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Phlebotomy

This lecture will concentrate on the historical perspective of phlebotomy, and show that man’s initial fascination with his blood and body fluids has had a direct influence on the study of Biomedical Science today.

Meaning of ‘Phlebotomy’

The term ‘Phlebotomy’ suggests the taking of Blood only. This subject is not only concerned with “blood letting”, but rather the whole range of skills and knowledge necessary for the collection of viable specimens for later analysis in a laboratory.

History

‘Phlebotomy’ comes from the Greek word phlebos, meaning veins, and tome, meaning incision. Historical evidence suggests the possibility of blood letting for therapeutic reasons may have begun in Egypt around 1400B.C. Tomb paintings from this time show the application of a leech to a patient.

Hypocrites (460-377 B.C.), also known as the father of modern science, was responsible for early medical theory, which believed illness was caused by an “imbalance” in the body. The removal of this “excess” was thought to restore this balance.

The practice of bloodletting seemed logical when this foundation of all medical treatment was based on the four body humors: blood, phlegm, yellow bile, and black bile. Health was thought to be restored by plugging, starving, vomiting, or blood letting.

The art of blood letting was flourishing well before Hypocrites in the fifth century B.C. By the Middle Ages, both surgeons and barbers were specializing in this bloody practice. Barbers advertised with a red (for blood) and white (for tourniquet) striped pole. The pole itself represented the stick squeezed by the patient to dilate the veins.

The practice reached unbelievable heights in the 18th and early 19th centuries. The first U.S. president, George Washington, died from a throat infection in 1799 after being drained of nine pints of blood within 24 hours. The draining of 16-30 ounces (1-4 pints) of blood was typical. Blood was often caught in a shallow bowl. When the patient became faint, the “treatment” was stopped. Bleeding was often encouraged over large areas of the body by multiple incisions. By
the end of the 19th century (1875-1900), phlebotomy was declared quackery.

DISCLAIMER

We have taken great care to confirm the accuracy of the information present and to describe generally accepted practices. However, NPCE is not responsible for errors or omissions or for any consequences from application of the information in this guide and make no warranty, expressed or implied, with respect to the currency, completeness, or accuracy of the contents of the publication. Application of this information in a particular situation remains the professional responsibility of the practitioner; the clinical treatments described and recommended may not be considered absolute and universal recommendations.

The course will provide basic instruction on techniques, procedures, and issues pertaining to the proper collection of blood specimens for routine clinical laboratory testing. It will also provide additional information to further your phlebotomy education.

Once complete with review of all materials please use the following link to take your exam:

http://www.npce.org/

Once test has been completed you will be contacted by a representative to discuss the results of your exam as well as the next step to receiving your certificate of completion.

COURSE OBJECTIVES:

A. Demonstrate knowledge of the health care delivery system and medical terminology.
B. Demonstrate knowledge of infection control and safety.
C. Demonstrate understanding of the importance of specimen collection and specimen integrity in the delivery of patient care.
D. Demonstrate understanding of requisitioning, specimen transport and specimen processing.
E. Demonstrate understanding of quality assurance and quality control in phlebotomy.
F. Communicate (verbally and nonverbally) effectively and appropriately in the workplace.
G. Following standard operating procedures to collect specimens.

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E. Sample Test Questions and Answers

Levels of Difficulty

The NPCE Phlebotomy Examination will have test items that are written at three levels of difficulty, as certification testing requires more than merely knowing facts. It requires the use of higher level of thinking skills as well. Please keep this in mind when you are going over the material.

- Low Level- asks the examinee to recall a fact or remember information previously leaned.

- Middle Level- asks the examinee to interpret or apply information in answering a question.

- High Level- asks the examinee to learn and understand on the job blood collection instructions objectives in the phlebotomy field.

Overall rating of this exam is Intermediate.
Section 1

Phlebotomist Title and Initials

Professionalism

Professionalism is defined as the conduct and qualities that characterize a professional phlebotomist. The perception of the phlebotomy professional is based on the image that is created by the phlebotomist’s conduct and appearance. Statistics state that, general appearance and grooming directly influence whether the phlebotomist is perceived as a professional. People form opinions of a person within the first several seconds of meeting, and this judgment on the superficial aspect of a person sets an image in the observer’s mind that will influence the interaction.

Clothing, proper personal hygiene, and physical well-being contribute to a person’s professional appearance. National healthcare institutional policies for attire are influenced by federal standards that require employers to provide protective clothing for laboratory workers, including phlebotomists. The phlebotomist is required to display attitude, personal characteristics, and behaviors consistent with accepted federal standards of professional conduct. Some of the personal behaviors and characteristics that a phlebotomist must maintain to uphold a professional image, are as follows:

Self-Confidence

Phlebotomists who exhibit self-confidence have the ability to trust their own personal judgment. The perception you have of yourself has an enormous impact on how others perceive you. Certain key factors affect being perceived as self-confident; erect posture, professional appearance, courage, and ability of communication.

Integrity

Integrity is a personal feeling of “completeness” derived from honesty, and consistency of character; this can be seen in the person’s actions, values, and beliefs. Professional standards of integrity or honesty require a person to do what is right regardless of the circumstances and in all situations and interactions. A phlebotomist often functions independently and may be tempted to take procedural shortcuts when pressed for time. A phlebotomist with integrity understands that following the rules for collection is essential to the quality of test results; therefore, he or she respects those rules.

Compassion

Compassion is an emotion prompted by others’ experiences and concerns. Compassion means being sensitive to a person’s needs, and ability to offer reassurance in a caring
and humane way. A phlebotomist shows compassion by understanding fear that that a patient has about a certain illness, by using empathy to sense others’ experiences, and by demonstrating a calm and helpful demeanor.

**Self-Motivation**
A motivated person will find the workplace stimulating no matter what the tasks may entail. Motivation is a direct reflection of a person’s attitude toward life. A phlebotomist who exhibits self-motivation takes initiative to follow through on tasks, consistently strives to improve and correct behavior, and takes advantage of every learning opportunity that may come along. A phlebotomist who is motivated makes every effort to provide excellence in all aspects of patient care in which he or she is involved.

**Dependability**
A phlebotomist who works hard and shows constant, reliable effort and perseverance is a valuable asset to any healthcare organization. Values such as being ethical, responsible, reliable, personable, and accountable are all values that make a phlebotomist a desirable candidate for new job opportunity and ultimately promotions in the healthcare setting or anywhere.

**Ethical Behavior**
Phlebotomists must know that there are policies designed to regulate what should, or should not be done by those who work in the healthcare setting. The system of policies or principles is called a code of ethics. Ethics are centered on an individual’s conduct. Ethical behavior means making the right choices that maintain a high level of respect for you, the phlebotomist, and for the profession in which you work. In healthcare, ethical behavior requires conforming to a standard of right and wrong conduct to avoid harming patients in any way. A code of ethics, although not enforceable by law, leads to uniformity and defined expectations for members of the profession. Professional organizations, such as ASCP, have developed codes of ethics for laboratory professionals. The Hippocratic Oath includes the phrase primum non nocere, which means “first do no harm.” The main goal in any healthcare professional’s code of ethics must always be to safeguard the patient’s welfare. A guide to working with that principle in mind is a document of accepted quality-care principles developed by the American Hospital Association and the related patient rights. Any questions relating to patient information should be referred to the proper authority. Unauthorized release of information concerning a patient is considered an invasion of privacy. In 1996, a federal law was passed “Health Insurance Portability (HIPAA) of 1996”, requiring all healthcare providers to obtain a patient’s consent in writing before disclosing medical information.
such as a patient’s test results, treatment, or condition to any unauthorized person.

**HIPAA**

As a person’s health information has become easily transferable from one facility to the next through electronic exchange, a growing problem with confidentiality has arisen. The HIPAA law was enacted in order to more closely secure this information and regulate patient privacy. HIPAA provisions protect a broad range of health information. Safeguarding the confidentiality of protected health information (PHI) is the primary aim of the HIPAA privacy rule. The law defines PHI as “individually identifiable health information that is transmitted by electronic media; maintained in any medium described in the definition of electronic media or transmitted or maintained in any other form or medium.” The law established national standards for the electronic exchange of PHI and states that patients must be informed of their rights concerning the release of PHI and how it will be used. Penalties for HIPAA violations include disciplinary action, fines, and possible jail time. The law states that healthcare workers (HCWs) must obtain the patient’s written authorization for any use or disclosure of PHI unless the use or disclosure is for treatment, payment, or healthcare operations. To avoid litigation in this area, all HCWs and students must sign a confidentiality and nondisclosure agreement affirming that they understand HIPAA and will keep all patients’ information confidential. Clinical laboratory (lab) services perform tests on patient specimens. Results of testing are primarily used by physicians to aid in the diagnosis, evaluation, and monitoring of patient medical conditions. Clinical labs are typically located in hospitals, outpatient clinics, physicians’ offices, and large reference laboratories.

**Traditional Laboratories**

There are two divisions in the clinical laboratory, the clinical analysis area and the anatomical and surgical pathology area. All laboratory testing is associated with one of these two areas. Laboratories in large hospitals have organizational structures similar to the facility, based on management structure or hierarchy. People who do similar tasks are grouped into departments, the goal being to perform each task as efficiently and accurately as possible.

**Hematology**

The hematology department performs laboratory tests that identify diseases associated with blood and the blood-forming tissues. The most commonly ordered hematology test is the complete blood count (CBC). The CBC is performed using automated instruments, such as the Coulter counter, that electronically count cells and calculate results.
Coagulation

Coagulation is the study of the ability of blood to form and dissolve clots. Coagulation tests are closely related to hematology tests and are used to discover, identify, and monitor defects in the blood-clotting mechanism. They are also used to monitor patients who are taking medications called anticoagulants (chemicals that inhibit blood clotting) or "blood thinners." The two most common coagulation tests are the prothrombin time, used to monitor warfarin therapy, and the activated partial thromboplastin time, for evaluating heparin therapy.

Microbiology

The microbiology department analyzes body fluids and tissues for the presence of microorganisms, primarily by means of culture and sensitivity (C&S) testing. Results of a C&S tell the physician the type of organisms present and the particular antibiotics that would be most effective for treatment. It is very important to collect, transport, and handle microbiology specimens properly in order to determine the presence of microorganisms and identify them appropriately. Subsections of microbiology are bacteriology (the study of bacteria), parasitology (the study of parasites), mycology (the study of fungi), and virology (the study of viruses).

Section 2

Clinical Laboratory Improvement Amendments of 1988 (CLIA' 88) are federal regulations passed by Congress and administered by the Centers for Medicare and Medicaid Services (CMS), an agency that manages federal healthcare programs of Medicare and Medicaid. These regulations establish quality standards that apply to all facilities, including clinics and physicians’ office laboratories that test human specimens for the purpose of providing information used to diagnose, prevent, or treat disease and assess health status. The standards address quality assurance, quality control, proficiency testing, laboratory records, and personnel qualifications. The goal of the standards is to ensure the accuracy, and reliability of patient test results regardless of the location, type, or size of the laboratory.

The Clinical Laboratory Improvement Advisory Committee (CLIAC) was formed to assist in administering these regulations. The purpose is to provide technical and scientific guidance to the appropriate people in CMS who are administering the regulations. All
laboratory facilities subject to CLIA’ 88 regulations are required to obtain a certificate from the CMS according to the complexity of testing performed.

Three categories of testing are recognized: waived (simple, with a low risk of error), moderate (including provider performed microscopy), and high complexity. Complexity of testing is based on the difficulty involved in performing the test and the degree of risk to a patient if the test is performed incorrectly. CLIA requirements are more stringent for labs that perform moderate- and high-complexity testing than waived testing, and their facilities are subject to routine inspections. Specimen collection is an important part of CLIA inspections, and laboratories that are of moderate or high complexity are required to have written protocols for patient preparation, specimen collection, labeling, preservation, and transportation.

Clinical and Laboratory Standards Institute (CLSI) is a global, nonprofit, standards developing organization with representatives from the profession, industry, and government. Its mission is to develop best practices in clinical and laboratory testing and promote their use throughout the world, using a consensus-driven process that balances the viewpoints of industry, government, and the healthcare professions.

The organization uses a widespread agreement process to develop voluntary guidelines and standards for all areas of the laboratory. Phlebotomy program approval, certification examination questions, and the standard of care are based on these important guidelines and standards. Recently, the Joint Commission moved toward stricter patient ID requirements by their revision of NPSGs in regard to patient identification. Laboratories must now “actively involve” patients in their identification prior to any specimen collection.

This is the first time the commission requires those who draw blood specimens from inpatients to go beyond an arm bracelet. For outpatients without ID bands, the agency requirements are met when the patients speak their names and provide a second verbal identifier such as their birth dates.
Delta Checks

Delta checks help ensure quality in testing. A delta check compares current results of a lab test with previous results for the same test on the same patient. Although some variation are expected, a major difference in results could indicate error and requires investigation.

**Statute of limitations:** A law setting the length of time after an alleged injury in which the injured person is permitted to file a lawsuit. The time limit is specified in each state’s medical malpractice law. The question for all parties involved is when does the clock start? The statute of limitations period typically begins when one of the following circumstances occurs:

1. The day the alleged negligent act was committed
2. When the injury resulting from the alleged negligence was actually discovered or should have been discovered by a reasonably alert patient
3. The day the physician–patient relationship ended or the day of the last medical treatment in a series
4. In the case of minors, often not until the minor reaches the age of majority

**Vicarious liability:** Liability imposed by law on one person for acts committed by another. One example is employer liability for negligence by an independent contractor or consultant who was hired. This is based on the principle that the contractor or consultant is acting on behalf of the employer by virtue of the contract between them.

**GUIDELINES TO AVOID LAWSUITS**

- Acquire informed consent before collecting specimens.
- Respect a patient’s right to confidentiality.
- Strictly adhere to accepted procedures and practices.
- Use proper safety containers and devices.
- Listen and respond appropriately to the patient’s requests.
- Accurately and legibly record all information concerning patients.
- Document incidents or occurrences.
- Participate in continuing education to maintain proficiency.
- Perform at the prevailing standard of care.
- Never perform procedures that you are not trained to do.
Section 3

Healthcare-Associated Infections

Approximately 5% of patients in the United States are exposed to and contract some sort of infection after admission to a healthcare facility. The term nosocomial infection applies to infections acquired in healthcare facilities. The term healthcare-associated infection (HAI) applies to infections associated with healthcare delivery in any healthcare setting, including home care.

According to the CDC, HAIs account for an estimated 1.2 million infections and 110,000 associated deaths each year. Healthcare facility–acquired or associated infections can result from contact with various sources, including infected personnel, other patients, visitors, and contaminated food, drugs, or equipment. The Healthcare Infection Control Practices Advisory Committee (HICPAC) advises the CDC on updating guidelines regarding the prevention of infections in hospitals and other healthcare facilities.

Hand Hygiene

Hand hygiene is the most important means of preventing the spread of infection. Hand hygiene measures include the frequent use of antiseptic hand cleaners or hand washing, depending upon the degree of contamination. It is important that all healthcare personnel learn proper hand hygiene procedures and recognize situations when they should be performed. CDC/HICPAC guidelines recommend the use of alcohol-based antiseptic hand cleaners (gels, foams, and rinses) in place of hand washing as long as the hands are not visibly soiled. These products have been shown to have superior microbiocidal activity.

Hand Washing

There are different methods of hand washing, depending on the degree of contamination and the level of antimicrobial activity required. A routine hand-washing procedure uses plain soap and water to mechanically remove soil and bacteria. Hand antisepsis requires the use of an antimicrobial soap to remove, kill, or inhibit transient microorganisms. A 2-minute surgical hand scrub uses an antimicrobial soap or equivalent to remove or destroy microorganisms and reduce levels of normal flora prior to surgical procedures.

Hand washing procedures

PURPOSE: Decontaminate hands to prevent the spread of infection
EQUIPMENT: Liquid soap, disposable towels, trash can

1. Stand back so that you do not touch the sink it may be contaminated.
2. Turn on the faucet and wet hands. Water should not be too hot or too cold. Hands should be wet before applying soap to minimize drying, chapping, or cracking of hands from frequent hand washing.
3. Apply soap and work up a lather. A good lather is needed to reach all surfaces.
4. Scrub all surfaces, including between the fingers and around the knuckles.
5. Scrubbing is necessary to dislodge micro-organisms from surfaces.
6. Rub your hands together vigorously. Friction helps loosen dead skin, dirt, debris, and microorganisms.

Section 4
The Joint Commission’s “Do Not Use” List

<table>
<thead>
<tr>
<th>Do Not Use</th>
<th>Rationale</th>
<th>Replace with</th>
</tr>
</thead>
<tbody>
<tr>
<td>IU</td>
<td>Mistaken for “IV” or “10”</td>
<td>Write “international unit”</td>
</tr>
<tr>
<td>U</td>
<td>Mistaken for “0” (zero)</td>
<td>Write “unit”</td>
</tr>
<tr>
<td>MS</td>
<td>Can mean morphine sulfate</td>
<td>Write “morphine sulfate”</td>
</tr>
<tr>
<td>MSO4 and MgSO4</td>
<td>Can be confused with one another</td>
<td>Write “magnesium sulfate”</td>
</tr>
<tr>
<td>Q.D., QD, q.d., qd</td>
<td>Mistaken for each other</td>
<td>Write “daily”</td>
</tr>
<tr>
<td>No leading zero</td>
<td>Decimal point is missed</td>
<td>Write 0.X mg</td>
</tr>
<tr>
<td>Trailing zero</td>
<td>Decimal point is missed</td>
<td>Write X mg</td>
</tr>
</tbody>
</table>

Please take a break and revisit all the content in sections 1-4. Highlight key factors that will help you better understand the topics.

If there is something you are not understanding please feel free to email us at education@npce.org and we will guide you with links on specific subjects.
Section 5

Homeostasis

The human body constantly strives to maintain its internal environment in a state of equilibrium. This state condition is called homeostasis, which translated means “standing the same.” The body maintains homeostasis by compensating for changes in a process that involves feedback and regulation in response to internal external changes.

Gas Exchange and Transport

During normal external respiration, oxygen and carbon dioxide are able to diffuse through the walls of the sacs and the tiny, one-cell-thick capillaries of the lungs. Blood in lung capillaries is low in $O_2$ and high in $CO_2$. Therefore, $O_2$ from the alveoli diffuses into the capillaries while $CO_2$ diffuses from the capillaries into the alveoli to be expired. The amount of $O_2$ that can be carried in the blood plasma is not enough to meet the needs of the body. Fortunately, hemoglobin has the ability to bind $O_2$, increasing the amount the blood can carry by more than 65%. Most of the $O_2$ that diffuses into the capillaries in the lungs binds to the iron-containing heme portion of hemoglobin molecules. Very little is dissolved in the blood plasma. $O_2$ combined with hemoglobin is called oxyhemoglobin. Hemoglobin also has the ability to bind with $CO_2$. Hemoglobin combined with $CO_2$ is called carbaminohemoglobin. However, only about 25% of the $CO_2$ from the tissues is carried to the lungs in this manner. Approximately 10% is carried as gas dissolved in the blood plasma. The remaining 65% is carried as bicarbonate ion, which is formed in the red blood cells and released into the blood plasma. In the lungs, the bicarbonate ion reenters the red blood cells and is released as $CO_2$ again so it can diffuse into the alveoli and be exhaled by the body. Partial pressure is defined as the pressure exerted by one gas in a mixture of gases. Oxygen associates with hemoglobin in the lungs, where the partial pressure of oxygen is increased, and dissociates from hemoglobin in the tissues, where the partial pressure of oxygen is decreased. Carbon dioxide associates with hemoglobin in the tissues, where the partial pressure of carbon dioxide is increased, and dissociates with hemoglobin in the lungs, where the partial pressure of carbon dioxide is decreased.

Electrocardiogram

Electrocardiogram (ECG, also known as an EKG) is a graphic record of the heart’s electrical activity during the cardiac cycle. An ECG is produced by a machine called an electrograph, which records the electrical currents corresponding to each event in heart muscle contraction. Electrical impulses are recorded as waves when electrodes are
placed on the skin at specific locations. The recording is called an ECG tracing. The P wave of the tracing represents the activity of the atria and is usually the first wave seen. The QRS complex (a collection of three waves), along with the T wave, represents the activity of the ventricles. An ECG is useful in diagnosing damage to the heart muscle and abnormalities in the heart rate.

**Blood pressure** is the force exerted by the blood on the walls of blood vessels. It is commonly measured in a large artery (such as the brachial artery in the upper arm) using a sphygmomanometer, more commonly known as a blood pressure cuff. Blood pressure results are expressed in millimeters of mercury (mm Hg) and are read from a manometer that is either a gauge or a mercury column, depending upon the type of blood pressure cuff used. The two components of blood pressure measured are:

- Systolic pressure: the pressure in the arteries during contraction of the ventricles
- Diastolic pressure: the arterial pressure during relaxation of the ventricles.

A brachial blood pressure reading is taken by placing a blood pressure cuff around the upper arm and a stethoscope over the brachial artery. The cuff is inflated until the brachial artery is compressed and the blood flow is cut off. Then the cuff is slowly deflated until the first heart sounds are heard with the stethoscope. The pressure reading at this time is the systolic pressure. The cuff is then slowly deflated until a muffled sound is heard. The pressure at this time is the diastolic pressure.

**H-Shaped Antecubital Veins**

The H-shaped venous distribution pattern is displayed by approximately 70% of the population and includes the median cubital vein, cephalic vein, and basilic vein.

- **Median cubital vein:** Located near the center of the antecubital area, it is the preferred vein for venipuncture in the H-shaped pattern. It is typically larger, closer to the surface, better anchored, and more stationary than the others, making it the easiest and least painful to puncture and the least likely to bruise.
- **Cephalic vein:** Located in the lateral aspect of the antecubital area, it is the next choice vein for venipuncture in the H-shaped pattern. It is often harder to palpate than the median cubital but is fairly well anchored and often the only vein that can be palpated in obese patients.
- **Basilic vein:** A large vein located on the medial aspect of the antecubital area, it is the last-choice vein for venipuncture in either venous distribution pattern. It is generally easy to palpate but is not as well anchored and rolls more easily, increasing the possibility of accidental puncture of the anterior or posterior
branch of the medial cutaneous nerve or the brachial artery, both of which commonly underlie this area. Punctures in this area also tend to be more painful.

**M-Shaped Antecubital Veins**

The veins that form the M-shaped venous distribution pattern include the cephalic vein, median vein, median cephalic vein, median basilic vein, and basilic vein. The veins most commonly used for venipuncture in this distribution pattern are described as follows:

- **Median vein:** The first choice for venipuncture in the M-shaped pattern because it is well anchored, tends to be less painful to puncture, and is not as close to major nerves or arteries as the others, making it generally the safest one to use.
- **Median cephalic vein:** The second choice for venipuncture in the M-shaped pattern because it is accessible and is for the most part located away from major nerves or arteries, making it generally safe to puncture. It is also less likely to roll and relatively less painful to puncture.
- **Median basilic vein:** The last choice for venipuncture in the M-shaped pattern because it is more painful to puncture and, like the basilic vein, is located near the anterior and posterior branches of the medial cutaneous nerve and the brachial artery.

**Blood Type**

Blood type is inherited and is determined by the presence or absence of certain proteins called antigens on the surface of the red blood cells. Some blood-type antigens cause formation of antibodies to the opposite blood type. If a person receives a blood transfusion of the wrong type, the antibodies may react with the donor RBCs and cause them to agglutinate, or clump together, and lyse that is, to hemolize or disintegrate. Such an adverse reaction between donor cells and a recipient, which can be fatal, is called a transfusion reaction. The most commonly used method of blood typing recognizes two blood group systems: the ABO system and the Rh factor system.

**ABO Blood Group System**

ABO blood group system recognizes four blood types, A, B, AB, and O, based on the presence or absence of two antigens identified as A and B. An individual who is type A has the A antigen, type B has the B antigen, type AB has both antigens, and type O has neither A nor B. Type O is the most common type, and type AB is the least common. Unique to the ABO system are preformed antibodies in a person’s blood that are
directed against the opposite blood type.

Type A blood has an antibody directed against type B, called anti-B. A person with type B has anti-A, type O has both anti-A and anti-B, and type AB has neither. Individuals with type AB blood were once referred to as universal recipients because they have neither A nor B antibody to the RBC antigens and can theoretically receive any ABO type blood. Similarly, type O individuals were once called universal donors because they have neither A nor B antigen on their RBCs, and in an emergency, their blood can theoretically be given to anyone. However, type O blood does contain plasma antibodies to both A and B antigens, and when given to an A or B type recipient, it can cause a mild transfusion reaction. To avoid reactions, patients are usually given type-specific blood, even in emergencies.

**Rh Blood-Group System**

Rh blood-group system is based upon the presence or absence of an RBC antigen called the D antigen, also known as Rh factor. An individual with the D antigen present on red blood cells is said to be positive for the Rh factor, or Rh-positive. An individual whose RBCs lack the D antigen is said to be Rh-negative. A patient must receive blood with the correct Rh type as well as the correct ABO type.

**Clot Activators**

Clot activator is a substance that enhances coagulation in tubes used to collect serum specimens. Clot activators include substances that provide more surface for platelet activation, such as glass (silica) particles and inert clays like Celite, and clotting factors such as thrombin. Silica particles are the clot activators in serum-separator tubes (SSTs) and plastic red-top tubes.

Silica particles cause the blood to clot within 15 to 30 minutes. Blood collected in thrombin tubes generally clots within 5 minutes. Celite tubes are used with some point-of-care coagulation systems. Tubes containing clot activators require five gentle inversions for complete and rapid clotting to occur.

**Thixotropic Gel Separator**

Thixotropic gel is an inert synthetic substance initially contained in or near the bottom of certain blood collection tubes. The density of the gel is between that of the cells and the serum or plasma. When a specimen in a gel tube is centrifuged, the gel undergoes a change in viscosity and moves to a position between the cells and the serum or plasma, forming a physical barrier between them.
This physical separation prevents the cells from continuing to metabolize substances such as glucose in the serum or plasma. Serum gel-barrier tubes include Becton Dickinson (BD) tubes with gold plastic stoppers or tubes with mottled red/gray rubber stoppers called serum-separator tubes (SSTs); new BD tubes containing thrombin that clot in 5 minutes called Rapid Serum Tubes (RSTs) Kendall tubes with mottled red/gray rubber stoppers called Monoject Corvac tubes; and Greiner Bio-One Vacuette serum tubes with red plastic stoppers and yellow tops.

Heparinized plasma gel-barrier tubes include BD tubes with light-green plastic or mottled gray/green rubber stoppers called plasma-separator tubes (PSTs) and Vacuette tubes with green plastic stoppers and yellow tops. In addition, BD has EDTA gel-barrier tubes with pearl-colored stoppers called plasma-preparation tubes (PPTs).

**Order of draw**

Refers to the order in which tubes are collected during a multiple-tube draw or are filled from a syringe. CLSI recommends the following order of draw for both ETS collection and in filling tubes from a syringe:

1. Sterile tube (blood culture)
2. Blue-top coagulation tube
3. Serum tube with or without clot activator, with or without gel
4. Heparin tube with or without gel plasma separator
5. EDTA tube
6. Glycolytic inhibitor tube

**Capillary Puncture Steps**

Capillary punctures have the same general steps regardless of whether they are fingersticks or heelsticks. Position is important to patient comfort and the success of specimen collection. For finger punctures, the patient’s arm must be supported on a firm surface with the hand extended and palm up. A young child is typically held in the lap by a parent who restrains the child with one arm and holds the child’s arm steady with the other. For heel punctures, an infant should be supine with the foot lower than the torso so the force of gravity can assist blood flow.
Selecting Site

General site selection criteria include one that is warm, pink or normal color, and free of scars, cuts, bruises, or rashes. Swollen or previously punctured sites should be avoided, because accumulated tissue fluid can contaminate the specimen and negatively affect test results. Specific locations for capillary puncture include fingers of adults and heels of infants.

Order of draw for capillary puncture

The order of draw for collecting multiple specimens by capillary puncture is not the same as for venipuncture. Puncturing the skin releases tissue thromboplastin, which activates the coagulation process in the blood drops.

Specimens must be collected quickly to minimize the effects of platelet clumping and microclot formation and to ensure that an adequate amount of specimen is collected before the site stops bleeding. Hematology specimens are collected first because they are most affected by the clotting process. Serum specimens are collected last because they are supposed to clot. The CLSI order of draw for capillary specimens is as follows:

- Blood gas specimens (CBGs)
- EDTA specimens
- Other additive specimens
- Serum specimens

Routine Blood Film/Smear Preparation

Blood film or smear is required to perform a manual differential (Diff), a test in which the number, type, and characteristics of blood cells are determined by examining a stained blood smear under a microscope. A manual differential may be performed as part of a complete blood count or to confirm abnormal results of a machine-generated differential or platelet count.

Two blood smears are normally prepared and submitted for testing. Although a common practice in the past, today blood smears are rarely made at the bedside. They are typically made in the hematology department from blood collected in an EDTA tube, either by hand or using an automated machine that makes a uniform smear from a single drop of blood. A few special tests require evaluation of a blood smear made from a fresh drop of blood from a fingertip. Skin puncture collection of peripheral smears is typically preferred. In addition, some hematologists prefer blood smears made from
blood that has not been in contact with EDTA. When collected with other skin puncture specimens, blood smears should be collected first to avoid effects of platelet clumping.

**Arterial Puncture**

Paramedical personnel who may be required to perform arterial puncture include nurses, medical technologists and technicians, respiratory therapists, emergency medical technicians, and level II phlebotomists. Phlebotomists who collect arterial specimens must have extensive training involving theory, demonstration of technique, observation of the actual procedure, and performance of arterial puncture with supervision before performing arterial punctures on their own.

Personnel who perform ABG testing are designated level I or level II depending on their formal education, training, and experience. Level II personnel supervise level I personnel and perform testing as well. For quality assurance purposes, individuals performing arterial puncture must undergo periodic evaluation. Those who do not meet acceptable standards must have remedial instruction and be re-evaluated before being allowed to collect arterial specimens independently. Different sites can be used for arterial puncture. The criteria for site selection include:

- Presence of collateral circulation, which means that the site is supplied with blood from more than one artery, so that circulation can be maintained if one vessel is obstructed or damaged. Collateral circulation is the primary site-selection criterion. It can be evaluated using a portable ultrasound instrument or by performing a simple test called the modified Allen test.

- Artery accessibility and size. The more accessible and larger an artery is, the easier it is to palpate and puncture.

- Type of tissue surrounding the puncture site. The chosen artery should be in an area that poses little risk of injuring adjacent structures or tissue during puncture, helps fix or secure the artery to keep it from rolling, and allows adequate pressure to be applied to the artery after specimen collection.

- Absence of inflammation, irritation, edema, hematoma, lesion or a wound, an arteriovenous (AV) shunt in close proximity, or a recent arterial puncture at the site.

**The Radial Artery**

The first choice and most commonly used site for arterial puncture is the radial artery, located on the thumb side of the wrist. Although smaller than arteries at other sites, it is easily accessible in most patients.
Advantages

There are many advantages to using the radial artery to collect ABGs. For example:

- The biggest advantage of using the radial artery is the presence of good collateral circulation. Under normal circumstances, both the radial artery and the ulnar artery supply the hand with blood. If the radial artery were accidentally damaged as a result of an arterial puncture, the ulnar artery would still supply the hand with blood. Consequently the ulnar artery is normally off limits for arterial specimen collection.
- It is generally easy to palpate because it lies fairly close to the surface of the skin.
- There is less chance of hematoma formation following specimen collection because it can easily be compressed over the ligaments and bones of the wrist.
- There is a reduced risk of accidentally puncturing a vein or damaging a nerve because no major veins or nerves are immediately adjacent to the radial artery.

Disadvantages

Disadvantages of using the radial artery for collecting ABG include:

- Considerable skill is required to puncture it successfully because of its small size.
- It may be difficult or impossible to locate on patients with hypovolemia or low cardiac output.

Modified Allen Test

Must be determined that the patient has collateral circulation before arterial puncture is performed. The modified Allen test is an easy way to assess collateral circulation before collecting a blood specimen from the radial artery. It is performed without the use of special equipment. If the test result is positive, arterial puncture can be performed on the radial artery. If the result is negative, arterial puncture should not be performed on that arm and the patient’s nurse should be notified.

Radial ABG Procedure

Puncture of the radial artery can be performed only if it is determined that there is collateral circulation provided by the ulnar artery and the site meets other selection criteria previously described. Major points of radial ABG procedure are as follows:
Position the Arm

Position the patient’s arm out to the side, away from the body with the palm facing up and the wrist supported. The patient should extend the wrist at approximately a 30-degree angle to stretch and fix the tissue over the ligaments and bone of the wrist.

Locate the Artery

Use the index finger of your non-dominant hand to locate the radial artery pulse proximal to the skin crease on the thumb side of the wrist. Palpate the artery to determine its size, direction, and depth.

Clean the Site

Prepare the site by cleaning with an antiseptic. Allow the site to air dry, being careful not to touch it with any unsterile object.

Prepare Equipment

Attach the safety needle to the syringe if not preassembled and set the syringe plunger to the proper fill level if applicable. Clean the gloved non-dominant finger so that it does not contaminate the site when relocating the pulse before needle entry.

Insert the Needle

Pick up and hold the syringe or collection device in your dominant hand. Uncap and inspect the needle for defects. Relocate the artery by placing the index finger of the opposite hand directly over the pulse.

Warn the patient of puncture and ask him or her to relax the wrist as much as possible while maintaining its extended position.

Direct the needle away from the hand, facing into the arterial blood flow, and insert it bevel-up into the skin at a 30 to 45 degree angle approximately 5 to 10 millimeters distal to the index finger that is locating the pulse.

Advance the Needle into the Artery

Slowly advance the needle, directing it toward the pulse beneath the index finger. When
the artery is pierced stop advancing the needle.

Do not pull back on the syringe plunger.

The blood will pump, or pulse, into the syringe under its own power unless a needle smaller than 23-gauge is used, in which case a gentle pull on the plunger may be required. Hold the syringe very steady until the desired amount of blood is collected.

If the artery is missed, slowly withdraw the needle until the bevel is just under the skin before redirecting the needle into the artery.

Withdraw the Needle and Apply Pressure

When the desired amount of blood has been obtained, withdraw the needle, immediately place a folded clean and dry gauze square over the site with one hand, and simultaneously activate the needle safety device with the other hand or place the needle in an approved needle removal safety device.

Apply firm pressure to the puncture site for a minimum of 3 to 5 minutes. Longer application of pressure is required for patients on anticoagulant therapy.

Note: More detailed information will be provided
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>aseptic</td>
<td>Pertaining to a condition that is free of disease-producing microorganisms (germs).</td>
</tr>
<tr>
<td>capillary</td>
<td>The smallest of all blood vessels, which allow the exchange of nutrients and oxygen between the cells and blood; capillaries connect arteries to veins.</td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention (CDC)</td>
<td>Federal agency responsible for identifying, monitoring, and reporting diseases, especially infectious diseases capable of becoming widespread or epidemic.</td>
</tr>
<tr>
<td>chain of infection</td>
<td>The six steps (links) that must take place for infection to occur (reservoir, infectious agent, portal of exit, mode of transmission, portal of entry, and susceptible host).</td>
</tr>
<tr>
<td>chemistry</td>
<td>Evaluation of chemical constituents that normally occur in the human body, such as glucose, sodium, and potassium.</td>
</tr>
<tr>
<td>Clinical Laboratory Improvement Amendment (CLIA’88)</td>
<td>Federal legislation that became effective in 1992. It mandates that all laboratories be regulated using the same standards, regardless of size, type, or location.</td>
</tr>
<tr>
<td>Clinical and Laboratory Standards Institute (CLSI)</td>
<td>Nonprofit organization that sets recommendations, guidelines, or standards for all areas of the laboratory to improve the quality of medical care.</td>
</tr>
<tr>
<td>confidentiality</td>
<td>Privacy regarding patient information.</td>
</tr>
<tr>
<td>dermal puncture</td>
<td>Use of a sharp device to remove a small specimen of capillary blood.</td>
</tr>
<tr>
<td>ethics</td>
<td>An area of philosophy that examines values, actions, and choices to determine right and wrong.</td>
</tr>
<tr>
<td>Health Insurance Portability and Accountability Act (HIPAA)</td>
<td>A federal law that establishes a national standard for electronic health care transactions and protects the privacy and confidentiality of patient information. Among other provisions, HIPAA states that information about a patient must not be discussed with individuals other than the patient unless the patient has given written or verbal permission for you to do so.</td>
</tr>
<tr>
<td>hematology</td>
<td>Study of blood and blood-forming tissues.</td>
</tr>
<tr>
<td>hepatitis</td>
<td>Inflammation of the liver from viral or toxic origin; can be caused by transmission through blood and body fluids.</td>
</tr>
<tr>
<td>histology</td>
<td>Study of human body tissues and cells.</td>
</tr>
<tr>
<td>human immunodeficiency virus (HIV)</td>
<td>Virus that causes acquired immune deficiency syndrome (AIDS).</td>
</tr>
<tr>
<td>immunology</td>
<td>Study of how the body resists allergies and other agents that affect the body's immune system; also called serology.</td>
</tr>
<tr>
<td>isolation precautions</td>
<td>Practices to prevent the spread of infection based upon how the infectious agent is transmitted.</td>
</tr>
<tr>
<td>microbiology</td>
<td>The study of one-cell organisms (microorganisms) that are usually visible only under a microscope; the main focus is bacteria.</td>
</tr>
<tr>
<td>microcollection</td>
<td>The process of obtaining blood using a dermal (skin) puncture procedure, also known as microtechnique.</td>
</tr>
</tbody>
</table>
### Common Terms Section 2

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>microsurgery</td>
<td>Surgery involving reconstruction of small tissue structures.</td>
</tr>
<tr>
<td>microtechnique</td>
<td>Process of obtaining blood using a dermal (skin) puncture procedure; also known as microcollection.</td>
</tr>
<tr>
<td>negligence</td>
<td>An intentional or unintentional error or wrongdoing.</td>
</tr>
<tr>
<td>nosocomial infection</td>
<td>Infection acquired while in a hospital or medical setting.</td>
</tr>
<tr>
<td>Occupational Safety and Health Administration (OSHA)</td>
<td>A federal body responsible for preventing or minimizing employee injuries and exposure to harmful agents.</td>
</tr>
<tr>
<td>Patient’s Bill of Rights</td>
<td>Document created by the American Hospital Association that identifies privileges health care facility patients are to have.</td>
</tr>
<tr>
<td>personal protective equipment (PPE)</td>
<td>Protective coverings such as gloves, goggles, gowns, and masks that are worn to minimize exposure to blood and body fluids; required by OSHA to be worn when handling body fluids.</td>
</tr>
<tr>
<td>phlebotomist</td>
<td>An individual trained and skilled in obtaining blood samples for clinical testing.</td>
</tr>
<tr>
<td>phlebotomy</td>
<td>An invasive procedure in which a sharp object is introduced into a vein to obtain blood.</td>
</tr>
<tr>
<td>point-of-care testing (POCT)</td>
<td>Tests performed at the patient's bedside or work area, using a portable instrument.</td>
</tr>
<tr>
<td>professionalism</td>
<td>A group of characteristics or qualities that display a positive image or code of ethics.</td>
</tr>
<tr>
<td>reference laboratory</td>
<td>An offsite lab to which specimens are referred for testing; usually used for tests not routinely performed in physicians’ offices.</td>
</tr>
<tr>
<td>serology</td>
<td>The identification of antibodies in the blood’s serum.</td>
</tr>
<tr>
<td>Standard Precautions</td>
<td>Infection control guidelines issued by the CDC to decrease exposure to potentially infectious substances in acute care settings.</td>
</tr>
<tr>
<td>toxicology</td>
<td>Detection and study of agents that are harmful to the body.</td>
</tr>
<tr>
<td>urinalysis</td>
<td>Examination of urine for physical, chemical, and microscopic characteristics.</td>
</tr>
<tr>
<td>venipuncture</td>
<td>Procedure in which a sharp object is introduced into a vein for the purpose of withdrawing blood or instilling medications.</td>
</tr>
<tr>
<td>Blood Culture</td>
<td>Aerobic followed by Anaerobic - if insufficient blood for both culture bottles, use Aerobic bottle only</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
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<tr>
<td>KFK119</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>2.7ml</td>
<td></td>
</tr>
<tr>
<td>Citrate</td>
<td></td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
</tr>
<tr>
<td>KFK168</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>6ml</td>
<td></td>
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<tr>
<td>Serum</td>
<td></td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
</tr>
<tr>
<td>KFK114</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>6ml</td>
<td></td>
</tr>
<tr>
<td>SST™ II</td>
<td></td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
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<tr>
<td>KFK999</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>6.5ml</td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td></td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
</tr>
<tr>
<td>KFK171</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>4ml</td>
<td></td>
</tr>
<tr>
<td>EDTA</td>
<td></td>
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<tr>
<td>Cat. No.</td>
<td></td>
</tr>
<tr>
<td>KFK277</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>6ml</td>
<td></td>
</tr>
<tr>
<td>Cross Match</td>
<td></td>
</tr>
<tr>
<td>Cat. No.</td>
<td></td>
</tr>
<tr>
<td>KFK250</td>
<td></td>
</tr>
<tr>
<td>Draw Volume</td>
<td></td>
</tr>
<tr>
<td>2ml</td>
<td></td>
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<tr>
<td>Fluoride</td>
<td></td>
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<tr>
<td>Oxalate</td>
<td></td>
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<tr>
<td>Blood Glucose</td>
<td></td>
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<tr>
<td>Ethanol</td>
<td></td>
</tr>
<tr>
<td>Lactate</td>
<td></td>
</tr>
</tbody>
</table>

- Coagulation Studies, INR + KCCT, D-Dimer, Fibrinogen
- Aldosterone, B12, Ferritin and S. Folate, Downs Screen and all routine Biochemistry profiles except those mentioned elsewhere
- Carboxyhaemoglobin Methaemoglobin Cytogenetics
- FBC, Platelets, Sickle Test, Malaria, HbA1c, Hb Electrophoresis. The following tests require a separate tube and need to be sent to the laboratory straight away: Tacrolimus, Mycophenolate, Viscosity, Cyclosporin, Lead, C3D, Ammonia, ACTH, ESR, Chromosomes, Renin, Cryoglobulin (+2x Red), CTX
- Blood Group Cross Matching
- Tube must have four patient identifiers and be signed
- Tube must be full
- Tube must be full
- Tube must be full
- Tube must be full
Skin Layers

The needle is beneath or under the skin
Major Veins
Major Arteries

Arteries

- Right Internal Carotid
- Right External Carotid
- Right Common Carotid
- Brachiocephalic
- Left Common Carotid
- Left Subclavian (to Arms)
- Arch of Aorta
- Left Axillary
- Left Brachial
- Aorta
- Celiac Trunk
- Splenic
- Gastric
- Left Renal (to Kidney)
- Left Testicular/Guarian (Gonadal)
- Inferior Mesenteric
- Left Radial
- Left Ulnar
- Left Deep Palmar Arch
- Left Superior Palmar Arch
- Left Popliteal
- Left Anterior Tibial
- Left Posterior Tibial
- Left Posterior Pedis
- Left Dorsal Arch

Right Arteries

- Right Digital
- Right Femoral
- Right Peroneal

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General Structure: ARTERIES and VEINS

The arteries and veins are composed of three coats of tunics and a hollow core, called a lumen, through which the blood flows.

Tunica interna (intima), ENDOTHELUM (simple squamous epithelium) and a layer of Elastic Tissue called the internal elastic membrane.

Tunica media, thickest layer Elastic Fibers & Smooth Muscle

Tunica externa (adventitia) Elastic & Collagenous Fibers
Arteries

- Strong, very Elastic
- Adapted to carry blood under high pressure
- 3 layers
  - Endothelium
    - Smooth surface
  - Tunica Media
    - Smooth muscle, Elastic fibers
  - Tunica Adventitia
    - Sympathetic branch of ans innervate smooth muscle in artery and arteriole
    - Hold about 20% total blood volume.
Veins

- Carry deoxygenated blood to the heart
- Three layers with middle layer poorly developed
- Less muscle and elastic tissue
- Very distensible
- Carry about 60% of total blood volume
- Functions as blood reservoir
- Vein in limbs have valves like flaps
- Respond to falling BP by vasoconstricting
**Healthy venous valves**

Venous blood flows upward against gravity and any backflow is prevented by valves that shut against the flow.

**Varicose veins**

The valves become damaged and do not function properly. Backflow of blood is not prevented and ‘pooling’ of blood stretches and balloons the vein walls.
Proper Method for Tying a Tourniquet

Figure 1: Wrap the tourniquet around the arm 3–4 inches above the venipuncture site. Keeping the tourniquet flat to the skin will help minimize the discomfort felt by the patient.

Figure 2: Stretch the tourniquet tight, and cross the ends.
DRAW PROCESS

Figure 1: Inspect the site for potential veins to use, and palpate to further locate a vein and to test for firmness.

Figure 3: Median basilic vein

Figure 4: Circular motion

Figure 5: Proper hand position to hold an evacuated tube system.
Note: This method of traction is discouraged due to an increased risk of the Phlebotomist sticking themselves rather than the patient!

Assemble the needle, the barrel, and the first tube you wish to use as in the figures above. The needle should not be uncovered until ready to perform venipuncture. Place any additional tubes to be used in a convenient location, keeping some spares handy. The gauze, alcohol pads, and bandages should be ready. (Note: some phlebotomists may elect to do this step before applying the tourniquet; this is preferable.)
BLOOD COLLECTION:

ROUTINE VENIPUNCTURE AND SPECIMEN HANDLING

Objectives for the tutorial:

- Describe and perform the venipuncture process including:
  - Proper patient identification procedures.
  - Proper equipment selection and use.
  - Proper labeling procedures and completion of laboratory requisitions.
  - Order of draw for multiple tube phlebotomy.
  - Preferred venous access sites, and factors to consider in site selection, and ability to differentiate between the feel of a vein, tendon and artery.
  - Patient care following completion of venipuncture.
  - Safety and infection control procedures.
  - Quality assurance issues.

- Identify the additive, additive function, volume, and specimen considerations to be followed for each of the various color coded tubes.

- List six areas to be avoided when performing venipuncture and the reasons for the restrictions.

- Summarize the problems that may be encountered in accessing a vein, including the procedure to follow when a specimen is not obtained.

- List several effects of exercise, posture, and tourniquet application upon laboratory values.
VENIPUNCTURE PROCEDURE

The venipuncture procedure is complex, requiring both knowledge and skill to perform. Each phlebotomist generally establishes a routine that is comfortable for her or him. Several essential steps are required for every successful collection procedure:

1. Identify the patient.
2. Assess the patient’s physical disposition (i.e. diet, exercise, stress, basal state).
3. Check the requisition form for requested tests, patient information, and any special requirements.
4. Select a suitable site for venipuncture.
5. Prepare the equipment, the patient and the puncture site.
6. Perform the venipuncture.
7. Collect the sample in the appropriate container.
8. Recognize complications associated with the phlebotomy procedure.
9. Assess the need for sample recollection and/or rejection.
10. Label the collection tubes at the bedside or drawing area.
11. Promptly send or deliver the specimens with the requisition to the laboratory.
ORDER FORM / REQUISITION

A requisition form must accompany each sample submitted to the laboratory.

The requisition form must contain the proper information in order to process the specimen. The essential elements of the requisition form are:

- Patient's surname, first name, and middle initial.
- Patient's ID number.
- Patient's date of birth and sex.
- Requesting physician's complete name.
- Source of specimen. This information must be given when requesting microbiology, cytology, fluid analysis, or other testing where analysis and reporting is site specific.
- Date and time of collection.
- Initials of phlebotomist.
- Indicating the test(s) requested.

An example of a simple requisition form will be provided by the organization make sure to fill out a sample form with your supervisor and have them check the form.
LABELING THE SAMPLE

A properly labeled sample is essential so that the results of the test match the patient. The key elements in labeling are:

- Patient's surname, first and middle.
- Patient's ID number.
- NOTE: Both of the above MUST match the same on the requisition form.
- Date, time and initials of the phlebotomist must be on the label of EACH tube.

Automated systems may include labels with bar codes.

Examples of labeled collection tubes are shown below:
EQUIPMENT

THE FOLLOWING ARE NEEDED FOR ROUTINE VENIPUNCTURE:

- Evacuated Collection Tubes - The tubes are designed to fill with a predetermined volume of blood by vacuum. The rubber stoppers are color coded according to the additive that the tube contains. Various sizes are available. Blood should NEVER be poured from one tube to another since the tubes can have different additives or coatings (see illustrations at end).
- Needles - The gauge number indicates the bore size: the larger the gauge number, the smaller the needle bore. Needles are available for evacuated systems and for use with a syringe, single draw or butterfly system.
- Holder/Adapter - use with the evacuated collection system.
- Tourniquet - Wipe off with alcohol and replace frequently.
- Alcohol Wipes - 70% isopropyl alcohol.
- Povidone-iodine wipes/swabs - Used if blood culture is to be drawn.
- Gauze sponges - for application on the site from which the needle is withdrawn.
- Adhesive bandages / tape - protects the venipuncture site after collection.
- Sharps Container - needles should NEVER be broken, bent, or recapped. Needles should be placed in a proper disposal unit IMMEDIATELY after their use.
- Gloves - can be made of latex, rubber, vinyl, etc.; worn to protect the patient and the phlebotomist.
- Syringes - may be used in place of the evacuated collection tube for special circumstances.
**Order of Draw: Multiple Tube Collections**

The following chart reflects the most current standard for the order in which blood samples are collected in tubes. This includes the change in which CLSI (formerly NCCLS) recommended. [Order of Draw (NCCLS H3-A5, Vol 23, No 32, 8.10.2)]

<table>
<thead>
<tr>
<th>Color</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Blood Cultures—SPS</td>
</tr>
<tr>
<td>Light Blue</td>
<td>Citrate Tube</td>
</tr>
<tr>
<td>Gold</td>
<td>SST Gel Separator Tube</td>
</tr>
<tr>
<td>Red</td>
<td>Serum Tube</td>
</tr>
<tr>
<td>Dark Green</td>
<td>Heparin Tube</td>
</tr>
<tr>
<td>Light Gray</td>
<td>PST Gel Separator Tube</td>
</tr>
<tr>
<td>Purple (Lavender)</td>
<td>EDTA Tube</td>
</tr>
<tr>
<td>Gray</td>
<td>Fluoride (Glucose) Tube</td>
</tr>
</tbody>
</table>

**Note:** Always follow your facility’s protocol for order of draw!

* When using a winged blood collection set (a.k.a. Butterfly) for venipuncture and a coagulation (citrate) tube is the first specimen to be drawn, a discard tube should be drawn first. The discard tube must be used to fill the blood collection set tubing’s “dead space” with blood but the discard tube does not need to be completely filled. This important step will ensure maintenance of the proper blood-to-additive ratio of the blood specimen. The discard tube should be a nonadditive or coagulation tube.
ORDER OF DRAW

Blood collection tubes must be drawn in a specific order to avoid cross-contamination of additives between tubes. The recommended order of draw for plastic vacutainer tubes is:

- First - blood culture bottle or tube (yellow or yellow-black top)
- Second - coagulation tube (light blue top). If just a routine coagulation assay is the only test ordered, then a single light blue top tube may be drawn. If there is a concern regarding contamination by tissue fluids or thromboplastins, then one may draw a non-additive tube first, and then the light blue top tube.
- Third - non-additive tube (red top)
- Last draw - additive tubes in this order:
  - SST (red-gray or gold top). Contains a gel separator and clot activator.
  - Sodium heparin (dark green top)
  - PST (light green top). Contains lithium heparin anticoagulant and a gel separator.
  - EDTA (lavender top)
  - ACDA or ACDB (pale yellow top). Contains acid citrate dextrose.
  - Oxalate/fluoride (light gray top)

**NOTE:** Tubes with additives must be thoroughly mixed. Erroneous test results may be obtained when the blood is not thoroughly mixed with the additive.
PROCEDURAL ISSUES

PATIENT RELATIONS AND IDENTIFICATION:

The phlebotomist's role requires a professional, courteous, and understanding manner in all contacts with the patient. Greet the patient and identify yourself and indicate the procedure that will take place. Effective communication - both verbal and nonverbal - is essential.

Proper patient identification MANDATORY. Always ask the patient for a full name during introduction. Make sure that the patient you are about the screen is the patient scheduled.

Patient must provide identification other than the verbal statement of a name. Using the requisition for reference, ask a patient to provide additional information such as a surname or birthdate. A government issued photo identification card such as a driver's license can aid in resolving identification issues.

If possible, speak with the patient during the process. The patient who is at ease will be less focused on the procedure. Always thank the patient and excuse yourself courteously when finished.
PATIENT'S BILL OF RIGHTS

The Patient's Bill of Rights has been adopted by many hospitals as declared by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The basic patient rights endorsed by the JCAHO follow in condensed form are given below.

The patient has the right to:

- Impartial access to treatment or accommodations that are available or medically indicated, regardless of race, creed, sex, national origin, or sources of payment for care.
- Considerate, respectful care.
- Confidentiality of all communications and other records pertaining to the patient's care.
- Expect that any discussion or consultation involving the patient's case will be conducted discreetly and that individuals not directly involved in the case will not be present without patient permission.
- Expect reasonable safety congruent with the hospital practices and environment.
- Know the identity and professional status of individuals providing service and to know which physician or other practitioner is primarily responsible for his or her care.
- Obtain from the practitioner complete and current information about diagnosis, treatment, and any known prognosis, in terms the patient can reasonably be expected to understand.
- Reasonable informed participation in decisions involving the patient's health care. The patient shall be informed if the hospital proposes to engage in or perform human experimentation or other research/educational profits affecting his or her care or treatment. The patient has the right to refuse participation in such activity.
- Consult a specialist at the patient's own request and expense.
- Refuse treatment to the extent permitted by law.
- Regardless of the source of payment, request and receive an itemized and detailed explanation of the total bill for services rendered in the hospital.
- Be informed of the hospital rules and regulations regarding patient conduct.
VENIPUNCTURE SITE SELECTION

Although the larger and fuller median cubital and cephalic veins of the arm are used most frequently, the basilic vein on the dorsum of the arm or dorsal hand veins are also acceptable for venipuncture. Foot veins are a last resort because of the higher probability of complications.

Certain areas are to be avoided when choosing a site:

- Extensive scars from burns and surgery - it is difficult to puncture the scar tissue and obtain a specimen.
- The upper extremity on the side of a previous mastectomy - test results may be affected because of lymphedema.
- Hematoma - may cause erroneous test results. If another site is not available, collect the specimen distal to the hematoma.
- Intravenous therapy (IV) / blood transfusions - fluid may dilute the specimen, so collect from the opposite arm if possible. Otherwise, satisfactory samples may be drawn below the IV by following these procedures:
  - Turn off the IV for at least 2 minutes before venipuncture.
  - Apply the tourniquet below the IV site. Select a vein other than the one with the IV.
  - Perform the venipuncture. Draw 5 ml of blood and discard before drawing the specimen tubes for testing.
- Lines - Drawing from an intravenous line may avoid a difficult venipuncture, but introduces problems. The line must be flushed first. When using a syringe inserted into the line, blood must be withdrawn slowly to avoid hemolysis.
- Cannula/fistula/heparin lock - hospitals have special policies regarding these devices. In general, blood should not be drawn from an arm with a fistula or cannula without consulting the attending physician.
- Edematous extremities - tissue fluid accumulation alters test results.
PERFORMANCE OF A VENIPUNCTURE

- Approach the patient in a friendly, calm manner. Provide for their comfort as much as possible, and gain the patient's cooperation.
- Identify the patient correctly.
- Properly fill out appropriate requisition forms, indicating the test(s) ordered.
- Verify the patient's condition. Fasting, dietary restrictions, medications, timing, and medical treatment are all of concern and should be noted on the lab requisition. (If the test requires fasting)
- Check for any allergies to antiseptics, adhesives, or latex by observing for armbands and/or by asking the patient.
- Position the patient. The patient should either sit in a chair, lie down or sit up in bed. Hyperextend the patient's arm.
- Apply the tourniquet 3-4 inches above the selected puncture site. Do not place too tightly or leave on more than 2 minutes (and no more than a minute to avoid increasing risk for hemoconcentration). Wait 2 minutes before reapplying the tourniquet.
- The patient should make a fist without pumping the hand.
- Select the venipuncture site.
- Prepare the patient's arm using an alcohol prep. Cleanse in a circular fashion, beginning at the site and working outward. Allow to air dry.
- Grasp the patient's arm firmly using your thumb to draw the skin taut and anchor the vein. The needle should form a 15 to 30 degree angle with the surface of the arm. Swiftly insert the needle through the skin and into the lumen of the vein. Avoid trauma and excessive probing.

- When the last tube to be drawn is filling, remove the tourniquet.
- Remove the needle from the patient's arm using a swift backward motion.
- Press down on the gauze once the needle is out of the arm, applying adequate pressure to avoid formation of a hematoma.
- Dispose of contaminated materials/supplies in designated containers.
- Mix and label all appropriate tubes at your drawing station.
PERFORMANCE OF A FINGERSTICK

- Follow the procedure as outlined above for greeting and identifying the patient. As always, properly fill out appropriate requisition forms, indicating the test(s) ordered.
- Verify the patient's condition. Fasting, dietary restrictions, medications, timing, and medical treatment are all of concern and should be noted on the lab requisition.
- Position the patient. The patient should either sit in a chair, lie down or sit up in bed. Hyperextend the patient's arm.
- The best locations for fingersticks are the 3rd (middle) and 4th (ring) fingers of the non-dominant hand. Do not use the tip of the finger or the center of the finger. Avoid the side of the finger where there is less soft tissue, where vessels and nerves are located, and where the bone is closer to the surface. The 2nd (index) finger tends to have thicker, callused skin. The fifth finger tends to have less soft tissue overlying the bone. Avoid puncturing a finger that is cold or cyanotic, swollen, scarred, or covered with a rash.
- Using a sterile lancet, make a skin puncture just off the center of the finger pad. The puncture should be made perpendicular to the ridges of the fingerprint so that the drop of blood does not run down the ridges.
- Wipe away the first drop of blood, which tends to contain excess tissue fluid.
- Collect drops of blood into the collection device by gently massaging the finger. Avoid excessive pressure that may squeeze tissue fluid into the drop of blood.
- Cap, rotate and invert the collection device to mix the blood collected.
- Have the patient hold a small gauze pad over the puncture site for a couple of minutes to stop the bleeding.
- Dispose of contaminated materials/supplies in designated containers.
- Label all appropriate tubes at the patient bedside.
- Deliver specimens promptly to the laboratory after the job if requested by the client.
ADDITIONAL CONSIDERATIONS

Part A

To prevent a hematoma:

● Puncture only the uppermost wall of the vein
● Remove the tourniquet before removing the needle
● Use the major superficial veins
● Make sure the needle fully penetrates the upper most wall of the vein. (Partial penetration may allow blood to leak into the soft tissue surrounding the vein by way of the needle bevel)
● Apply pressure to the venipuncture site

To prevent hemolysis (which can interfere with many tests):

● Mix tubes with anticoagulant additives gently 5-10 times
● Avoid drawing blood from a hematoma
● Avoid drawing the plunger back too forcefully, if using a needle and syringe, or too small a needle, and avoid frothing of the sample
● Make sure the venipuncture site is dry
● Avoid a probing, traumatic venipuncture
● Avoid prolonged tourniquet application or fist clenching.
ADDITIONAL CONSIDERATIONS

Part B

Indwelling Lines or Catheters:
- Potential source of test error
- Most lines are flushed with a solution of heparin to reduce the risk of thrombosis
- Discard a sample at least three times the volume of the line before a specimen is obtained for analysis

Hemoconcentration: An increased concentration of larger molecules and formed elements in the blood may be due to several factors:
- Prolonged tourniquet application (no more than 1 minute)
- Massaging, squeezing, or probing a site
- Long-term IV therapy
- Sclerosed or occluded veins

Prolonged Tourniquet Application:
- Primary effect is hemoconcentration of non-filterable elements (i.e. proteins). The hydrostatic pressure causes some water and filterable elements to leave the extracellular space.
- Significant increases can be found in total protein, aspartate aminotransferase (AST), total lipids, cholesterol, iron
- Affects packed cell volume and other cellular elements
- Hemolysis may occur, with pseudohyperkalemia.
Patient Preparation Factors

- **Therapeutic Drug Monitoring:** different pharmacologic agents have patterns of administration, body distribution, metabolism, and elimination that affect the drug concentration as measured in the blood. Many drugs will have "peak" and "trough" levels that vary according to dosage levels and intervals. Check for timing instructions for drawing the appropriate samples.

- **Effects of Exercise:** Muscular activity has both transient and longer lasting effects. The creatine kinase (CK), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and platelet count may increase.

- **Stress:** May cause transient elevation in white blood cells (WBC’s) and elevated adrenal hormone values (cortisol and catecholamines). Anxiety that results in hyperventilation may cause acid-base imbalances, and increased lactate.

- **Diurnal Rhythms:** Diurnal rhythms are body fluid and analyte fluctuations during the day. For example, serum cortisol levels are highest in early morning but are decreased in the afternoon. Serum iron levels tend to drop during the day. You must check the timing of these variations for the desired collection point.

- **Posture:** Postural changes (supine to sitting etc.) are known to vary lab results of some analytes. Certain larger molecules are not filterable into the tissue, therefore they are more concentrated in the blood. Enzymes, proteins, lipids, iron, and calcium are significantly increased with changes in position.

- **Other Factors:** Age, gender, and pregnancy have an influence on laboratory testing. Normal reference ranges are often noted according to age.
SAFETY AND INFECTION CONTROL

Because of contacts with sick patients and their specimens, it is important to follow safety and infection control procedures.

PROTECT YOURSELF

- Practice universal precautions:
  - Wear gloves and a lab coat or gown when handling blood/body fluids.
  - Change gloves after each patient or when contaminated.
  - Wash hands frequently.
  - Dispose of items in appropriate containers.
- Dispose of needles immediately upon removal from the patient's vein. Do not bend, break, recap, or resheath needles to avoid accidental needle puncture or splashing of contents.
- Clean up any blood spills with a disinfectant such as freshly made 10% bleach.
- If you stick yourself with a contaminated needle:
  - Remove your gloves and dispose of them properly.
  - Squeeze puncture site to promote bleeding.
  - Wash the area well with soap and water.
  - Record the patient's name and ID number.
  - Follow institution's guidelines regarding treatment and follow-up.
  - NOTE: The use of prophylactic zidovudine following blood exposure to HIV has shown effectiveness (about 79%) in preventing seroconversion

PROTECT THE PATIENT

- Place blood collection equipment away from patients, especially children and psychiatric patients.
- Practice hygiene for the patient's protection. When wearing gloves, change them between each patient and wash your hands frequently. Always wear a clean lab coat or gown.
TROUBLESHOOTING GUIDELINES

IF AN INCOMPLETE COLLECTION OR NO BLOOD IS OBTAINED:

- Change the position of the needle. Move it forward (it may not be in the lumen)

- or move it backward (it may have penetrated too far).

- Adjust the angle (the bevel may be against the vein wall).

- Loosen the tourniquet. It may be obstructing blood flow.
- Try another tube. Use a smaller tube with less vacuum. There may be no vacuum in the tube being used.
- Re-anchor the vein. Veins sometimes roll away from the point of the needle and puncture site.
- Have the patient make a fist and flex the arm, which helps engorge muscles to fill veins.
- Pre-warm the region of the vein to reduce vasoconstriction and increase blood flow.
- Have the patient drink fluids if dehydrated.
IF BLOOD STOPS FLOWING INTO THE TUBE

● The vein may have collapsed; resecure the tourniquet to increase venous filling. If this is not successful, remove the needle, take care of the puncture site, and redraw.

● The needle may have pulled out of the vein when switching tubes. Hold equipment firmly and place fingers against patient's arm, using the flange for leverage when withdrawing and inserting tubes.

PROBLEMS OTHER THAN AN INCOMPLETE COLLECTION:

● A hematoma forms under the skin adjacent to the puncture site - release the tourniquet immediately and withdraw the needle. Apply firm pressure.

● The blood is bright red (arterial) rather than venous. Apply firm pressure for more than 5 minutes.
PERFORMANCE OF A FINGERSTICK

- Follow the procedure as outlined above for greeting and identifying the patient. As always, properly fill out appropriate requisition forms, indicating the test(s) ordered.
- Verify the patient's condition. Fasting, dietary restrictions, medications, timing, and medical treatment are all of concern and should be noted on the lab requisition.
- Position the patient. The patient should sit in a chair, lie down or sit up in bed. Hyperextend the patient's arm.
- The best locations for finger sticks are the 3rd and 4th fingers of the non-dominant hand. Do not use the tip of the finger or the center of the finger. Avoid the side of the finger where there is less soft tissue, where vessels and nerves are located, and where the bone is closer to the surface. The 2nd (index) finger tends to have thicker, callused skin. The fifth finger tends to have less soft tissue overlying the bone. Avoid puncturing a finger that is cold or cyanotic, swollen, scarred, or covered with a rash.
- Using a sterile lancet, make a skin puncture just off the center of the finger pad. The puncture should be made perpendicular to the ridges of the fingerprint so that the drop of blood does not run down the ridges.
- Wipe away the first drop of blood, which tends to contain excess tissue fluid.
- Collect drops of blood into the collection device by gently massaging the finger.
- Avoid excessive pressure that may squeeze tissue fluid into the drop of blood.
- Cap, rotate and invert the collection device to mix the blood collected.
- Have the patient hold a small gauze pad over the puncture site for a couple of minutes to stop the bleeding.
- Dispose of contaminated materials/supplies in designated containers.
- Label all appropriate tubes at the patient bedside.
- Deliver specimens promptly to the laboratory.
Corrective Technique

Step 3: Go to the vein. This means you can readjust the needle, the angle, the direction of the needle, etc.

Example: Increase the angle

Skin Layer

Step 4: Check for a blood return. If using a Vacutainer, the tube will begin to fill as soon as the vein is punctured. If using a syringe, you will have to manually aspirate the plunger to check for a return.

Skin Layer

Fully punctured vein. Blood will flow into tubes, or when aspirated with plunger.
Corrective Technique

Note! If the bevel is exposed, the needle is considered contaminated, and cannot be re-inserted. The procedure must be stopped, altogether, and restarted elsewhere.

Exposed bevel: Minimal to no leakage from site, but procedure still must be stopped!

Skin Layer

or

Exposed bevel: At this point, blood will begin to leak out from the site!

Skin Layer
BLOOD COLLECTION ON BABIES: (If Applicable)

- The recommended location for blood collection on a newborn baby or infant is the heel. The diagram below indicates in green the proper area to use for heel punctures for blood collection:

![Diagram of a baby foot with green area indicated for blood collection](image)

- Prewarming the infant's heel (42 C for 3 to 5 minutes) is important to obtain capillary blood gas samples and warming also greatly increases the flow of blood for collection of other specimens. However, do not use too high a temperature warmer, because baby’s skin is thin and susceptible to thermal injury.
- Clean the site to be punctured with an alcohol sponge. Dry the cleaned area with a dry cotton sponge. Hold the baby’s foot firmly to avoid sudden movement.
- Using a sterile blood lancet, puncture the side of the heel in the appropriate regions shown above in green. Do not use the central portion of the heel because you might injure the underlying bone, which is close to the skin surface. Do not use a previous puncture site. Make the cut across the heelprint lines so that a drop of blood can well up and not run down along the lines.
- Wipe away the first drop of blood with a piece of clean, dry cotton. Since newborns do not often bleed immediately, use gentle pressure to produce a rounded drop of blood. Do not use excessive pressure or heavy massaging because the blood may become diluted with tissue fluid.
- Fill the capillary tube(s) or micro collection device(s) as needed.
- When finished, elevate the heel, place a piece of clean, dry cotton on the puncture site, and hold it in place until the bleeding has stopped.
- Be sure to dispose of the lancet in the appropriate sharps container. Dispose of contaminated materials in appropriate waste receptacles. Remove your gloves and wash your hands.
ADDITIONAL CONSIDERATIONS

To prevent a hematoma
- Puncture only the uppermost wall of the vein
- Remove the tourniquet before removing the needle
- Use the major superficial veins
- Make sure the needle fully penetrates the upper most wall of the vein. (Partial penetration may allow blood to leak into the soft tissue surrounding the vein by way of the needle bevel)
- Apply pressure to the venipuncture site

To prevent hemolysis (which can interfere with many tests)
- Mix tubes with anticoagulant additives gently 5-10 times
- Avoid drawing blood from a hematoma
- Avoid drawing the plunger back too forcefully, if using a needle and syringe, and avoid frothing of the sample
- Make sure the venipuncture site is dry
- Avoid a probing, traumatic venipuncture

Indwelling Lines or Catheters
- Potential source of test error
- Most lines are flushed with a solution of heparin to reduce the risk of thrombosis.
- Discard a sample at least three times the volume of the line before a specimen is obtained for analysis.
Hemoconcentration: An increased concentration of larger molecules and formed elements in the blood may be due to several factors:

- Prolonged tourniquet application (no more than 2 minutes)
- Massaging, squeezing, or probing a site
- Long-term IV therapy
- Sclerosed or occluded veins

**Prolonged Tourniquet Application**

- Primary effect is hemoconcentration of non-filterable elements (i.e. proteins). The hydrostatic pressure causes some water and filterable elements to leave the extracellular space.
- Significant increases can be found in total protein, aspartate aminotransferase (AST), total lipids, cholesterol, iron
- Affects packed cell volume and other cellular elements
PATIENT PREPARATION FACTORS

● Therapeutic Drug Monitoring: different pharmacologic agents have patterns of administration, body distribution, metabolism, and elimination that affect the drug concentration as measured in the blood. Many drugs will have "peak" and "trough" levels that vary according to dosage levels and intervals. Check for timing instructions for drawing the appropriate samples.

● Effects of Exercise: Muscular activity has both transient and longer lasting effects. The creatine kinase (CK), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and platelet count may increase.

● Stress: May cause transient elevation in white blood cells (WBC's) and elevated adrenal hormone values (cortisol and catecholamines). Anxiety that results in hyperventilation may cause acid-base imbalances, and increased lactate.

● Diurnal Rhythms: Diurnal rhythms are body fluid and analyte fluctuations during the day. For example, serum cortisol levels are highest in early morning but are decreased in the afternoon. Serum iron levels tend to drop during the day. You must check the timing of these variations for the desired collection point.

● Posture: Postural changes (supine to sitting etc.) are known to vary lab results of some analytes. Certain larger molecules are not filterable into the tissue, therefore they are more concentrated in the blood. Enzymes, proteins, lipids, iron, and calcium are significantly increased with changes in position.

● Other Factors: Age, gender, and pregnancy have an influence on laboratory testing. Normal reference ranges are often noted according to age.
SAFETY AND INFECTION CONTROL

Because of contacts with sick patients and their specimens, it is important to follow safety and infection control procedures.

PROTECT YOURSELF

- Practice universal precautions:
- Wear gloves and a lab coat or gown when handling blood/body fluids.
- Change gloves after each patient or when contaminated.
- Wash hands frequently.
- Dispose of items in appropriate containers.
- Dispose of needles immediately upon removal from the patient's vein. Do not bend, break, recap, or resheath needles to avoid accidental needle puncture or splashing of contents.
- Clean up any blood spills with a disinfectant such as freshly made 10% bleach.
- If you stick yourself with a contaminated needle:
  - Remove your gloves and dispose of them properly.
  - Squeeze puncture site to promote bleeding.
  - Wash the area well with soap and water.
  - Record the patient's name and ID number.
  - Follow institution's guidelines regarding treatment and follow-up.
POSSIBLE COMPLICATIONS FROM PHLEBOTOMY

PROBLEMS OBTAINING A SPECIMEN

Blood Sample That Cannot Be Obtained

Probing is not recommended. Probing is painful to the patient. In most cases another puncture in a site below the first site, or use of another vein on the other arm, is advisable.

It is advisable not to attempt a venipuncture more than twice. Notify the patient’s Registered Nurse

Another person should attempt to draw the specimen

If another person is asked to draw a patient, the new person must re-identify the patient.

If an incomplete collection or no blood is obtained

- Change the position of the needle. Move it forward (it may not be in the lumen) Ø or move it backward (it may have penetrated too far).
- Adjust the angle (the bevel may be against the vein wall).
- Re-anchor the vein. Veins sometimes roll away from the point of the needle and puncture site.

If blood stops flowing into the syringe/tube

- The vein may have collapsed; resecure the tourniquet to increase venous filling. If this is not successful, remove the needle, take care of the puncture site, and redraw.
- The needle may have pulled out of the vein when switching tubes. Hold equipment firmly and place fingers against patient’s arm, using the flange for leverage when withdrawing and inserting tubes.
HEMATOMA

A hematoma forms under the skin adjacent to the puncture site - release the tourniquet immediately and withdraw the needle. Apply firm pressure.

To prevent a hematoma

- Puncture only the uppermost wall of the vein (just under the skin)
- Remove the tourniquet before removing the needle
- Use the major superficial veins (the large veins just under the skin)
- Make sure the needle fully penetrates the uppermost wall of the vein. (partial puncture may allow blood to leak into the tissues just under the skin)
- Apply pressure to puncture site

Petechiae

Little red spots, ranging in size from pinpoint to several millimeters in diameter. Petechiae consist of extravasated blood. This complication may be a result of a coagulation abnormality, such as a platelet defect and should be brought to the attention of the patient’s healthcare provider.

Syncopy (fainting)

Patients may become dizzy and fain at the thought or sight blood, this is the most common complication phlebotomy. It is caused because of rapid fall in blood pressure. An automatic nervous system reaction, (psychosomatic trigger), usually based on fear. Treatment and safe handling of an unconscious patient is a necessity of any qualified Phlebotomist.

- Abort draw: Remove tourniquet, needle and bend arm
- Call for assistance
- Using good body mechanics, slide patient to floor, keeping hand firmly behind the cervical spine area. Protect head and neck from injury!
- Elevate feet above heart and monitor blood pressure, breathing, etc.
- Use ammonia only if patient is not responsive within 5 minutes and blood pressure remains low.
- Assist to upright position in stages (monitor B/P with each change in position) this is a gradual process. If patient stands up to quickly, he will most likely to faint
again due to drop in B/P.

**Scarred Vein**
Areas that have been burned or scarred should be avoided during phlebotomy. Burned area is very sensitive and susceptible to infection, whereas veins under scarred area are difficult to palpate.

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**BLOOD: SAMPLES & COLLECTIONS**

**TYPES OF BLOOD SAMPLES**

1. **Whole Blood**
A blood sample that is drawn and mixed immediately with an anticoagulant to maintain the integrity of the blood cells and prevent clotting, allowing whole blood analysis to be accurate. The blood remains in liquid state.

2. **Serum**
The liquid portion of whole blood that has been allowed to clot. The clotting factors are bound in the clot. (Blood collected in a tube with no additive will clot within 15-45 minutes. One 10 ml tube of whole blood will yield about 3-4 ml of serum. This is the only tube that should not be inverted).

3. **Plasma**
The liquid portion of blood that has not been allowed to clot. Usually, formed when freshly drawn blood is mixed with anticoagulants. The clotting factors are present in the plasma. This sample is mixed 6-8 times and immediately centrifuged and plasma removed.
COLLECTION TUBES

SST- Serum Separator Tube (two types): Gold/Red-Gray Marble

Additive: Polymer gel and powdered glass clot activator
Stopper Type: HemogardTM Gold top/Conventional Red-Gray Marble
Tube Type/Size: Plastic tube 13 x 100/16 x 100
Specimen Type: Serum
Draw Amount: 5.0 ml/8.5 ml
Inversions: 5

Laboratory Use: Sterile SST® brand tube for serum clot activator determinations that require serum in chemistry or infectious disease testing. Gel separates serum from cells. Tube inversion ensures mixing of clot activator with blood and clotting within 30 minutes.

Draw a sufficient amount of whole blood into a plain, red-top tube or serum separator (SST®) tube. If using an SST® tube, gently invert the tube several times to activate clotting. Allow blood to clot at ambient temperature for 20-30 minutes. Centrifuge for 10 minutes to separate serum from clot and transfer the serum to a screw-capped, plastic vial if required; this should be completed within 1 hour of obtaining the specimen.
Mint Green Stopper- PST, Plasma Separator Tube: HOSPITAL PATIENTS ONLY

Additive: Lithium Heparin, Polymer gel plasma separator
Stopper Type: HemogardTM
Tube Type/Size: Plastic tube 13 x 75
Specimen Type: Whole Blood, Plasma
Draw Amount: 3.0 ml
Inversions: 8
Laboratory Use: General chemistries and some therapeutic drugs. DO NOT USE FOR LITHIUM TESTING.

NOTE: After the tube has been filled with blood, immediately invert the tube several times in order to prevent coagulation.

Green Stopper Tube (two types): Dark Green/Clear Green

Additive: Sodium Heparin
Stopper Type: HemogardTM
Tube Type/Size: Plastic tube 13 x 75
Specimen Type: Whole Blood, Plasma
Draw Amount: 4.0 ml/2.0 ml (pediatric tube) Inversions: 8
Laboratory Use: For plasma determinations in chemistry. Tube inversion prevents clotting. Dark green 4.0 ml Sodium Heparin used for chromosome studies.

NOTE: After the tube has been filled with blood, immediately invert the tube several times in order to prevent coagulation.
**Lavender Stopper Tube (two types): Dark Lavender/Clear Lavender**

Additive: EDTA-K2
Stopper Type: HemogardTM
Tube Type/Size: Plastic tube 13 x 75
Specimen Type: Whole Blood, Plasma
Draw Amount: 4.0 ml/2.0 ml (pediatric tube) Inversions: 8
Laboratory Use: Dark Lavender 4.0 ml for whole hematology, ammonia, lead, HIV, RNA quantization determinations and for blood bank testing. Tube inversion prevents clotting.

**NOTE:** After the tube has been filled with blood, immediately invert the tube several times in order to prevent coagulation.

**Light Blue Stopper Tube (two types): Solid Light Blue/Clear Light Blue**

Additive: Sodium Citrate (3.2%, 0.109M) Stopper Type: HemogardTM
Tube Type/Size: Glass 13 x 75
Specimen Type: Whole Blood, Plasma
Draw Amount: 2.7 ml/1.8 ml (pediatric tube only) Inversions: 4 (gently)
Laboratory Use: For coagulation determinations of plasma specimens. Tube inversion prevents clotting.

**Note:** Certain tests require chilled specimens. Follow recommended procedures for collection and transporting of coagulation specimen.

**NOTE:** It is imperative that the tube be completely filled. The ratio of blood to anticoagulant is critical for valid results. Immediately after draw, invert the tube 6 to 10 times in order to activate the anticoagulant.
Gray Stopper Tube

Additive: Sodium fluoride/Potassium oxalate
Stopper Type: HemogardTM
Tube Type/Size: Plastic 13 x 75
Specimen Type: Whole Blood, Plasma
Draw Amount: 4.0 ml
Inversions: 8
Laboratory Use: For glucose, toxicology determinations. Antiglycolytic additives stabilize glucose values for up to 24 hours at room temperature. Tube inversion ensures proper mixing of additive and blood.

NOTE: After the tube has been filled with blood, immediately invert the tube several times in order to prevent coagulation.

Red Stopper Tube

Additive: Clot Activator (powdered glass) Stopper Type: HemogardTM
Tube Type/Size: Plastic 13 x 75
Specimen Type: Serum
Draw Amount: 6.0 ml
Inversions: 5
Laboratory Use: For serum determinations in chemistry, serology and blood bank testing. Can be used as sterile transport tube.
Royal Blue Stopper Tube: (two types): No additive/EDTA

There are 2 types of royal blue top Monoject® tubes - one with EDTA anticoagulant and the other plain. These are used in the collection of whole blood or serum for trace metals analysis.

Additive: None/EDTA
Stopper Type: Hemogard® Tube Type/Size: Glass 13 x 100
Specimen Type: Whole Blood, Plasma
Draw Amount: 7.0 ml
Inversions: None
Laboratory Use: For trace element, toxicology and nutrition determinations. Special stopper formulation offers the lowest verified levels of trace elements available. Refer to specific test for proper tube.
### COLLECTION TUBES FOR PHLEBOTOMY

<table>
<thead>
<tr>
<th>Red Top</th>
<th>Gold Top</th>
<th>Light Green Top</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDITIVE</strong></td>
<td>None</td>
<td>Plasma Separating Tube (PST) with Lithium heparin</td>
</tr>
<tr>
<td><strong>MODE OF ACTION</strong></td>
<td>Serum separator tube (SST) contains a gel at the bottom to separate blood from serum on centrifugation</td>
<td>Anticoagulates with lithium heparin; Plasma is separated with PST gel at the bottom of the tube</td>
</tr>
<tr>
<td><strong>USES</strong></td>
<td>Chemistries, Immunology and Serology</td>
<td>Chemistries</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**USE NOTES:**
- Red Top: Used for Blood clots, and the serum is separated by centrifugation.
- Gold Top: Used for Serum separator tube (SST) contains a gel at the bottom to separate blood from serum on centrifugation.
- Light Green Top: Used for Anticoagulates with lithium heparin; Plasma is separated with PST gel at the bottom of the tube.
COLLECTION TUBES FOR PHLEBOTOMY (Page 2)

<table>
<thead>
<tr>
<th>Purple Top</th>
<th>ADDITIVE</th>
<th>EDTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Forms calcium salts to remove calcium</td>
<td></td>
</tr>
<tr>
<td>USES</td>
<td>Hematology (CBC) and Blood Bank (Crossmatch); requires <strong>full draw</strong> - invert 8 times to prevent clotting and platelet clumping</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Light Blue Top</th>
<th>ADDITIVE</th>
<th>Sodium citrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Forms calcium salts to remove calcium</td>
<td></td>
</tr>
<tr>
<td>USES</td>
<td>Coagulation tests (protime and prothrombin time), <strong>full draw</strong> required</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Green Top</th>
<th>ADDITIVE</th>
<th>Sodium heparin or lithium heparin</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Inactivates thrombin and thromboplastin</td>
<td></td>
</tr>
<tr>
<td>USES</td>
<td>For lithium level, use sodium heparin For ammonia level, use sodium or lithium heparin</td>
<td></td>
</tr>
</tbody>
</table>
# COLLECTION TUBES FOR PHLEBOTOMY

## Dark Blue Top

<table>
<thead>
<tr>
<th>ADDITIVE</th>
<th>EDTA-</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Tube is designed to contain no contaminating metals</td>
</tr>
<tr>
<td>USES</td>
<td>Trace element testing (zinc, copper, lead, mercury) and toxicology</td>
</tr>
</tbody>
</table>

## Light Gray Top

<table>
<thead>
<tr>
<th>ADDITIVE</th>
<th>Sodium fluoride and potassium oxalate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Antiglycolytic agent preserves glucose up to 5 days</td>
</tr>
<tr>
<td>USES</td>
<td>Glucoses, requires <strong>full draw</strong> (may cause hemolysis if short draw)</td>
</tr>
</tbody>
</table>

## Yellow Top

<table>
<thead>
<tr>
<th>ADDITIVE</th>
<th>ACD (acid-citrate-dextrose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODE OF ACTION</td>
<td>Complement inactivation</td>
</tr>
<tr>
<td>USES</td>
<td>HLA tissue typing, paternity testing, DNA studies</td>
</tr>
</tbody>
</table>
## COLLECTION TUBES FOR PHLEBOTOMY (Page 4)

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Additive</th>
<th>Mode of Action</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow - Black Top</td>
<td>Broth mixture</td>
<td>Preserves viability of microorganisms</td>
<td>Microbiology - aerobes, anaerobes, fungi</td>
</tr>
<tr>
<td>Black Top</td>
<td>Sodium citrate (buffered)</td>
<td>Forms calcium salts to remove calcium</td>
<td>Westergren Sedimentation Rate; requires <strong>full draw</strong></td>
</tr>
<tr>
<td>Orange Top</td>
<td>Thrombin</td>
<td>Quickly clots blood</td>
<td>STAT serum chemistries</td>
</tr>
</tbody>
</table>
**COLLECTION TUBES FOR PHLEBOTOMY** (Page 5)

<table>
<thead>
<tr>
<th>Light Brown Top</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDITIVE</strong></td>
<td>Sodium heparin</td>
</tr>
<tr>
<td><strong>MODE OF ACTION</strong></td>
<td>Inactivates thrombin and thromboplastin; contains virtually no lead</td>
</tr>
<tr>
<td><strong>USES</strong></td>
<td>Serum lead determination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pink Top</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDITIVE</strong></td>
<td>Potassium EDTA</td>
</tr>
<tr>
<td><strong>MODE OF ACTION</strong></td>
<td>Forms calcium salts</td>
</tr>
<tr>
<td><strong>USES</strong></td>
<td>Immunohematology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>White Top</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDITIVE</strong></td>
<td>Potassium EDTA</td>
</tr>
<tr>
<td><strong>MODE OF ACTION</strong></td>
<td>Forms calcium salts</td>
</tr>
<tr>
<td><strong>USES</strong></td>
<td>Molecular/PCR and bDNA testing</td>
</tr>
</tbody>
</table>
Specialized Collection Tubes

1. Ascorbic Acid Tube: Used exclusively for blood serotonin assay. This tube contains EDTA as an anticoagulant and ascorbic acid as the preservative. Red and yellow marbled stopper.

2. FDP or FSP Tubes: Special collection tubes are required for fibrin degradation products analysis. These tubes maybe light blue or black stopper. Approximately 2 ml of blood is collected into the tube. The tube should be inverted immediately. A fibrin clot will occur within 30 seconds.

CROSSMATCHES

The Crossmatch is also known as compatibility testing, pre-transfusion testing or type and Crossmatch (Type and Cross; T & C). The definition of a compatibility test (crossmatch) is a series of procedures use to give an indication of blood group compatibility between the donor and the recipient and to detect irregular antibodies in the recipient's serum.
PURPOSE

The main purpose for performing a crossmatch is to promote (not ensure) the safe transfusion of blood. We are performing testing to the best of our ability that will demonstrate that the donor blood is compatible with the recipient's blood. Crossmatch procedures should be designed for speed and accuracy - get the safest blood reasonably possible available to the patient as soon as possible.

Once donor blood is crossmatched with a potential recipient, the results of the crossmatch is good only 3 days. If the physician wants the donor blood available longer, we must get a new recipient sample and repeat tests. This protocol helps detect new antibodies that may be forming, especially when patient has been transfused within past three months.

PROCEDURE

1. Double check the patient's identity
2. Draw at least one red top tube (without polymer gel), two if possible. Label the tubes with information below,
   a. Name
   b. Date and time collected
   c. Hospital number
   d. Initials of person collecting
   ● Collect specimen carefully to avoid hemolysis of the red cells
   ● Most facilities have a type of identification band that is placed on the patient’s wrist as soon as the specimen has been collected. There is also a label that has a preprinted ID number, identical to the one on the wrist band. This label must be affixed to the tube of blood. This same ID number will be placed on the unit of blood that has been crossmatched. This must be double checked prior to infusion by the practitioner.

*NOTE: Always double or triple check names and ID numbers where there is a possibility that blood will be transfused. A unit of blood given to the wrong person could kill.*

BLOOD CULTURE

PURPOSE

The detection of septicemia
PREPARATION OF THE PATIENT

1. Explain that the physician has ordered a series of test and you will have to perform several sticks.
2. Clean the skin first using alcohol (using concentric rings from the inside out)
3. Follow this with an iodine swab using same technique
4. Allow iodine to dry before performing the venipuncture. Once the iodine is dry, do no palpate the vein again unless you have “sterilized” your own gloved finger as you did for site puncture.

PROCEDURE

Each laboratory uses its own particular blood culture system. The protocol for the collection of cultures also varies from hospital to hospital. The following are certain procedural steps that are common to all blood culture methods.

1. Paint the septum of the blood culture bottle(s) with iodine.
2. For the first culture, if possible, collect a specimen from each arm. The amount of blood to be drawn depends on the culture system used. (usually 5-10 ml) Draw the blood in sterile syringes only.
3. After completion of the draw, replace the needle used to make the venipuncture with a new sterile one. Inject the sample into the blood culture bottle and quickly, but gently mix to avoid clotting.
4. In subsequent cultures, one venipuncture will be enough; however, each one should be obtained from alternate arms.
5. After returning to the laboratory, you may be required to “vent” one of the culture bottles if a two bottle system is used. Check with the lab regarding the proper procedure to follow.

VALUES: Normal blood cultures should be sterile. The growth of microorganisms in the blood is a life threatening situation.

ORAL GLUCOSE TOLERANCE TEST (GTT)

PURPOSE

To confirm diabetes mellitus; to aid in diagnosis of malabsorption syndrome and hypoglycemia.
PREPARATION OF PATIENT

1. The patient should not eat, drink coffee or alcohol, smoke or exercise vigorously for at least 10 hours prior to or during the testing.
2. If this testing is to be done on an outpatient basis, inform the patient of the time involved.

PROCEDURE

1. Patient’s height and weight if obtained to determine amount of glucose solution to give. Several calculators and methods of calculation are available for this purpose.
2. Draw a fasting sample in a gray top tube. Also collect a fasting urine specimen.
3. Give the patient the predetermined amount of glucose solution to drink. Make sure solution is chilled. NOTE THE TIME. (Patient must drink all the solution in a 5 minute time limit.)
4. Draw a specimen at 30 minutes, 1 hour, 2 hours, and 3 hours. Also collect urine samples at each blood collection. NOTE TIMES.

Special Considerations: If the patient becomes nauseated or faint, note for vomiting and should this occur within the first 30 minutes of test, discontinue and notify the physician. Encourage patient to drink more water during the test to promote adequate urine excretion.

This test is considered a timed test and therefore the physician can make the most accurate diagnosis if the testing is followed as closely as possible. If it is impossible to collect any specimen at the appointment time, notify the lab.
GENERAL COLLECTION REQUIREMENTS

Below is an illustrative list of chemical, hematological, and serologic tests done in many laboratories. The section labeled “Tube” is the mandatory tube to be drawn for the test indicated. Any other tubes drawn for that test would be determined by your facility. In large labs many more tests are performed than those listed below, whereas small labs may do very few in the list. Good phlebotomy technique includes more than just collecting a specimen in the proper evacuated tube. It is important that attention be paid to any special instructions required by the testing laboratory.

CO
DE
B-Light blue top
Gr-Grey Top
Gn-Green Top
L-Lavender Top
NB-Navy Blue Top
R-Red Top
S-Use Syringe
SPECIAL COLLECTION TECHNIQUES

General considerations: Most laboratory testing is routine blood collecting, using the Evacuated system or in some instances needle and syringe. There are certain test that require specific handling of the specimen prior to testing if there is any delay in transporting to the lab.

The following section deals with the test most often encountered in a general care hospital or health care facility, that require special techniques or handling. This section does not attempt to cover all lab testing, but is an excellent reference for basic test. The phlebotomist should refer to the procedure manual provided by their laboratory.

Collecting a Blood Culture

Supplies needed,

- Sterile gloves
- Disposal exam gloves
- Face shield or goggles
- Surgical mask
- Fluid-resistant gown or lab coat
- 2 x 2 gauze pads
- Alcohol sponges or blood culture prep kit
- Tourniquet
- 20 ml syringe
- Sterile needles: 20-22 gauge or 23-25 gauge butterfly
- Blood culture collection tubes
- Permanent black pen for labeling bottles
- Laboratory requisition forms
- Puncture-resistant needle disposal container
- Plastic bag for used supplies
- Bandage

Procedure Guidelines

1. Perform your beginning procedure actions.
2. Check the requisition slip to determine what specimen to collect. Select the
proper supplies.
3. Assemble the needle and syringe. Move the plunger back and forth to break the seal.
4. Apply a tourniquet and locate a vein. Select the largest, most stable vein in the area. When palpated, the site should feel firm and rebound slightly.
5. Cleanse the site with alcohol. Wipe in a circular motion. Begin in the center of the venipuncture site and extend the circle out 3 inches in diameter. Repeat the cleansing procedure twice. Use a clean swab each time you cleanse the skin.
6. Allow the alcohol or other skin prep to dry thoroughly.
7. Remove the needle cover, holding the needle by the wings, with the bevel facing up, in your dominant hand.
8. Stabilize the vein by holding it with your thumb, approximately 1 inch below the puncture site.
9. Insert the needle into the patient’s vein at 35-45 degree angle. You will feel a change of pressure when the needle enters the vein. Advance the needle at least 1/4 inches.
10. Rest your dominant hand on patient’s arm. Make sure that the needle does not move. Blood should begin to flow into the hub of the needle.
11. Holding the syringe with the dominant hand, slowly pull back on the plunger with the non-dominant hand, withdrawing the required amount of blood.
12. Release the tourniquet when the last drop of blood is obtained. Hold the collection device securely, and then pull the upper end of tourniquet downward. Avoid pulling upward, as this may cause the needle to come out of the patient’s arm.
13. Place the 2 x 2 gauze pad 1 inch above the insertion site. Avoid using cotton balls. Cotton balls tend to stick to the insertion site, and when removed, remove the platelet plug, causing bleeding.
14. Quickly withdraw the needle. Immediately bring the gauze pad down over the site, and apply pressure. Maintain pressure for 3-4 minutes, or until bleeding stops.
15. Cover the puncture site with a bandage.
16. Using a Kelly or other instrument, carefully remove the needle from the syringe, and discard the needle in the puncture resistant container. Apply a sterile needle.
17. Apply full protective equipment, including gown, face shield, mask and gloves.
18. Snap the caps off culture bottles.
19. Cleanse the rubber stoppers well, using alcohol. Wipe in a circular motion. Use a new sponge for each bottle. Allow to dry thoroughly.
20. Remove the cap from the sterile needle and pierce the rubber stopper of the
anaerobic bottle. Slowly depress the plunger, filling the bottle with the appropriate amount of blood. Withdraw the needle and repeat with the aerobic bottle. Inject slowly, and exercise slowly, and exercise care to avoid injecting air into either bottle.

21. Discard the needle and syringe in the puncture-resistant container
22. Label the bottles according to facility policy.
23. Perform your procedure completion actions.
24. Transport the samples to the laboratory immediately in a plastic transport bag, or according to facility policy.

Collecting a Blood Sample Using a Butterfly Needle Syringe

Supplies needed,

- 2 pairs of disposable exam gloves
- Face shield or goggles
- Surgical mask
- Fluid-resistant gown or lab coat
- 2 x 2 gauze pads
- Alcohol or povidone-iodine sponges
- Tourniquet
- 10 ml syringe
- Sterile 23 gauge butterfly needle
- Sterile 20 gauge needle
- Bandage tape to secure the butterfly in place
• Blood collection tubes
• Labels for collection tubes
• Permanent black pen for labeling tubes
• Laboratory requisition forms
• Puncture- resistant needle disposal container
• Plastic bag for used supplies
• Bandage

Procedure Guidelines

1. Perform your beginning procedure actions.
2. Check the requisition slip to determine what specimen to collect. Select the proper tubes.
3. Assemble the needle and syringe. Uncoil the butterfly tubing. Move the plunger back and forth to break the seal.
4. Apply a tourniquet and locate a vein. Select the largest, most stable vein in the area.
5. When palpated, the site should feel firm and rebound slightly. Cleanse the site with alcohol. Wipe in a circular motion. Begin in the centre if the venipuncture site and extend the circle out 2 inches in diameter.
6. Allow the alcohol or other skin prep dry thoroughly.
7. Remove the needle cover, holding the needle by the wings, with the bevel facing up, in your dominant hand.
8. Stabilize the vein by holding it with your non-dominant thumb, approximately 1 inch below the puncture site.
9. Insert the needle into the patient’s vein. You will feel a change of pressure when the needle enters the vein. Advance the entire length of the needle.
10. Rest your dominant hand on the patient’s arm. Make sure that the needle does not move. Blood should begin to flow into the attached tubing.
11. Gently tape the butterfly wings against the skin to hold the needle in place.
12. Holding the syringe with the dominant hand, slowly pull back on the plunger, filling the syringe with blood.
13. Release the tourniquet when the last drop of blood is obtained. Pull the upper end of the tourniquet downward. Avoid pulling upward, as this may cause the needle to come out of patient’s arm.
14. Place a 2x2 gauze pad 1 inch above the insertion site. Avoid using cotton balls. Cotton balls tend to stick to the insertion site and when removed, remove the
platelet plug, causing bleeding.
15. Quickly withdraw the needle. Immediately bring the gauze pad down over the
   site, and apply pressure. Maintain pressure for 3 to 4 minutes, or until bleeding stops.
16. Cover the puncture site with a bandage.
17. Remove the butterfly tubing from the syringe. Carefully discard them in the
   puncture-resistant container.
18. Open the package for the 20 gauge needle and attach the needle to the syringe.
19. Perform your procedure completion actions.
20. After leaving the room, apply full personal protective equipment.
21. Transfer the blood to the vacuum tubes in a rack by inserting the needle through
   the rubber stopper, allowing the tube to fill. Allow the rack to support the tube
   when the needle is inserted. Avoid holding it with your hand.
22. Fill the tubes in order of the draw.
23. Gently invert the tubes several times to mix the samples. Avoid shaking.
24. Discard the needle and syringe in the puncture- resistant container.
25. Label the tubes according to the facility policy.
26. Transport the blood to the lab, following facility policy.

**Drawing Blood Using a Lancet for Microdraw or Infant Heel Stick**

Supplies needed,

- Disposable exam gloves
- Lancets
- Microvette collection devices
- 2 x 2 gauze pads
- Alcohol or povidone-iodine sponges
- Labels for collection
- Permanent black pen for labeling tubes
- Laboratory requisition forms
- Puncture-resistant needle disposal container
- Plastic bag for used supplies
- Bandage or spot adhesive bandages.
Procedure Guidelines

1. Perform your beginning procedure actions. Check the requisition slip to determine what specimen to collect. Select the proper tubes.
2. Identify the specimen collection site.
3. Cleanse the site with alcohol. Wipe in a circular motion. Begin in the center of the puncture site and extend the circle out 2 inches in diameter. Allow the alcohol or other skin prep to dry.
4. Hold the plastic end of the lancet in your dominant hand. With your non-dominant hand, break the plastic cover off the end to expose the needle.
5. Hold the lancet at 45 degree angle. With the sharp of the lancet, pierce the skin. For an adult fingerstick, make the stick perpendicular to the lines in the fingerprints. Follow the directions for the type of lancet you are using. If the lancet has a plunger, depress it to pierce the skin while holding pressure on the site.
6. Remove the lancet. Discard it in the puncture-resistant sharps container.
7. Wipe the first drop of blood away with a sterile 2 x 2 sponge. You will need the rest to fill the containers.
8. Hold the collection tube near the collection site. Position the tube almost horizontally, with the end slightly down. Squeeze the skin slightly, allowing blood to flow into the tube. Do not squeeze hard, as this forces tissue fluid into the sample, diluting it. If blood does not flow freely, create suction by placing your gloved finger over the end of the capillary tube, or by squeezing the small bulb. Fill the tube approximately 2/3 to 3/4 full. Usually, two or three tubes are filled.
9. Apply a gentle pressure with the 2 x 2 gauze to the skin to prevent painful bleeding inside the tissues. The patient can hold the gauze sponge in place until the bleeding stops. Avoid using cotton balls. Cotton balls tend to stick to the puncture site, and when removed, remove the platelet plug, causing bleeding.
10. Label the sample while in the patient’s room.
11. Perform your procedure completion actions.
Measure Bleeding Time Supplies needed:

- Disposable exam gloves
- Alcohol or povidone-iodine sponges
- Surgicutt*, template, spring-loaded blade, or similar device.
- Tourniquet
- Blood pressure cuff
- Watch with second hand
- Filter paper
- 2 x 2 gauze pads
- Puncture-resistant sharps container
- Plastic bags for used supplies
- Steri-strips, butterfly bandage, or other bandage

Procedure Guidelines

1. Perform your beginning procedure actions. Double-check the requisition slip.
2. Support the patient’s arm on the bed or other surface, palm up. Make sure the patient is comfortable and can maintain this position for the duration of the procedure.
3. Apply the blood pressure cuff to the upper arm. Do not inflate it. Apply gloves.
4. You will perform the test approximately 4 inches below the antecubital space. Cleanse the site with alcohol or povidone-iodine. Wipe in a circular motion. Begin in the center of the puncture site and extend the circle 3 inches in diameter.
5. Allow the alcohol or other skin prep to dry.
6. Remove the Surgicutt*, template, or other product from the package. Twist off the tab on the site, taking care not to touch the blade or activate the trigger.
7. Inflate the blood pressure cuff until the gauge reads 40mmHg. You must start the test within 60 seconds of inflating the cuff.
8. Apply the Surgicutt* or other device to the prepared skin, approximately 4 inches below the antecubital space. Position the device so the blade is parallel to the bend in the elbow.
9. Depress the trigger while monitoring the second hand on your watch. Remove the blade from the skin with one second of depressing the trigger. Record the time. Discard the device containing the blade in the puncture-resistant container.
10. Absorb the blood with the edge of the filter paper. Position the paper near the incision, without touching the wound directly. Placing the paper directly on the incision will interfere with the results of the test.
11. With the filter paper, blot the bleeding every 30 seconds. When the blood no longer stains the paper, stop timing. Discard the filter paper in the plastic bag. Record the time the test ended.
13. Deflate the blood pressure cuff.
14. Wipe remaining blood from the skin.
15. Apply a Steri-strip, butterfly bandage, or dressing to the incision.
16. Remove the gloves and discard in the plastic bag.
17. Remove the blood pressure cuff.
18. Perform your procedure completion actions.

### ARTERIAL PUNCTURE

Arterial puncture is a relatively straightforward technique that is easily performed at the bedside. Pulse oximetry will give a reasonable estimate of the adequacy of oxygenation in many circumstances but does not assess acid-base status or ventilation and should not be used alone in cases where these measurements are important.

An arterial blood gas sample reveals how well the lungs are functioning in terms of gas exchange. It should be clearly explained to the patient that this procedure is more uncomfortable than a routine venipuncture and more difficult to accomplish.

An arterial blood gas (ABG) will help in the assessment of oxygenation, ventilation, and acid-base homeostasis. It can also aid in the determination of poisonings (carboxyhemaglobinemia or methemoglobinemia) and in the measurement of lactate concentration.

#### Who should perform this test?

Paramedics, physicians, nurses (RNs), and respiratory technicians/technologists are the most trained and experienced at performing arterial blood gas samples. Level Two Phlebotomists who have undergone specific training involving theory, and under supervision of a qualified ABG technician.

#### Technique

Percutaneous puncture of the artery should be performed using standard precautions. The radial artery is the most common and best site for arterial puncture. The radial artery is easily compressible, superficial and has good collateral circulation. Except under unusual circumstances (i.e. severe peripheral vascular disease), it is not necessary to routinely perform an Allen’s test prior to arterial puncture. In patients that are hypotensive, the axillary and femoral arteries are potential alternate sites. Contraindications to these alternate sites include severe coagulaopathy and bypass.
grafting of that limb. Complications include pain, vasovagal episodes, hematomas, bleeding, and rarely aneurysms.

**Site Selection**

Several sites can be used; however, the criteria for the selection include the presence of collateral circulation, how large and accessible the artery is, and the type of tissue surrounding the puncture site. The site chosen should not be inflamed, irritated, edematous or close to a wound. Never select a site in an area with an A-V shunt or fistula.

1. **The radial artery** – This is the first choice and most common site for ABG collection. The radial artery is located in the thumb side of the wrist, and is smaller than arteries at other sites. This artery is easily accessible most of the time.

2. **The Brachial Artery** – This is the second choice for ABG collection. This artery is located in the medical anterior aspect of the antecubital fossa near the insertion of the biceps.

3. **The Femoral Artery** – Although the largest artery used for arterial blood gas it is the final artery site to use. It is located superficially in the groin, lateral to the pubis bone. Due it is location and close proximity to other vital sites, a physician and/or ER Trauma Team specialists are most qualified to collect the sample from this artery.

**Necessary Equipment**

1. Materials for skin cleansing (Alcohol and cotton)
2. Syringe with 3 to 5 mL of Lidocaine 1% and a 23- to 25-gauge needle.
3. Preheparinised 3 to 5 mL syringe with 23 to 25 gauge needle. To heparinize the syringe, aspirate 0.5 mL of heparin into the syringe, hold the syringe upright, pull the plunger all the way out to the end, and then return all of the heparin to the original container. This can be done with butterfly wings.
4. Gloves
5. Ice for transport.
Preparation

Steady State
The patient’s temperature, breathing pattern and concentration of oxygen inhaled affect the amount of oxygen and carbon dioxide in the blood. Ideally, a patient should have been in a stable or steady state: meaning no exercise, suctioning or respirator for at least 30 minutes prior to obtaining blood gases.

Anesthetics
These help reduce the painful procedure of having an arterial blood draw. Without this, the patients may respond with breathing harder, holding the breath, crying or hyperventilating, which all can affect the blood gas results. Administration of anesthetics may be omitted for patients who had had the procedure before and are not apprehensive about it.

Procedure for radial arterial puncture
1. Wear gloves.
2. Consider the use eye protection.
3. Place the patient’s palm upward and gently extend the wrist 10-20 degrees.
4. Clean the site with alcohol.
5. Consider 1-2% lidocaine with a 25 gauge needle to make a wheal over the puncture site for patient comfort.
6. Enter the skin at a 30-45% angle with a heparinized ABG syringe.
7. Withdraw the needle from the skin and compress the site for 5 minutes.
8. Do not recap the needle (except for specially designed hinged caps) and remove the needle from the syringe and secure a syringe cap.
9. Place in an ice water slurry and transport to the lab expeditiously or
10. Place a drop of blood in an ABG analysis cassette and insert into a bedside testing device.

Allen’s Test
1. Instruct the patient to make a tight fist. If the patient is unresponsive raise the arm above the heart for several seconds to force blood to leave the hand.
2. Apply direct pressure on the radial and ulnar arteries to obstruct blood flow to the hand as the patient opens and closes his fist rapidly.
3. Instruct the patient to open his hand, with the radial artery remaining compressed. If the patient is unresponsive, keep the arm above the heart level.
4. Examine the Palmer surface of the hand for an erythematous blush or pallor within 15 seconds.
5. A positive Allen’s test is when a blush indicates ulnar patency.
6. A negative Allen’s test indicates occlusion of the ulnar artery. This radial artery should not be punctured.

Precautions
1. If a local anesthetic is used check for medication allergies.
2. Alternate sites for serial ABGs.
3. Always do an Allen’s Test before puncture.

Complications
- False value
- Discomfort
- Delay in cooling
- Intraluminal clotting
- Hematoma
- Hemorrhage
- Impaired circulation to extremity
- Infection
- Arterial spasm
- Thrombosis
- Nerve injury.

Care after punctured
1. Maintain continuous firm pressure on the countryside for 10 minutes. Make sure all bleeding stops.
2. The site should be checked for a delayed hematoma and circulation to the extremity every 15 minutes for the first hour.
3. Assess the results of the arterial blood gases.
4. Document decided puncher, ease of puncher, time of applied pressure, site assessment, and circulatory assessment after arterial puncture.

**Specimen Rejection**

1. Inadequate volume of specimen for the test
2. Clotted
3. Incorrect or no identification
4. Delay in delivering the sample for analysis
5. Not placed in ice
6. Air bubbles
7. Wrong syringe used
GLOSSARY

A

ABG
Arterial Blood Gas.

ABO Blood Group
The major human blood type system which depends on the presence or absence of antigens known as A and B.

Absorb
To suck up, as through pores.

Acid-citrate-dextrose (ACD)
An anticoagulant containing citric acid, sodium citrate and dextrose. This was formerly used primarily as a whole blood preservative, but is currently used for plateletpheresis.

Acquired Immunodeficiency Syndrome (AIDS)
An epidemic disease caused by an infection of the human immunodeficiency virus (HIV-1, HIV-2), a retrovirus that causes immune system failure and debilitation and is often accompanied by infections such as tuberculosis. AIDS is spread through direct contact with bodily fluids.

Acute
Of short duration. Rapid and abbreviated in onset in reference to a disease process.

Adsorb
to attract and retain other material on the surface.

Aerobic
Having molecular oxygen present. In respect to phlebotomy, blood cultures are often drawn for the purpose of determining the presence and identification of aerobic microorganisms.
Aerosol canisters
Enclosed containers used to hold specimen tubes for centrifugation.

AHF
Antihemophilic Factor. See: Factor VIII

AIDS
See: "Acquired Immunodeficiency Syndrome"

Airborne Precautions
One of a number of newly proposed precautions recommended by the CDC which includes Standard Precautions plus special precautions for patients known or suspected to be infected with microorganisms transmitted by airborne droplet nuclei (small-particle residue {5μ or smaller in size} of evaporated droplets containing microorganisms that remain suspended in the air and that can be dispersed widely by air currents within a room or over a long distance).

Albumin
Main protein in human blood.

Allergen
An antigenic substance capable of producing an immediate-type hypersensitivity (allergy).

Anaerobic
Growing, living or occurring in the absence of molecular oxygen; pertaining to an anaerobe. As in phlebotomy, the drawing of blood cultures for the purpose of possible isolation and identification of anaerobic bacteria.

Anaphylaxis
An acute, generalized life-threatening allergic or hypersensitive reaction in a previously sensitized person (i.e. a person who has previously been exposed to that particular allergen) who comes into contact with the same allergen again. Reactions that occur almost immediately tend to be the most severe. Anaphylaxis can be caused by any allergen. The most common allergens are medications, insect bites, certain foods, and allergy injections.
Anemia
The condition of having less than the normal number of red blood cells or hemoglobin in the blood. The oxygen-transporting units are, therefore, insufficient. Patients can feel tired, fatigue easily, appear pale, develop palpitations, and become short of breath. There are many causes of anemia, including: bleeding, abnormal hemoglobin formation (such as in sickle cell anemia), iron, B12 (pernicious anemia), or folate deficiency, rupture of red blood cells (hemolytic anemia), and bone marrow diseases.

Anesthetic
A drug that causes unconsciousness or a loss of general sensation. A local anesthetic causes loss of feeling in a part of the body.

Antecubital fossa
That part of the arm opposing the elbow.

Anterior
Toward the front or in front of. See ventral.

Antibody
A molecule that has a specific affinity for and reacts with the antigen that was responsible for it's production or with one which is closely related.

Anticoagulant
Any substance that prevents blood clotting.

- Anticoagulant solutions used for the preservation of stored whole blood and blood fractions are acid citrate dextrose (ACD), citrate phosphate dextrose (CPD), citrate phosphate dextrose adenine (cPDA 1) and heparin.
- Anticoagulants used to prevent clotting of blood specimens for laboratory analysis are heparin and several substances that make calcium ions unavailable to the clotting process, including EDTA (ethylenediamintetraacetic acid), sodium citrate and oxalate.

Antigen
A substance that is capable of producing a specific immune response with a specific antibody.
Antihemophilic factor
See: Factor VIII

Anti-platelet agents
Medications that, like aspirin, reduce the tendency of platelets in the blood to clump and clot.

Antiseptic
Something that discourages the growth microorganisms. By contrast, aseptic refers to the absence of microorganisms. Also, see germicide and disinfectant.

Apheresis
A technique in which blood products are separated from a donor and the desired elements collected and the rest returned to the donor. This has the advantage of specificity and a good harvest; for example a good platelet collection may be obtained from two or three donors in which the conventional method would involve up to ten donors.

Arteriole
A small branch of an artery that leads to a capillary. Also, see capillary.

Arteriovenous fistula
The surgical joining of an artery and a vein under the skin for the purpose of hemodialysis. Larger arteriovenous shunts can place strain on the heart since arterial blood is diverted back to the venous circulation before it has a chance to deliver nutrients and oxygen to the body tissues. SYN: arteriovenous shunt.

Artery
Blood vessel carrying blood away from the heart. Arterial blood is normally full of oxygen. The oxygenated hemoglobin (oxyhemoglobin) makes it look bright red. Arteries are routinely accessed to retrieve arterial blood samples for blood gas measurements (ABG).

Aseptic
The absence of microorganisms. By contrast, something that just discourages the growth of microorganisms is antiseptic.
Aseptic technique
A method used by microbiologists and clinicians to keep cultures, sterile instruments and media, and people free of microbial contamination.

Aspirate
As it relates to blood drawing, the material that is withdrawn with a negative pressure apparatus (syringe).

Autohemolysis
Hemolysis of red blood cells of a person by his own serum.

B

Bacteremia
The presence of viable bacteria circulating in the bloodstream. Diagnosed with blood cultures.

Basal state
As it pertains to phlebotomy, the basal state is the state of the body early in the morning, approximately 12 hours after the last ingestion of food or other nutrition. This is the base state of the body during which fasting blood work is drawn.

Basilic vein
Large vein on the inner side of the biceps. Often chosen for intravenous injections and blood drawing.

Basophil
A granular leukocyte with an irregularly shaped nucleus that is partially constricted into two lobes, and with cytoplasm that contains coarse, bluish-black granules of variable size.

BetadineT
A popular tradename iodine-containing topical antiseptic agent; povidone-iodine.
Bleeding-time
A test which measures the time it takes for small blood vessels to close off and bleeding to stop. Abnormal results can be seen in those with congenital or acquired platelet function disorders or thrombocytopenia. Some medications, including aspirin will prolong a bleeding time. For more information.

Blind stick
Performing a venipuncture with no apparently visible or palpable vein. Though this technique is discouraged, it is occasionally necessary requiring a skilled phlebotomist who is experienced and well versed in vascular anatomy.

Blood
The fluid in the body that contains red cells and white cells as well as platelets, proteins, plasma and other elements. It is transported throughout the body by the Circulatory System. Arterial blood is the means by which oxygen and nutrients are transported to tissues, venous blood is the means by which carbon dioxide and metabolic byproducts are transported for excretion. See also: whole blood; peripheral blood; defibrinated blood.

Blood-borne pathogens
Any disease producing microorganism which is spread through direct contact with contaminated blood. OSHA defines blood-borne pathogens as "pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV)."

Blood cell
There are three main types of cell in the blood stream. The red cell, which carries oxygen, the white cell, which fights infections and the platelet, which helps prevent bleeding. The correct balance between each cell type must be maintained for the body to remain healthy.

Blood vessel
All the vessels lined with endothelium through which blood circulates.

Bruise
A bruise or "contusion" is an traumatic injury of the soft tissues which results in breakage of the
local capillaries and leakage of red blood cells. In the skin it can be seen as a reddish-purple
discoloration which does not blanch when pressed upon. When it fades it becomes green and
brown as the body metabolizes the blood cells in the skin. It is best treated with local application
of a cold pack immediately after injury. Also see hematoma.

**Butterfly**
A small needle with two plastic wings attached which are squeezed together to form a tab that is
used to manipulate the needle. A long 6-12” plastic tubing is attached which again offers better
manipulation. This assembly is then attached to a syringe or Evacuated tube holder for the
purpose of drawing a blood sample.

**Cannula**
A tube for insertion into a duct or cavity.

**Capillary**
Any one of the minute vessels that connect the arterioles and venules, forming a network in
nearly all parts of the body. Their walls act as semipermeable membranes for the interchange of
various substances, including fluids, between the blood and tissue fluid

**Carbamate hemoglobin**
The hemoglobin compound bound with carbon dioxide in the red blood cells. The carbon dioxide
is transported from body cells, through the venous blood system, to the lungs for exchange with
oxygen. (see oxyhemoglobin)

**Carboxyhemoglobin**
Hemoglobin which has been bound with carbon monoxide, which has an affinity for hemoglobin
200 times greater than oxygen. Carbon monoxide poisoning.

**Catheter**
A thin, flexible tube. When a catheter is placed in a vein, it provides a pathway for giving drugs,
nutrients, fluids, or blood products. Also, blood samples can be withdrawn through the catheter.
CBC See: "complete cell count"

Central venous catheter
Small, flexible plastic tube inserted into the large vein above the heart, through which drugs and blood products can be given and blood samples withdrawn painlessly. SYN: Hickman catheter.

Centrifuge
A laboratory apparatus that separates mixed samples into homogenous component layers by spinning them at high speed. Different constituents of body fluids can be separated on the basis of their density by artificially increasing gravity in a centrifuge.

Chelate
Combining with a metallic ion into a ring complex.

Chlorhexidine gluconate
Antiseptic used in bleeding times, blood cultures and surgical procedures. Preparation contains chlorhexidine gluconate 2% w/v and isopropyl alcohol 70% v/v.

Chromatin
The more readily stainable portion of the cell nucleus. It is a DNA attached to a protein structure and is the carrier of genes in inheritance.

Circulation
The movement of fluid in a regular or circuitous course. Although the noun "circulation" does not necessarily refer to the circulation of the blood, for all practical purposes today it does. Heart failure is an example of a problem with the circulation.

Circulatory System
The circulatory system is composed of the heart, arteries, capillaries and veins. It serves to transport blood low in oxygen from the body to the lungs and heart (veins) and oxygenated blood from the lungs and heart throughout the body (arteries).
Citrate
A compound that is an intermediate in the citric acid cycle (Krebs cycle or glycolysis). Citrate chelates (binds) calcium ions, preventing blood clotting and, thus, is an effective anticoagulant.

Citrate phosphate dextrose (CPD)
An anticoagulant

Citrate phosphate dextrose adenine (CPDA-1)
An anticoagulant used for the preservation of whole blood and red cells for up to 35 days

Citric Acid Cycle
A group or series of enzymatic reactions in living aerobic organisms that results in the production of energy. Also known as the tricarboxylic acid cycle and the Krebs cycle. For a much more detailed and interactive explanation.

Clot
A semisolid mass of blood found inside or outside the body.

Coagulate
The process of clot formation. Part of an important host defense mechanism call homeostasis.

Coagulation factors
Group of plasma protein substances (Factor I thru XIII) contained in the plasma, which act together to bring about blood coagulation. For an in-depth explanation of blood coagulation.

Cohorting
In epidemiology, a group of individuals who share common characteristics; for example, patients in isolation may share the same airspace if the infectious agent is the same.

Collateral circulation
Blood which infuses an area through a secondary or accessory route. Blood which is carried through secondary channels after the primary vessels of that part have been obstructed or
Complete blood count (CBC)
The number of red blood cells, white blood cells and platelets (per cubic millimeter) that are present in the patient's sample of blood is determined. Also included is the hematocrit (%), hemoglobin concentration (gm%) and the differential. Most common test done on the blood.

Contagious
Infectious. May be transmitted from person to person.

Contamination
The soiling by inferior material, as by the introduction of organisms into a wound.

Contusion
A bruise or injury without a break in the skin.

Coumadin™
Trademark for the preparation of warfarin sodium.

Cytoplasm
The liquid portion of a cell including organelles and inclusions suspended in it. It is the site of most chemical activities of the cell.

Defibrinated blood
Blood which has been deprived of fibrin.

Dialysis
The process of cleansing the blood by passing it through a special machine. Dialysis is necessary when the kidneys are not able to filter the blood. Dialysis allows patients with kidney
failure a chance to live productive lives. There are two types of dialysis: hemodialysis and peritoneal dialysis. Each type of dialysis has advantages and disadvantages. Patients can often choose the type of long term dialysis that best matches their needs. For more information on dialysis.

Diaphoretic
Formation of profuse perspiration (sweat). A symptom of syncope or vasovagal response

Differential
A count made on a stained blood smear of the proportion of the different leukocytes (WBC's) and expressed as a percentage. A differential is a normal part of a complete blood count (CBC).

Disinfectant
An agent that disinfects, applied particularly to agents used on inanimate objects.

Distal
Remote, farther from any point of reference, opposed to proximal.
Dorsal Denoting a position more toward the back surface than some other object of reference; same as posterior in human anatomy.

Ecchymosis-
The skin discoloration caused by a bruise (contusion).

Edema
The swelling of soft tissues as a result of excess fluid accumulation. Edema may be localized, due to venous or lymphatic obstruction or to leakage of fluids from the vascular system into the intercellular tissue spaces. It can also be systemic and generalized due to heart or renal disease. Development of collateral circulation will result in a reduction of water accumulation.

EDTA
Ethylenediaminetetraacetate. A calcium chelating (binding) agent that is used as an anticoagulant for laboratory blood specimens. Also used in treatment of lead poisoning.

**Efferent**
Carrying away. An artery is an efferent vessel carrying blood away from the heart.

**Effluent**
An outflow, usually of fluid.

**Electrolyte**
A substance that will acquire the capacity to conduct electricity when put into solution. Electrolytes include sodium, potassium, chloride, calcium and phosphate. Informally called "lytes".

**Embolus**
A sudden blockage of a blood vessel by a blood clot or some other obstruction which has been transported through blood vessels and lodged at a site too small for passage. Examples of emboli are a detached blood clot, a clump of bacteria, or other foreign material, such as air. Contrast to thrombus.

**EMLA cream**
Also "Eutectic Mixture of Local Anesthetics". A cream mixture of lidocaine and prilocaine, this topical anesthetic is often used locally on children for mildly invasive procedures such as venipunctures and intramuscular injections. The cream is placed on the skin in the area where the procedure is to be performed. After 30-60 minutes, the cream is removed and the procedure completed.

**Endothelium**
The layer of cells lining the closed internal spaces of the body such as the blood vessels and lymphatic vessels.

**Engineering control**
controls (e.g., sharps disposal containers, self-sheathing needles) that isolate or remove the
bloodborne pathogens hazard from the workplace.

**Eosinophil**
An eosin (red) staining leukocyte with a nucleus that usually has two lobes connected by a slender thread of chromatin, and cytoplasm containing coarse, round granules that are uniform in size. See image

**Epidemiology**
The science concerned with the study of factors influencing the distribution of disease and their causes in a defined population to establish programs to prevent and control their development and spread.

**Epidermis**
The upper or outer layer of the two main layers of cells that make up the skin.

**Epithelium**
The outside layer of cells that covers all the free, open surfaces of the body including the skin, and mucous membranes that communicate with the outside of the body.

**Erythrocyte**
Cells that carry oxygen to all parts of the body. See: red blood cells.

**Etiology**
The cause or origin of a disease or disorder.

**Evacuated tube**
An often generic term used to describe equipment used to automatically aspirate blood from a vessel by venipuncture. The concept was first devised and produced by Becton Dickinson under the trademark, Evacuated tube.

**Evacuated Tube Holder**
A cylindrical shaped holder that accepts an Evacuated tube on one end and a Evacuated tube
needle on the other. The holder, tube and needle comprise the Evacuated tube System (see illustration), used to draw multiple tubes of blood with one venipuncture.

**Evacuated Tube Needle**

The needle used to attach to a Evacuated tube holder. The needle has a male thread on one end which screws into the holder. The threaded end also has a large gauge needle, enclosed by a rubber sheath. This needle will puncture the stopper of a Evacuated tube tube allowing blood to enter the tube. Upon withdrawal of this needle from the tube, the rubber sheath covers the needle bevel, stopping the flow of blood. Thus, any number of tubes may be drawn with only a single venipuncture.

**Evacuated Tube System**

The combination of a Evacuated tube holder, needle and sample tube which allows for a more automated method of drawing blood. When a multi-sample needle is used the system will allow for the aspiration of any number of sample tubes with only one venipuncture. (see Illustration)

**Evacuated tube**

Blood sample tubes containing a vacuum. When the tube stopper is pierced by a Evacuated tube needle which has been properly positioned in a vein, the vacuum draws blood into the tube.

**F**

**Factor VIII**

One of a number of coagulation (clotting) factors. Classic hemophilia (hemophilia A) is due to a congenital deficiency in the amount (or activity) of factor VIII. Factor VIII is also known as antihemophilic factor (AHF) or antihemophilic globulin (AHG). The gene for factor VIII (that for classic hemophilia) is on the X chromosome so females can be silent carriers without symptoms and males can be hemophiliacs.

**Faint**

See: syncope

**Fasting**

Without eating. A number of laboratory tests are performed on "fasting" blood specimens such as sugar (glucose) levels and tolerance tests such as glucose, lactose and dextrose. Specimens
are usually taken after overnight fasting.

**Fibrin**
The protein formed during normal blood clotting that is the essence of the clot.

**Fibrinogen**
The protein from which fibrin is formed/generated in normal blood clotting.

**Fistula**
An abnormal passageway usually between two internal organs. Such passages may be created experimentally for the purpose of obtaining body secretions for study. For example, see arteriovenous fistula.

**Flash-back**
Relative to venipunctures, the appearance of a small amount of blood in the neck of a syringe or the tubing of a butterfly. This is a sign that the vein has been properly accessed.

**Flexion**
The process of bending or the state of being bent. Flexion of the fingers results in a clenched fist.

**G**

**Gauge**
Needle diameter is measured by gauge; the larger the needle diameter, the smaller the gauge. For example, a very large diameter needle (16 ga.) may be used for hemodialysis, whereas a much smaller needle (23 ga.) would be used to draw blood for laboratory testing.

**Germicide**
An agent that kills pathogenic microorganisms
Glucose
The sugar measured in blood and urine specimens to determine the presence or absence of diabetes. Glucose is the end product of carbohydrate metabolism and is the chief source of energy for all living organisms.

Graft
An implant or transplant of any tissue or organ.

Harvesting
The collection and preservation of tissues or cells from a donor for the purpose of transplantation.

Hematocrit
The ratio of the total red blood cell volume to the total blood volume and expressed as a percentage.

Hematoma
A localized collection of blood within tissue due to leakage from the wall of a blood vessel, producing a bluish discoloration (ecchymosis) and pain.

Hemoconcentration
A decrease in the fluid content of the blood (plasma), resulting in an increase in concentration. This is determined by an increase in the hematocrit. Caused by a filtration of plasma into body tissues and often created by dehydration.

Hemodialysis
The removal of certain components of the blood by virtue of the difference in their rates of diffusion through a semipermeable membrane. A method often used for removing undesirable elements from the blood in kidney patients.
Hemoglobin
The oxygen carrying pigment of the red blood cells.

Hemolysis
The breaking of the red blood cells membrane releasing free hemoglobin into the circulating blood. In phlebotomy, this is usually the result of mechanical damage due to poor technique.

Hemostasis
The cessation of bleeding, either by vasoconstriction and coagulation or by surgical means.

Heparin
An anticoagulant that acts to inhibit a number of coagulation factors, especially factor Xa. Heparin is formed in the liver.

Hepatitis
Inflammation of the liver.

- **hepatitis A**: usually a self limited viral disease caused by the hepatitis A virus. Transmission is usually the result of poor hygiene and most often through the fecal-oral route. Most recently implicated in numerous outbreaks at restaurants where employee hygiene is suspect. Usual symptoms include mild flu-like distress and possible mild jaundice.
- **hepatitis B**: An acute form of hepatitis caused by hepatitis B virus. The virus is shed in body fluids of chronic and acute patients as well as asymptomatic carriers. Transmission is primarily by blood transfusions, needlestick injuries by health care workers and sharing of needles by drug abusers. It has also been known to be transferred from mother to neonate and by intimate sexual contact. Symptoms include fever, nausea, vomiting and jaundice. This is usually self-limiting but the range varies extensively.
- **hepatitis C**: Caused by hepatitis C virus, this is the most common for of hepatitis after blood transfusion. It is also the most prevalent form resulting from needle sharing by drug abusers and is occasionally implicated in health care worker involving parenteral transfer through needlesticks or scalpel injuries. Symptoms are generally mild and the disease may revert from acute to chronic in a large percentage of patients. Cirrhosis may occur.

Hickman catheter
A hollow silicone (soft, rubber-like material) tube inserted and secured into a large vein in the chest for long-term use to administer drugs or nutrients. The catheter is inserted through a small incision made near the collarbone. Medication, blood products, nutritional support, and new bone marrow can be delivered through the catheter.

**HIV**

See: Human Immunodeficiency Virus

**Human Immunodeficiency Virus**

The virus known to be responsible for producing Acquired Immunodeficiency Syndrome (AIDS).

**Humoral**

Pertaining to elements dissolved in blood or body fluids, e.g., humoral immunity from antibodies in the blood as opposed to cellular immunity.

**Hyperglycemia**

An abnormally high glucose in the blood.

**Hypersensitivity**

A state in which the body reacts with an exaggerated immune response to a foreign substance. Reactions are classified as delayed or immediate types.

**Hypodermic needle**

A needle that attaches to a syringe for the purpose of injections or withdrawal of fluids such as blood.

**Hypoglycemia**

An abnormally low glucose level in the blood.

ICD9 code
ICD9 codes describe medical or psychiatric procedures performed by physicians and other health providers. The ICD9 codes were developed by the Health Care Financing Administration (now CMS) to assist in the assignment of reimbursement amounts to providers by Medicare carriers. A growing number of managed care and other insurance companies, however, base their reimbursements on the ICD9 codes.

**Implant**

An object or material, such as tissue, partially or totally inserted or grafted into the body of a recipient.

**Invitro**

Outside the living body; inside a glass; observable in a test tube

**Invivo**

Inside the living body.

**K**

**Krebs Cycle**

See: Citric Acid Cycle

**L**

**Laminar flow hood**

Safety cabinets with air flow in such a direction as to carry any harmful materials or fumes away from the worker. A discussion of biological safety cabinets is provided in the CDC publication, "Biosafety in Microbiological and Biomedical Laboratories".

**Lancet**

A small pointed blade usually with two edges used for incising or puncturing.
Lateral
A position farther from the midline of the body or another reference structure.

Leukocyte
See: "white blood cells".

Lymph
Fluid found in lymphatic vessels and nodes derived from tissue fluids. Lymph is collected from all parts of the body and returned to the blood by the lymphatic system.

Lymphedema
Lymphedema is a type of swelling which occurs in lymphatic tissue when excess fluid collects in the arms or legs because the lymph nodes or vessels are blocked or removed. Regarding phlebotomy, this can be a major complication of mastectomies.

Lymphocyte
Any of the mononuclear, nonphagocytic leukocytes, found in the blood and lymph, which are the body's immunologically competent cells. Most are small, 7-10μ in diameter with a round or slightly indented nucleus that almost fills the cell with a thin rim of cytoplasm that may contain a few granules.

Lysosome
One of the minute particles seen with the electron microscope in many types of cells, containing various hydrolytic enzymes and normally involved in the process of localized digestion inside the cell.

Lytes
Short for "electrolytes".

Macrophage
Any of the many forms of mononuclear phagocytes found in tissues and originating from stem cells in the bone marrow. In normal circulation, the monocyte may be categorized as a macrophage.

**MCH - Mean Corpuscular Hemoglobin**

The average hemoglobin content in a red blood cell (erythrocyte), expressed in picograms/RBC. This is the average amount of hemoglobin per RBC. Calculation:

\[
MCH = (Hgb \times 10) \div RBC
\]

Where: Hgb = blood hemoglobin concentration (g/dL) RBC = Red cell count (millions/mL)

**MCHC - Mean Corpuscular Hemoglobin Concentration**

The average hemoglobin concentration in red blood cells (erythrocytes), expressed in "percent" (g/dL). This is the amount of hemoglobin relative to the size of the cell per RBC. Calculation:

\[
MCHC = Hgb \div Hct
\]

Where: Hgb = blood hemoglobin concentration (g/dL) Hct = hematocrit (%)

**MCV - Mean Corpuscular Volume**

Average volume of red blood cells (erythrocytes), expressed in cubic micrometers (μm3) or femtoliters. This is the average RBC size. Calculation:

\[
MCV = (Hct \div RBC) \times 10
\]

Where: Hct = hematocrit (%) RBC = Red cell count (millions/mL)

**Medial**

Pertaining to the middle aspect; closer to the midline of the body or structure.

**Microcapillary**

Referring to collection of blood specimens by puncturing capillaries, usually in the heel of infants or the fingers of children and adults. This procedure is limited to collection of very small quantities of sample.

**Monocyte**
A mononuclear, phagocytic leukocyte, 13-25μ in diameter, with an oval to kidney shaped nucleus, lacey chromatin and abundant gray-blue cytoplasm, sometimes containing fine reddish granule. See image.

**Mononuclear**
A cell containing but one nucleus. In blood circulation, monocyte and lymphocyte.

**Multi-sample adapter**
A device used with a butterfly and evacuated tube holder (see illustration) to allow for the withdrawal of multiple tubes of blood during a venipuncture.

**N**

**Negative air pressure**
Pressure less than that of atmosphere. For example, considering an isolation unit where the room air is under negative pressure, when the rooms door is open, air from outside the room is brought into the room which restricts any contaminated air from exiting.

**Neutrophil**
A polymorphonuclear granular leukocyte having a nucleus with 3-5 lobes connected by slender threads of chromatin, and cytoplasm containing fine inconspicuous granules. Neutrophils are the major phagocytes in the circulation.

**Nosocomial infection**
A hospital-borne infection. An infection whose origin is from within the hospital environment.

**O**

**Order of Draw**
Terminology used to define the order in which blood sample tubes should be drawn using a multi-sample technique such as the Evacuated tube System. Evacuated tube is a trademark of Becton Dickinson. For excellent educational materials provided by BD, go here.
Other Potentially Infectious Material (OPIM)
OPIM, as defined by the OSHA Bloodborne Pathogens Standards, means (1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Oxyhemoglobin
Hemoglobin that has been bound with oxygen in the lungs for the purpose of transport of oxygen to cells of the body. In the cells oxygen is exchanged for carbon dioxide (see carbamate hemoglobin).

P

Pallor
Paleness; decrease of absence of skin color.

Palmar
Referring to the palm surface or side of the hand

Palpate
To examine or feel by the hand. In relation to venipunctures, this technique is used to "feel" a vein which will tend to rebound when slight pressure is applied with the finger. The technique is used to help determine the size, depth and direction of a vein. In relation to arterial punctures, this technique is used to determine the position and depth of an artery.

Parafilm™
A thin film of paraffin used primarily in the laboratory to seal open containers such as test tubes.
**Pathogen**
Any microorganism that produces disease.

**Pathogenic**
Having the capability of producing disease.

**Peripheral blood**
Blood obtained from the circulation away from the heart, such as from the fingertip, heel pad, earlobe or from an antecubital vein.

**Peritoneal dialysis**
Dialysis through the peritoneum.

**Peritoneum**
The membrane lining the abdominal and pelvic wall.

**pH**
The symbol used to depict the hydrogen ion concentration of a solution, i.e. acidity. pH 7.0 is neutral; above 7.0 is alkaline, below is acid.

**Phagocytosis**
A phagocyte is any cell capable of ingesting particulate matter. The term usually refers to WBC's, specifically polymorphonuclear leukocytes, monocytes and macrophages in tissues. The particulate is taken into the cell in a membrane-bound vacuole called a phagosome. The phagosome combines with lysosomes within the cell cytoplasm forming phagolysosomes which then digest and destroy the particulate. (See illustration)

**Phlebitis**
Inflammation of a vein. The condition is marked by infiltration of the layers of the vein and the formation of a clot. It produces edema, stiffness and pain in the affected area.

**Phlebotomist**
One who practices phlebotomy
Phlebotomy
The incision of a vein as for blood letting (venesection); needle puncture of a vein for the purpose of drawing blood (venipuncture).

Pipet
A glass or transparent plastic tube used to accurately measure small amounts of liquid.

Plasma
The fluid portion of the blood in which the cellular components are suspended. Plasma contains coagulation factors used in the clotting of blood as opposed to serum.

Platelet
Also known as a thrombocyte, this is a particulate component of the blood, approximately 2-4 microns in diameter and known for its involvement in blood coagulation. This structure, which has no nucleus or DNA, is formed by breaking off from the cytoplasm of the parent cell, known as a megakaryocyte in the bone marrow. Under normal conditions, platelets will aggregate at the site of a break in vascular integrity, forming the beginning stages of a clot. Normal platelet counts range from 150,000-450,000/cm3.

Plateletpheresis
The selective separation and removal of platelets from withdrawn blood. The remainder of the blood is re-transfused back into the donor. Also: thrombapheresis and thrombocytapheresis.

Polymorphonuclear
A white blood cell with a nucleus so deeply lobed so as to appear to have multiple nuclei. Leukocytes so categorized include neutrophils, and to a lesser degree, eosinophils and basophils.

Posterior
Situated at the back (dorsal) part of a structure.

Povidone-iodine
Used as a topical antiseptic, this is a compound made by reacting iodine with povidone which slowly releases iodine. As related to phlebotomy, povidone-iodine is routinely used as the antiseptic of choice for blood cultures, bleeding times and for patients with allergies to alcohol. BetadineT.

**Prone**
Lying face down; opposed to supine.

**Prophylaxis**
A preventative treatment.

**Protoplasm**
The viscid, translucent fluid that makes up the essential material of all plant and animal cells. The protoplasm surrounding the nucleus is called cytoplasm and that composing the nucleus is nucleoplasm.

**Proximal**
Nearest to any other point of reference.

**Q**

**QNS**
"Quantity Not Sufficient"

**R**

**Red blood cell (RBC)**
One of the solid components of the blood which is normally a biconcave disc with no nucleus. This is the component of the blood that contains hemoglobin which is responsible for oxygen and carbon dioxide exchange. A red cell count is performed as part of a complete blood count and ranges from 4,500,000-5,000,000 RBC’s per cubic millimeter.
Red Blood Cell Indices

See:
- mean corpuscular hemoglobin (MCH)
- mean corpuscular volume (MCV)
- mean corpuscular hemoglobin concentration (MCHC)

Reverse isolation
An isolation procedure designed to protect the patient from contracting disease. Frequently used for transplant patients or for patients whose immune response has been greatly reduced.

Rh System
The most complex of all human blood groups and is responsible for serious hemolytic disease of the newborn.

S
ded

Sclerosis
A hardening, especially from inflammation and certain disease states. Though sclerosis may occur in many areas of the body, the term is most often associated with blood vessels.

Semipermeable
Permitting the passage of certain molecules and hindering others.

Serum
Referring to blood, the clear liquid portion of blood that separates out after clotting has taken place. Since clotting has occurred, serum is fibrinogen deficient. Contrast to plasma.

Standard Precautions
The most important of two categories of precautions under new CDC recommendations to replace the current "Universal Precautions" guidelines. These precautions are designed for the
care of all patients in hospitals regardless of their diagnosis or presumed infection status and is the primary strategy for successful nosocomial infection control. Compare to "Transmission-Based Precautions". Go directly to the CDC for the complete recommendation.

Stat
Abbreviation for the Latin word statim, meaning immediately.

Supine
Lying down with the face up; opposed to prone.

Syncope (vasovagal syncope)
Fainting; a temporary loss of consciousness due to a reduction of blood to the brain. For a much more in-depth explanation go here.

Syringe
An instrument used to inject fluids into or aspirate fluids from any vessel or cavity. A syringe generally consists of two parts, the barrel and the plunger and works much as the piston of an automobile. As the plunger is pulled up a negative pressure is created which draws fluids up into the barrel; if the plunger is pushed down a positive pressure is exerted and any fluid in the barrel is expelled. A hypodermic needle is normally affixed to the end of the syringe for injections and a butterfly for a venipuncture. The use of a syringe and straight hypodermic needle for phlebotomy is no longer considered an acceptable procedure.

Therapeutic
Pertaining to results obtained through treatment; having medicinal or healing properties; a healing agent.

Thrombocytopenia
Decrease in the number of blood platelets below normal values.

Thrombosis
The formation of a blood clot (thrombus) within a vessel.
Thrombus
A blood clot obstructing a blood vessel or a cavity of the heart. Heparin and CoumadinTM are being used to assist in dissolving or preventing clot formations.

Tourniquet
In regards to venipuncture, a constrictive band, placed over an extremity to distend veins for the purpose of blood aspiration or intravenous injections. Materials used may be rubber, latex or other synthetic elastic material. A blood pressure cuff may also be used.

Transmission-Based Precautions
A new category of precautions as proposed by the CDC to replace the current "Universal Precautions". This category is used for patients known or suspected to be infected or colonized with epidemiologically important pathogens that can be transmitted by airborne or droplet transmission or by contact with dry skin or contaminated surfaces. Compare to "Standard Precautions".

Transplant
An organ or tissue taken from the body for grafting into another part of the same body or into another individual. SYN: graft

Universal (Standard) Precautions
A set of procedures and protocols designed to protect the healthcare worker which uses the basic concept that each patient must be treated as though they were infected with an infectious disease such as AIDS or hepatitis. See the section "Infection Control" in this site for further details.

Vacuole
Any small space of cavity formed in the protoplasm of a cell.

**Vascular**

Pertaining to or composed of blood vessels. The vascular system is composed of the heart, blood vessels, lymphatics and their parts considered collectively.

**Vascular graft**

Type of an arteriovenous fistula consisting of either a venous autograft or synthetic tube which is grafted to the artery and vein.

**Vasoconstriction**

Decrease in the inside diameter of especially arterioles leading to a decrease in blood flow to a part.

**Vasovagal response**

A transient vascular and neurogenic reaction marked by pallor, nausea, sweating, slowing heart rate and a rapid fall in arterial blood pressure which may result in loss of consciousness. It is most often the result of emotional stress associated with pain or fear. SYN: vasovagal syncope, vasovagal attack, vasodepressor syncope.

**Vein**

Blood vessels carrying blood to the heart. Blood contained within these vessels is generally bound with carbon dioxide which will be exchanged for oxygen in the lungs. The presence of carbon dioxide and the absence of oxygen accounts for the dark red appearance of the blood in venous circulation. The only exception to this is the pulmonary vein which is the vein returning to the heart from the lungs, this time with oxygenated blood (no carbon dioxide).

**Venesection**

Opening of a vein for the purpose of collecting blood. SYN: Blood letting

**Venipuncture**

The puncture of a vein for any purpose
Venous
Pertaining to the veins, or blood passing through them.

Ventral
Pertaining to the front side of the body. SYN: anterior

Venule
A very tiny vein, continuous with the capillaries. Compare with arteriole.

Volar
Pertaining to the palm or sole; indicating the flexor portion of the forearm, wrist or hand.

Warfarin sodium
The sodium salt of warfarin, one of the synthetic anticoagulants. CoumadinTM.

White blood cell
Also leukocyte. A variety of cells within the blood and bone marrow whose general purpose is to help in fighting infection. Each type is differentiated by use of a stained preparation (see differential) and is separated based on how the cells and their components take up the stain. The five general cells thus distinguished are neutrophils, lymphocytes, monocytes, basophils and eosinophils all of which are nucleated cells.

Whole blood
Blood from which none of the elements have been removed. It is usually referred to as that blood, collected from a donor and anticoagulated for the purpose of blood replenishment for a recipient.

White blood cell count
The number of white blood cells (leukocytes) found in the peripheral blood and measured per cubic millimeter. See also complete blood count.
Appendix C: Hepatitis

Hepatitis is a disease or condition marked by inflammation of the liver. There are several variations of the virus, but the most common forms of viral hepatitis are Hepatitis A, Hepatitis B, Hepatitis C, and Hepatitis D. Three of the variations are major concerns for healthcare workers:

- Hepatitis A
- Hepatitis B
- Hepatitis C

Hepatitis A

Hepatitis A virus, also known as HAV, can affect anyone. It is a liver disease caused by the hepatitis A virus. It is still considered a common disease in the United States. Young children can be infected with the virus but not show the symptoms. These children often spread the virus to older children and adults.

HAV is found in the stool (feces) of persons with hepatitis A. It is spread from person to person by putting anything in the mouth that has been contaminated with the stool of a person with hepatitis A. The virus can easily spread in areas where there is poor sanitation or poor personal hygiene.

In addition to getting HAV directly from infected people, you can get it by:

- Eating fruits, vegetables, or other food that may have become contaminated during handling
- Eating raw shellfish harvested from sewage-contaminated water
- Swallowing contaminated water or ice
- Persons with HAV can spread the virus to household members or to sexual partners. Casual contact as in the usual office, factory or school setting, does not spread the virus.

Who is more likely to get Hepatitis A?

- Persons who share a household or have sexual contact with someone who has
HAV

- Men who have sexual intercourse with men
- Persons who use street drugs
- Children and employees in child care centers (especially centers that have children in diapers) where a child or an employee has HAV
- Travelers to countries where HAV is common
- Persons with clotting factor disorders who receive factor concentrates
- Residents and staff of institutions for developmentally disabled persons when a resident or employee has HAV
- Workers who handle HAV-infected animals or work with HAV in a research laboratory setting

**Symptoms of HAV**

Children who are infected often have no symptoms. Three of every four adults who get HAV have symptoms. Symptoms usually develop over a period of several days.

Symptoms may include:

- Yellow eyes
- Dark urine
- Nausea
- Fever
- Tiredness
- Loss of appetite
- Stomach ache
- Vomiting

A person can spread HAV about one week before symptoms appear and during the first week of symptoms. Persons with no symptoms can still spread the virus. This often happens with young children who unknowingly spread HAV to older children and adults.

HAV usually does not cause death. There is no chronic (long-lasting) infection with HAV. Recovering from the disease produces lifelong immunity from future HAV infection. Once a person recovers from Hepatitis A, they will never get it again.
How to Prevent HAV

Good personal hygiene and proper sanitation can help prevent HAV. Always wash your hands after using the bathroom, changing a diaper, or before preparing or eating food. Vaccines are also available for long-term prevention of Hepatitis A virus infection in person 2 years of age and older. You will either need two shots of Hepatitis A vaccine or three shots of the combination Hepatitis A and Hepatitis B vaccine. After getting your first shot, your doctor or nurse will tell you when to return for the second shot. Immune globulin (IG) is available for short-term prevention of HAV infection in all ages. IG might be used for short-term protection in two situations:

- For travelers instead of, or in addition to Hepatitis A vaccine
- For unvaccinated persons, who have recently been exposed to HAV IG must be given within two weeks of exposure to HAV in order to work.

Who Should Receive Hepatitis A Vaccine?

- Children in states and countries with consistently increased rates of HAV (county and state health departments can tell you whether your areas have these higher HAV rates)
- Men who have sexual intercourse with men
- Persons use street drugs
- Persons who work in or travel to countries where infection with HAV is common (for the most protection, first dose should be given at least 4 weeks before travel)
- Persons with chronic liver disease
- Persons with clotting factor disorders, such as hemophilia
- Persons who work with HAV-infected animals or work with HAV in a research setting

Hepatitis B

Hepatitis B, also known as HBV, is a serious disease caused by the Hepatitis B virus. It
can cause lifelong infection, cirrhosis (scarring) of the liver, liver cancer, liver failure, and death.

HBV is an infection of the liver. It cannot be cured. However, there is a Hepatitis B vaccine available for all age groups to prevent HBV infection. There are also promising new treatments available for those who have developed chronic Hepatitis B infections.

Hepatitis B is the most common serious liver infection in the world. It is transmitted through blood and infected bodily fluids. HBV is 100 times more infectious than the AIDS virus, yet it can be prevented with a safe and effective vaccine. For the 400 million people worldwide who are already chronically infected with HBV, the vaccine is of no use.

Currently, 2 billion people have been infected (1 out of 3 people) worldwide. 400 million people are chronically infected, and 10 – 30 million people will become infected each year. An estimated 1 million people die each year from HBV and its complications. Approximately 2 people die each minute from Hepatitis B. As for those in the healthcare field, approximately 1 healthcare worker, in America, dies each day from HBV.

A simple blood test can determine whether a person has been infected with the virus or not.

How HBV is Spread

HBV is transmitted through blood and infected bodily fluids. This can occur through:

- Having unprotected sexual intercourse with someone who has the virus
- Sharing needles or drugs
- Needle sticks or sharps exposures on the job
- Sharing earrings, razors, nail clippers, or toothbrushes
- By piercing your body or getting a tattoo or through acupuncture when infected tools are used
- Touching infected blood or bodily fluids
- From an infected mother to her infant during the delivery process

HBV is not transmitted casually. It cannot be spread through sneezing, coughing, hugging or eating food prepared by someone who is infected with HBV. Everyone is at some risk for Hepatitis B infection, but some groups are at higher risk because of their occupation or life choices.
Who is more likely to get Hepatitis B?

- Healthcare workers and emergency personnel
- Infants born to mothers who are infected at the time of delivery
- Partners or individuals living in close household contact with an infected person
- Individuals with multiple sex partners, past or present
- Individuals who have been diagnosed with a sexually transmitted disease
- Illicit drug users (injecting, inhaling, snorting, popping pills)
- Men who have sexual intercourse with men
- Individuals who received a blood transfusion prior to 1992
- Individuals who get tattoos or body piercing
- Individuals who travel to countries where HBV is common (Asia, Africa, South America, the Pacific Islands, Eastern Europe, and the Middle East)
- Individuals emigrating from countries where HBV is common, or born to parents who emigrated from these countries (see above)
- Families adopting children from countries where HBV is common (see above)
- Individuals with early kidney disease or undergoing kidney dialysis
- Individuals who use blood products for medical conditions (i.e. hemophilia)
- Residents and staff of correctional facilities and group homes

Symptoms of HBV

People can have HBV without experiencing any symptoms. This is why it is called a “silent infection”. About 69% of infected people do not have noticeable symptoms when they are first infected. They may feel fine, or they may just feel like they have the flu. Even if there are no signs, HBV can be spread to others.

Symptoms include:

- Yellow skin or eyes
- Loss of appetite
- Tiredness
- Dark urine
- Light or gray stool
- Fever
- Mild nausea
- Vomiting
- May experience pain in the stomach or abdomen, muscles, and joints
- Bloated or swollen stomach

**Long Term Effects**

Though there is no cure for HBV, it can go away on its own, in some people. There is also medicine available that can help the liver of people who have chronic hepatitis. Long term effects include:

- The virus can be spread
- A higher chance of getting HIV (the virus that causes AIDS)
- Chronic hepatitis can badly damage the liver. It can lead to cancer and even death.

If a woman has HBV while she is pregnant, she should tell her doctor immediately. The virus can be spread to the infant. If this is the case, then the baby will need special treatment immediately after birth.

Most healthy adults (90%) who are infected with HBV will recover and develop protective antibodies against future Hepatitis B infections. A small number (5 – 10%) will be unable to get rid of the virus and will develop chronic infections. Unfortunately, this is not true for infants and young children – 90% of infants and up to 50% of young children infected with Hepatitis B will develop chronic infections. Therefore, vaccination is essential to protect infants and children.

**Treating HBV**

Treatment for HBV is customized to the infected individual by their physician. The infected person should inform their partner(s) and anyone they live with that they have HBV. Their partner(s) and/or people living with them will need to get the vaccine.

**Acute vs. Chronic Hepatitis B**

When a person is first infected with HBV, it is called an “acute infection”. A person may not have any symptoms or they could become seriously ill. Most adults will recover and get rid of the virus without any problems. If the virus remains in the blood for more than six months, then a person is diagnosed as having a “chronic infection”.
FYI: What is Hepatitis D?

Hepatitis D, also known as HDV Co-infection, is a type of viral hepatitis caused by the Hepatitis D virus (HDV), which needs the Hepatitis B virus to exist. Only people who are already infected with HBV can be infected with HDV.

HDV Co-infection occurs simultaneously when first infected with the Hepatitis B virus.

HDV Super-infection occurs in persons with an existing chronic Hepatitis B infection.

A co-infection may result in a more severe acute disease and a higher risk (2% - 20%) of developing acute liver failure compared with those infected with HBV alone.

HDV – HBV Super-infection

Chronic HBV carriers who acquire HDV super-infections usually develop chronic HDV infection, as well. Progression to cirrhosis is believed to be more common with HDV – HBV chronic infections. Transmission occurs in the same way as HBV. The only way to prevent HDV is to prevent HBV. There is really no effective treatment for HDV. For an acute HDV infection, only supportive care for symptoms can be provided. For a chronic HDV infection, some doctors may try interferon- alpha, but this may only slow disease progression. Ultimately, a liver transplant may be required.

Hepatitis E

Hepatitis E is transmitted in much the same way as Hepatitis A, primarily through contaminated water. However, HEV does not occur in the United States frequently. Signs and symptoms are the same as HAV. There is no vaccine. There is no chronic (long-term) infection.

Hepatitis C

Hepatitis C (HCV) is another hepatitis virus. Like all forms of hepatitis, it attacks the liver. 80% of infected persons have no signs or symptoms. The number of new infections per year has declined from an average of 240,000 in the 1980’s to about 30,000 in 2003. Most infections are due to illegal injection drug use. An estimated 3.9 million Americans have been infected with HCV, of whom 2.7 million are chronically infected.

Symptoms Include:
- Jaundice (Yellow skin)
- Fatigue (Feeling tired)
- Dark urine
- Abdominal pain
- Loss of appetite
- Nausea

Long Term Effects
Chronic infection occurs in 55% - 85% of infected persons. 70% of chronically infected persons experience chronic liver disease. 1% - 5% of infected persons may die from chronic liver disease. HCV is the nation’s leading indication for liver transplant.

How HCV is spread
Hepatitis C virus is a blood borne pathogen, much like Hepatitis B. This means the virus is spread when blood from an infected person enters the body of a person who is not infected. This can occur through:
- Having unprotected sexual intercourse with someone who has the virus
- Sharing needles or drugs
- Needle sticks or sharps exposures on the job
- Sharing earrings, razors, nail clippers, or toothbrushes
- By piercing your body or getting a tattoo or through acupuncture when infected tools are used
- Touching infected blood or bodily fluids
- From an infected mother to her infant during the delivery process

Who is more likely to get Hepatitis C?
- Injecting drug users
- Recipients of clotting factors made before 1987
- Hemodialysis patients
- Recipients of blood and/or solid organs before 1992 TM People with undiagnosed liver problems
- Infants born to infected mothers
- Healthcare/public safety workers
- People having sex with multiple partners
People having sex with an infected steady partner
People at risk for HCV infection might also be at risk for infection with HBV or HIV

How to Prevent HCV
Currently, there is no vaccine to prevent or to cure Hepatitis C. The best way to avoid contracting HCV and to prevent the spread of the virus is to:

- Do not shoot drugs; if you do shoot drugs, stop and get into a treatment program; if you can’t stop, never share needles, syringes, water, or “works”, and get vaccinated against Hepatitis A & B.
- Do not share personal care items that might have blood on them (razors, toothbrushes, etc.).
- If you are a healthcare or public safety worker, always follow routine barrier precautions and safely handle needles and other sharps; get vaccinated against Hepatitis B.
- Consider the risks if you are thinking about getting a tattoo or body piercing. You might get infected if the tools have someone else’s blood on them or the artist or piercer does not follow good health practices.
- HCV can be spread by sexual intercourse, but this is rare. If you are having sex with more than one steady partner, use condoms correctly and every time to prevent the spread of sexually transmitted diseases. You should also get vaccinated against Hepatitis B.
- If you are HCV positive, do not donate blood, organs, or tissue.

Treating HCV
Hepatitis C positive persons should be evaluated by their doctor for liver disease. Interferon and ribavirin are two drugs licensed for the treatment of persons with chronic Hepatitis C. Interferon can be taken alone or in combination with ribavirin. Combination therapy, using pegylated interferon and ribavirin, is currently the treatment of choice. Combination therapy can get rid of the virus in up to 5 out of 10 persons for genotype 1 and in up to 8 out of 10 persons for genotype 2 and 3. Drinking alcohol can make your liver disease worse.
Appendix D: Glove Removal
Step 1: First, make a fist with your thumb inside.

Step 2: Next, pinch close to the rim. Make sure you do not actually pinch the rim of the glove, as you may come into contact with your skin!
References


McCall, Ruth E. amd Tanskeresley, Cathee M. Phlebotomy Exam Review. Lippincott Williams & Wilkins.

CLSI. Tubes and Additives for Venous Blood Specimen Collection.

Helpful Sites:

http://www.hhs.gov/ocr/hipaa
http://www.cms.hhs.gov/clia
http://www.CLSI.org
Practice Exams

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