, allowing germs or bacteria to enter the body
- to prevent infection, skin must properly be cleaned/sterilized, and gloves should always be used

**Prolonged Tourniquet Application**

- tourniquets should not remain on a patient for more than two minutes
- if left on longer, integrity of blood and health of patient may be at risk
- prolonged tourniquet applications may lead to tissue or nerve damage
- if no vein can be found, the phlebotomist should try an alternate site
CHAPTER V

SPECIAL PHLEBOTOMY PROCEDURES

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1. BLEEDING TIME/PLATELET FUNCTION

The bleeding time refers to a test that identifies function disorders of platelets, also known as thrombocytes. Their function is to prevent blood loss due to injuries or wounds by releasing factors that promote the clotting of blood (coagulation). By doing so, platelets help maintain homeostasis (steady-state condition). Lasting or prolonged bleeding may take place because of abnormal platelet function or due to an insufficient amount of platelets.

If a person has an abnormally high amount of platelets, it can cause blood clots and lead to obstruction of blood vessels.

A normal bleeding time is between 2.5 minutes and 9.5 minutes.

Causes for lasting or prolonged bleeding time may include:

- platelet disorder
- fibrinogen disorders
- medications like aspirin
- decreased platelet number
- scurvy

Equipment:
- alcohol to clean the puncture site
- sphygmomanometer
- bleeding time device
- stopwatch

The Test:
- measures platelets’ ability to stop bleeding after wound/injury
- bleeding time device, placed firmly on patient's forearm, makes incision
- incision is 1 mm deep and 5 mm long
- platelet function assay may be used for patients using aspirin or NSAID drugs

The Procedure:
- place patient's arm on stable support, with the palm facing up
- selected site should be on the dorsal side of the mid forearm
- place sphygmomanometer on the upper arm
- check that the site is without scars or exposed veins, and remove excess hair
- clean selected site with alcohol (alcohol should be allowed to dry 30 – 60 sec)
- inflate sphygmomanometer to 40mmHg; make sure that it stays at 40 mmHg
- place device on site parallel to antecubital crease and apply light pressure
- push the device trigger at the same time as the watch
- dispose of device in sharps container
- begin timing at the time of puncture
- blot the blood flow by using filters/paper after 30 seconds
- blot the blood flow repeatedly every 30 seconds until blood flow stops
- if bleeding continues for more than 15 minutes, stop timing and apply pressure
- make note/record that bleeding time exceeds 15 minutes
2. BLOOD ALCOHOL TESTING

Blood alcohol testing measures the amount of alcohol within the body.

Because alcohol absorbs quickly into the blood, it can be measured just minutes after having an alcoholic beverage. The highest level of alcohol in the blood is present about one hour after having an alcoholic beverage.

The majority of alcohol will be broken down within the liver. The remaining alcohol is passed out by exhaling and urination.

Increased amounts of alcohol have a sedative effect, depressing the central nervous system.

A blood alcohol test is commonly used to determine if a person is intoxicated. The most common request for blood alcohol testing is by police officers, in order to determine whether a person is driving under the influence of alcohol above the legal limit.

A blood alcohol test may be done to:

- check blood alcohol levels if a person is suspected of driving intoxicated (under the influence of alcohol) above the legal limit
- check blood alcohol levels in under aged people
- check blood alcohol levels in people in alcohol treatment programs
- find cause of confusion, altered mental status, or even coma in patients

The Procedure:

- wrap tourniquet (elastic band) around upper arm to stop blood flow
- clean site with NON alcohol solution (alcohol content)
- insert needle at a 15 – 30° angle with bevel side up
- fill collection tube
- remove tourniquet after bleeding starts
- apply gauze as needle is removed
- put pressure on puncture site and check that bleeding has stopped
A phlebotomist may also perform specimen collection in blood donation facilities. Blood is collected from donors in order to be used for patients in need of blood products.

Donor units are separated into components and require precise labeling in order to trace each unit back to the donor.

Each donor unit provides:
- red blood cells (erythrocytes)
- plasma
- platelets (thrombocytes)
- blood typing reagents
- blood clotting factors
- proteins and immunoglobulin

Donor Candidates must:
- be between 17 and 66 years of age
- give permission or have written parental consent
- be in overall good health
- weigh a minimum of 110 pounds
- have sufficient amount of hemoglobin and/or hematocrit

Autologous Donations:
- person donates blood for their own future use
- if blood is donated before surgical procedure, the following criteria must be met:
  - written order of physician
  - patient must be capable of regenerating red blood cells
  - level of hemoglobin must be at least 11 grams
  - surgical procedure cannot be within 72 hours after donation

Blood Donation Procedure:
- two-step cleansing process using iodine preparations
- selection of large vein, generally the antecubital area
- 16-gauge needle and evacuated tube system are used
- the anticoagulant in tubes is citrate phosphate dextrose
- if tube does not fill completely, the sample must be discarded and the procedure repeated

Aftercare:
- in any blood donation procedure, patient must be monitored for any side effects such as dizziness and/or nausea that may occur
- if side effects occur, make sure to keep patient in a supine position (lying face-up on back) with the head lower than the heart
4. FORENSIC TESTING

Forensic testing is usually associated with court proceedings/legal cases.

All forensic testing must follow a chain of custody procedure which requires that any person handling specimens or samples to date and sign a legal document.

Further requirements:
- specimens must always be stored/kept in a locked container
- the legal document must state:
  - person's name specimen was received from
  - person's name collecting the specimen
  - person's name specimen was given to
  - length of time each person handled the specimen

Specimens collected for forensic testing may include:

- blood
- hair
- saliva
- sperm
- sweat
- skin
- nails
- teeth
- bones
- vegetation

Guidelines:

- gloves must be worn at all times
- specimen must be collected as soon as possible
- accuracy in packing, storing, and transporting the specimen is essential
- specimen must be labeled properly
- all handling of specimen must be recorded
5. GLUCOSE TESTING

Blood glucose testing measures the amount of sugar (glucose) in blood. Glucose is the primary energy source of the body. During the digestion process, carbohydrates break down into glucose. Blood glucose testing may be ordered by physicians if a patient shows signs of diabetes, or if a patient is diabetic, to check glucose levels. Glucose level is the most commonly requested timed specimen.

Symptoms of diabetes include:
- frequent urination
- blurred vision
- lightheadedness
- persistent thirst

Blood glucose tests may either be ordered as a fasting blood glucose test (no eating or drinking except water for at least 8 hours prior to test) or a random glucose test which can be taken at any time, although foods and fluids the patient might have had may affect the test.

Procedure:
- clean area of lower arm where needle will be inserted
- instruct patient to make a fist as tourniquet is applied
- insert needle and release tourniquet once blood flow starts
- apply pressure to puncture site and check that bleeding has stopped

A blood glucose tolerance test measures the ability of a patient to metabolize a large dose (oral) of glucose. Patients that receive a glucose tolerance test have been fasting and are therefore susceptible to fainting when given large amounts of glucose. The phlebotomist should accompany the patient to and from the drawing room/area in order to prevent any injuries.

Initial Procedure:
- collect initial fasting blood and urine samples
- no further testing is required if blood glucose level is above 200 mg/dl
- patient is given a large dose of glucose solution to drink if blood glucose level is below 200 mg/dl
- make sure all of the solution is swallowed in 5 minutes without vomiting

3-Hour Blood Glucose Tolerance Test Procedure:
- collect fasting blood and urine samples at:
  - 30 minutes
  - 1 hour
  - 2 hours
  - 3 hours
- label each blood and urine sample with the time collected
- patients are not allowed to:
  - eat, drink (except water), chew gum, smoke, consume alcohol, or leave the facility
Therapeutic phlebotomy refers to a prescribed amount of blood withdrawn in order to treat blood disorders such as:

- hemochromatosis
- polycythemia
- porphyries

- **Hemochromatosis:** disorder where the body absorbs too much iron from the foods eaten
  - extra iron is mainly stored in the liver, pancreas, and skin
  - condition leads to diabetes, cirrhosis of the liver, enlarged heart with congestive heart failure, higher skin pigmentation, or irregular heart beat

- **Polycythemia:** condition of an increase of circulating red blood cells and blood volume

- **Porphyries:** metabolic disorder that is associated with enlargement of spleen and liver, pigmentation and red color in urine, and sensitivity to light

Therapeutic phlebotomy may be performed every few days, or as needed, in order to improve symptoms.
The procedure may be scheduled as needed, or may be performed on a regular basis.

The procedure for therapeutic phlebotomy is a regular venipuncture procedure.
Per treatment, roughly 500 ml of blood are collected.

To perform therapeutic phlebotomy, the patient must have a written request from a physician, which must include the following information:

- amount of blood to be withdrawn
- frequency of donation
- desired hemoglobin level
7. TIMED SPECIMEN

A timed specimen is a measurement of the concentration of a substance in the blood, such as cretin, glucose, or sodium, over a specific period of time, usually between 8 and 24 hours.

Common Timed Specimen

- glucose levels
- iron levels
- cortisol levels
- peak and depression of medication levels
- cardiac enzyme levels
- hormone assays
- potassium
- sodium

For a timed specimen collection, the patient should be instructed to fast for 8 hours prior to the procedure. Fasting in this situation includes abstaining from all food and consuming only water. The patient should also be instructed to hold back from any exercise in order to be in a basal state.

If the patient fails to follow the instructions and does not fast, test results for glucose levels and triglycerides may be affected and may therefore be inaccurate.

Lipemia is a condition in which an increased amount of lipids (fatty acids) are found in the bloodstream. This is a common occurrence after meals, which is why fasting is vital before a test can be performed.

Critically lipemic specimens will show a milky, clouded serum as opposed to the normal, clear, or yellowish serum.
8. TOXICOLOGY

Toxicology is a branch of chemistry, biology, and medicine that focuses on the study of the adverse effects of chemicals on living organisms.

When performing specimen collection for toxicology, the phlebotomist must follow the laboratory protocol.

In order to maintain the integrity of the sample, the specimen must not come into contact with any outside influences such as oil, bacteria, or anything that would invalidate the results.

Common toxicology tests include:

- acetaminophen
- caffeine
- chloramphenicol
- ethanol
- methanol
- acetone
- amphetamines
- cannabinoids
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Basic Phlebotomy review and study guide was written by Dr. Joel Siegel and revised by Subject Matter Experts especially for MedCA.

Dr Joel Siegel taught phlebotomy courses for thirty years.

This guide is written in an easy to read and study format.

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