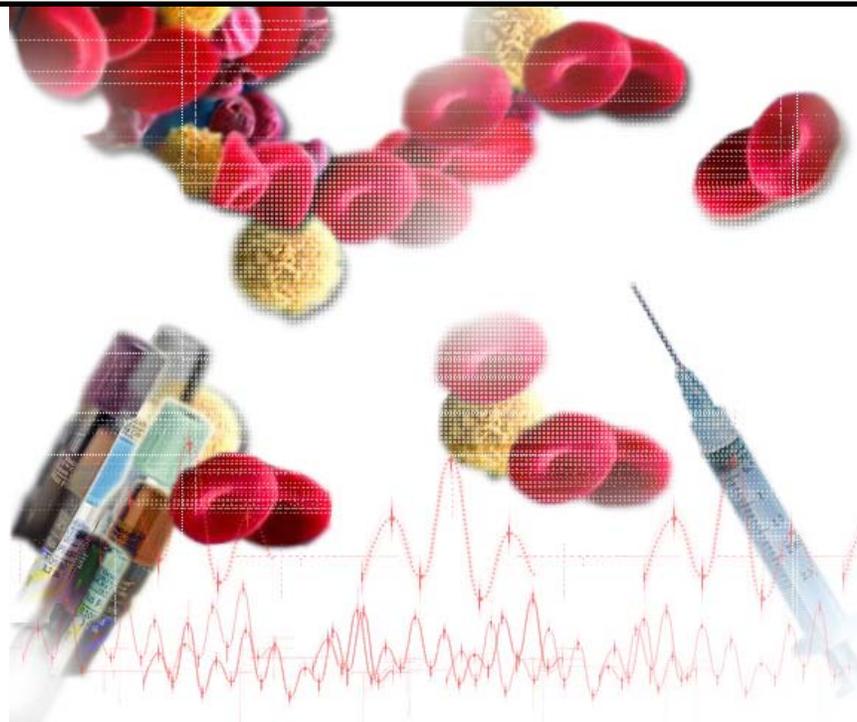




Medtexx Medical Corporation

***Fundamentals
Of
Phlebotomy***



Second Edition



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Table of Contents

Phlebotomy: The Historical Perspective	4
History	4
Devices Used for Drawing Blood	5
Universal Precautions & Biosafety Techniques	7
Infection Prevention	8
Human Anatomy & Physiology	10
Skin Layers	10
General Structure: Arteries and Veins	14
The Tourniquet	20
Assembling the Equipment	22
Blood Collection: Routine Venipuncture & Specimen Handling	24
Venipuncture Procedure	24
Order Form/Requisition Form	25
Labeling the Sample	27
Equipment	27
Order of Draw	28
Venipuncture Site Selection	31
Performance of a Venipuncture	31
Troubleshooting	33
Performance of a Fingerstick	39
Blood Collection on Infants	40
Additional Considerations	41
Safety & Infection Control	42
Possible Complications from Phlebotomy	43
Problems Obtaining a Specimen	43
Patient Complications	43
Blood: Samples & Collection	45
Types of Blood Samples	45
Collection Tubes	45
<i>Special Procedures</i>	53
Crossmatches	53
Blood Culture	54

PHLEBOTOMY

Oral Glucose Tolerance Test (GTT)	55
General Collection Requirements	56
Special Collection Techniques	59
Collecting a Blood Sample Using a Butterfly Needle Syringe	60
Drawing Blood Using a Lancet for Microdraw or Infant Heel Stick	62
Measured Bleeding Time	63
<u>Arterial Puncture</u>	<u>65</u>
<u>Glossary</u>	<u>69</u>
<u>Resources</u>	<u>96</u>
<u>Appendix A: Order of Draw for Multiple Tubes</u>	<u>i</u>
<u>Appendix B: Sample Requisition Form</u>	<u>ii</u>
<u>Appendix C: Hepatitis Overview</u>	<u>iii</u>
<u>Appendix D: Proper Glove Removal</u>	<u>xi</u>

PHLEBOTOMY: THE HISTORICAL PERSPECTIVE

Objective

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.

Devices Used for Drawing Blood

A variety of devices were used to draw blood,

- *Lancet* – The lancet was first used before 5th century B.C. the practitioner manually perforated the vein. Many shallow cuts were sometimes made.
- *Spring-Loaded Lancet* – Came into use during the early 18th century. The device was cocked and a “trigger” fired the spring-driven blade into the vein.
- *The Fleam* – Used during the 18th century. Many varieties existed. Sometimes a wooden “fleam stick” was used to hit the back of the blade and drive it into the vein.
- *Scarificator* – The scarificator, a series of twelve blades, was also in vogue during the 18th century. The device was cocked and the trigger released spring-driven rotary blades that caused many shallow cuts. The scarificator seems more merciful than other bloodletting instruments. Blood was caught in shallow bowls.
- *Flint Cup* – During the 17th to 19th centuries, blood was also captured in small flint cups. Heated air inside the cup created a vacuum causing blood to flow into the cup, a handy technique for drawing blood from a localized area. This practice was called ‘cupping’.
- *Leeches* – (*Hirudo medicinalis*); Leeches were “enticed” by “leeches” to attach themselves to the skin. The area was chosen and a drop of milk or blood was the bait. Once the leech was engorged, it was allowed to drop off. In the early 1800’s, the little animal became quite scarce, and leech farms were having difficulty keeping up with the demand. Therefore, they became quite expensive.

With this fascination came the need to “see” the components of the body fluids.

“Antony van Leeuwenhoek (1632-1723)” was an unlikely scientist. A tradesman of Delft, Holland, he came from a family of tradesmen, had no fortune, received no higher education or university degrees, and knew no languages other than his native Dutch. This would have been enough to exclude him from the scientific community of his time completely. Yet with skill, diligence, an endless curiosity, and an open mind free of the scientific dogma of his day, Leeuwenhoek succeeded in making some of the most important discoveries in the history of biology. It was he who discovered bacteria, free-living and parasitic microscopic protists, sperm cells, blood cells, microscopic nematodes and rotifers, and much more. His researches, which were widely circulated, opened up an entire world of microscopic life to the awareness of scientists.

Leeuwenhoek is known to have made over 500 "microscopes," of which fewer than ten have survived to the present day. In basic design, probably all of Leeuwenhoek's instruments -- certainly all the ones that are known -- were simply powerful magnifying glasses, not compound microscopes of the type used today. A drawing of one of Leeuwenhoek's "microscopes" is shown at the left. Compared to modern microscopes, it

PHLEBOTOMY

is an extremely simple device, using only one lens, mounted in a tiny hole in the brass plate that makes up the body of the instrument. The specimen was mounted on the sharp point that sticks up in front of the lens, and its position and focus could be adjusted by turning the two screws. The entire instrument was only 3-4 inches long, and had to be held up close to the eye; it required good lighting and great patience to use.

It is open to debate when blood first began to be examined for diagnostic purposes. It is known that other body fluids have been examined since medieval times.

The invention of the microscope in the 17th century, coupled with advances in physiologic chemistry and cellular physiology on the 19th century, paved the way for the examination of blood as a diagnostic tool.

UNIVERSAL PRECAUTIONS AND BIOSAFETY TECHNIQUES

1. Assume **ALL** human blood, plasma, serum, body fluids (semen, saliva, tears, cerebrospinal and amniotic fluid, milk and cervical secretions) and tissues to be contaminated with **Human Immunodeficiency Virus (HIV)** and/or **Hepatitis Viruses (e.g., HBV)**. Handle them with appropriate care!
2. Gain knowledge - Be prepared:
 - Personnel should understand their risk categorization (per Depts. of Labor and Health and Human Services) **before** initiating work: **Category I:** Personnel routinely handle blood, body fluids and issues. **Category II:** Personnel occasionally handle or work around such materials. **Category III:** Personnel never work with or around such materials.
 - Be familiar with the CDC/NIH Manual "**Biosafety** in Microbiological and Biomedical
 - Laboratories' view **biosafety** videos and are familiar with the company's **Biosafety** Manuals. Ask your supervisor to explain any procedures or concepts not clear to you **before** beginning work.
 - Category I and II personnel should get the new, safe and effective Hepatitis B vaccination.
3. Remember: The most susceptible route of laboratory infection for **HIV** and **HBV** is by accidental needle sticks, contamination of the mucous membranes, or through broken, abraded or irritated skin. Use appropriate caution and maximum protection to prevent such contact.
4. Avoid spilling, splashing or open aerosolization of human blood or body fluids. Wear latex gloves, protective lab garments and face and eye shields when handling human materials.
5. Understand the principles of good microbiological practice **before** working with biohazardous materials. Examples include use of aseptic technique, proper decontamination procedures, emergency biohazard spill management and proper use of **biosafety** equipment. Develop proficiency **before** beginning work.
6. Use **Biosafety Level-2** work practices, containment and laboratories when handling human materials where droplet and aerosol production are likely. Avoid aerosol-generating activities in handling human materials. When such procedures are necessary, use **biosafety** cabinets or other containment and personal protective equipment.
7. When culturing or manipulating known **HIV** or **HBV**, use **Biosafety Level-3 (BL-3)** procedures. Any procedure which requires concentration of **HIV** or **HBV** or other human viruses from human materials should be handled under **BL-3** containment and handling conditions. Use appropriate **biosafety** level conditions (**BL-2 or BL-3**) when handling non-human primates and other animals inoculated with human pathogenic materials.
8. Dispose of human and animal biohazardous waste or materials contaminated with them in accordance with CDC/NIH **biosafety** and institutional guidelines.
9. Decontaminate laboratory protective garments, gloves and protective equipment to render them non-infectious.
10. Clean all work areas and equipment used in handling human biohazardous materials with proven disinfectant (e.g., 1:10 dilution of Clorox) when concluding work to protect personnel from accidental infection.

PHLEBOTOMY

11. Assume that human serological and biological reagents (e.g., antibody, antigen or antisera) used in the laboratory are contaminated with *HIV* or other viruses and handle them accordingly.
12. Understand your institution's medical surveillance program and be familiar with the appropriate standard operating procedures for accidental exposure to human materials. Specific measures must be followed as per CDC/NIH Guidelines in the **Universal Precautions**. The specimens involved must be identified and tested for *HIV* and *HBV* and the procedures followed.
13. Report **every** accident to your supervisor and Occupational Medical Service personnel.
14. Responsibility for instituting, training and monitoring of **biosafety** practices in laboratories handling human materials, *HIV* or *HBV* rests with the **Laboratory Director** or the designated **Principal Investigator (PI)**. These individuals **must** categorize positions; provide facilities, **biosafety** equipment, **biosafety** procedures and training to employees accepting such work assignments to permit the safe conduct of the work. These responsible individuals **must** ascertain the proficiency of the employee in performing the assigned task **before** permitting the work to begin.
15. Laboratory personnel have a clear responsibility to fully understand and consistently adhere to the **biosafety** practices detailed in the **Biosafety** and General Safety Manuals as well as to the **biosafety** guidelines detailed here and by the CDC and NIH. Responsibility for conscious or thoughtless non-compliance with or violation of these guidelines falls on the laboratory worker.

Note: Hand Washing Technique for Skin Exposure to Blood or body Fluids

1. Wash with a good liquid antimicrobial detergent soap.
2. Rinse well with water.
3. Apply solution of 50% isopropyl or ethyl alcohol.
4. Wash again with the liquid soap and rinse well.

INFECTION PREVENTION

Approximately 100% of the infectious agents found in the clinical laboratory are spread by either airborne (inhalation) or contact transmission. Proper hand washing and strict adherence to Universal Precautions, body substance isolation and general safety will minimize the risk of infection. Infectious disease agents are most often transmitted in one of four methods.

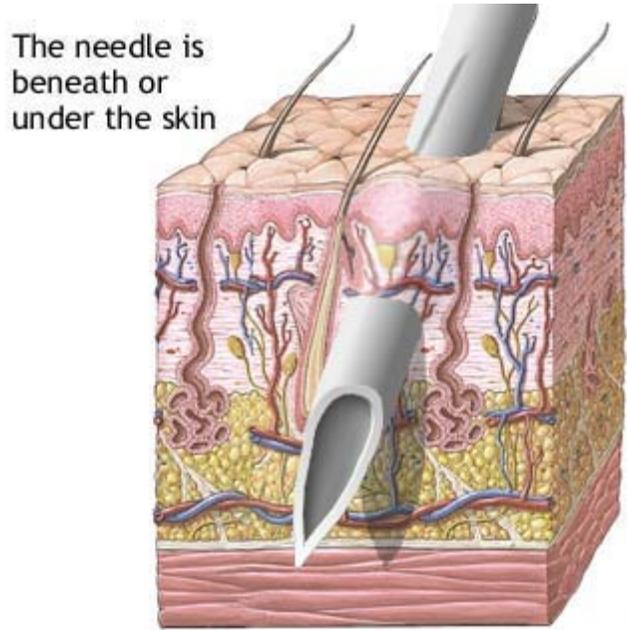
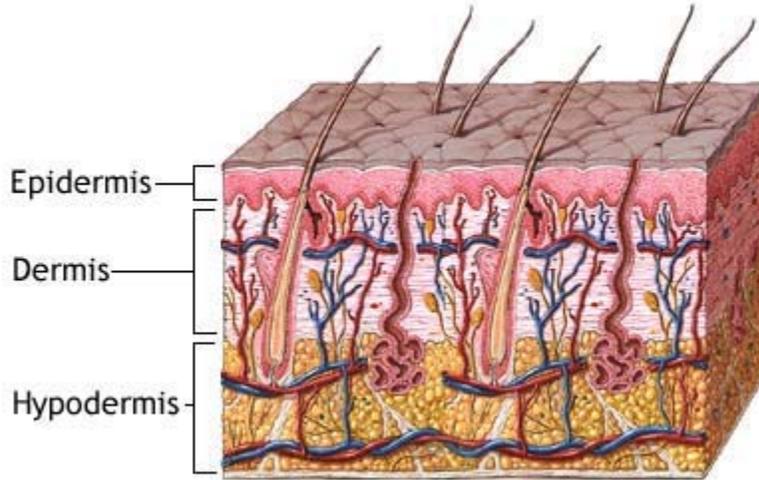
1. **Airborne or inhalation transmission.** A susceptible individual inhales droplets of particles of dust containing infectious agents. It is in this manner that streptococcal sore throat, respiratory viruses, and pulmonary tuberculosis can be contracted. Example: coughing, sneezing, centrifugation and the “popping” of specimen container tops are responsible for droplet formation.
2. **Contact Transmission.** May be direct or indirect. In direct contact, the causative agent is passed from one individual directly to another. Infections with sexually

transmitted diseases, including HIV are examples, of direct contact. Hand contact, such as shaking hands with an infected person is also thought to be one of the ways that respiratory virus infections are spread. It is also possible to be infected by contact with an inanimate object (blood collection tubes etc.). Either accidental needle sticks or by the sharing of needles by drug users are other examples. A person may be indirectly exposed by receiving blood infected with Hepatitis C or HIV.

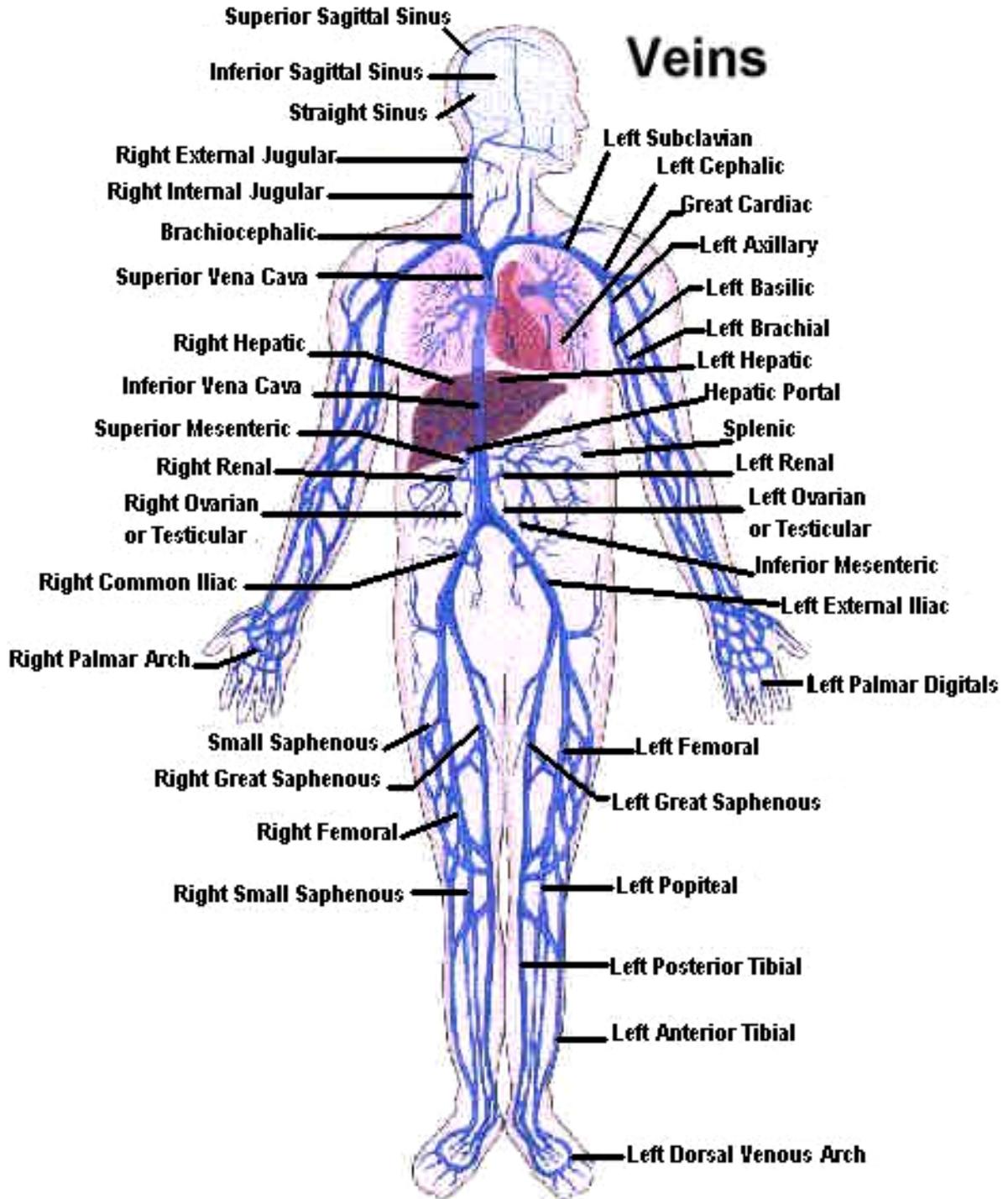
3. **Ingestion Transmission.** Food or water containing pathogenic organisms is ingested. Salmonellosis and Hepatitis A are examples.
4. **Vector Borne.** A vector or arthropod (mosquitoes, ticks etc.) are capable of transferring pathogens and resulting in malaria and encephalitis or Lyme disease, respectively.

HUMAN ANATOMY AND PHYSIOLOGY

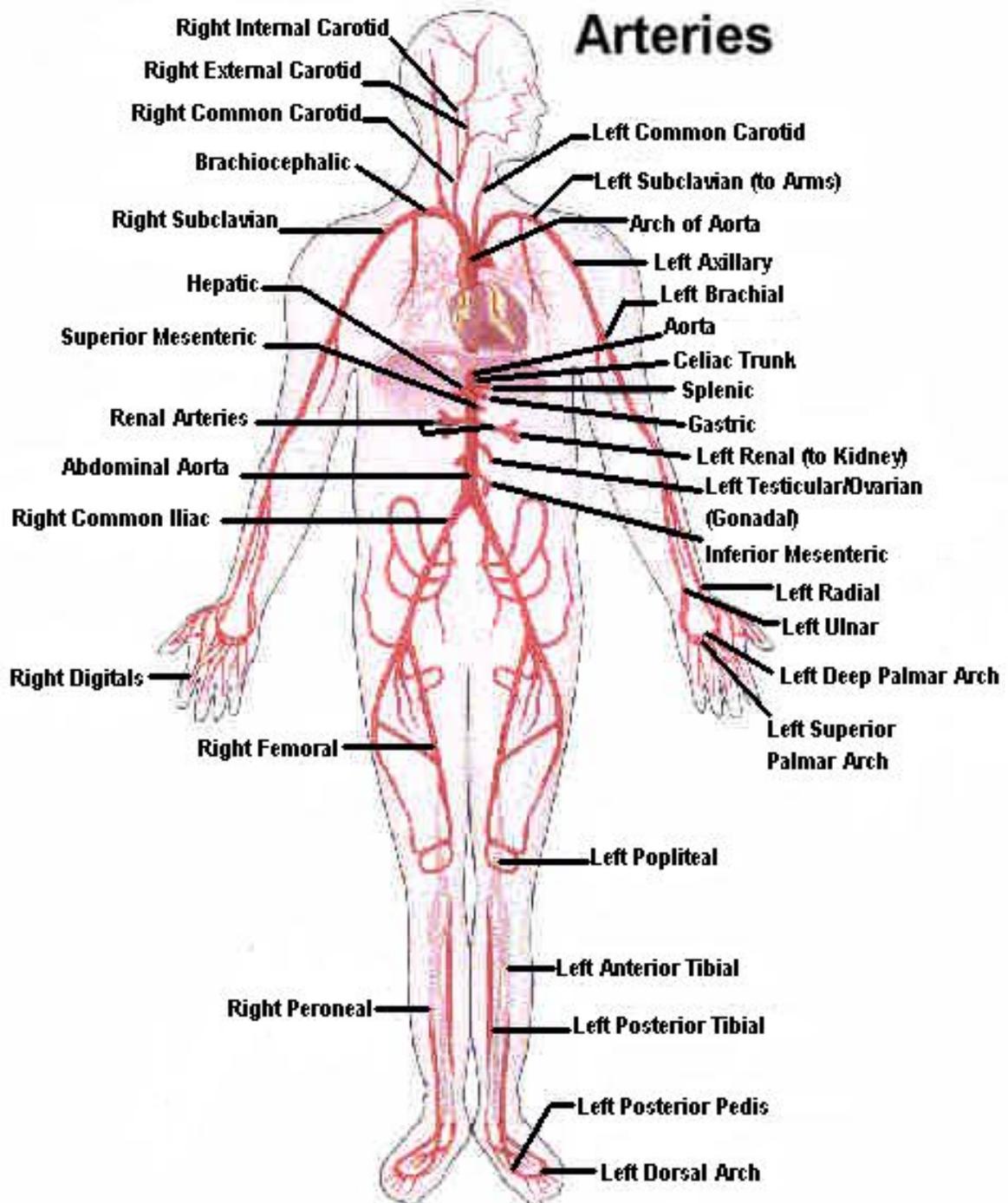
Skin Layers



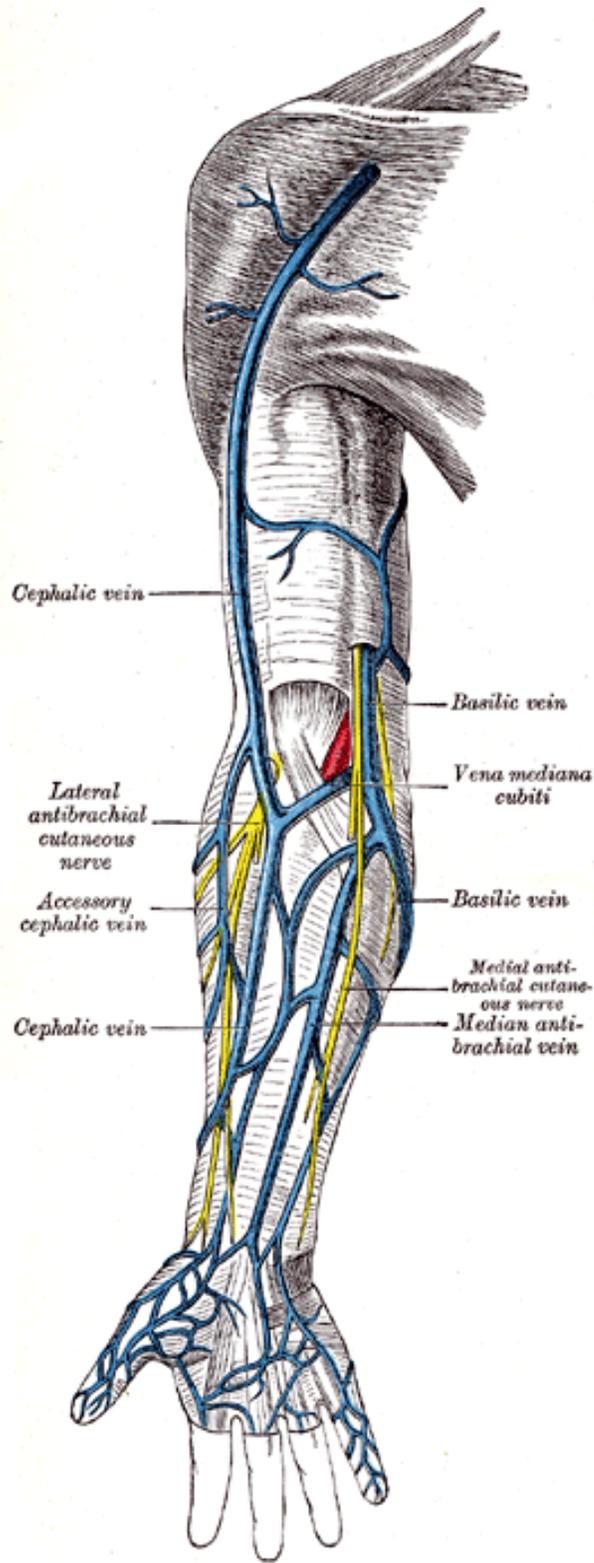
Major Veins



Major Arteries

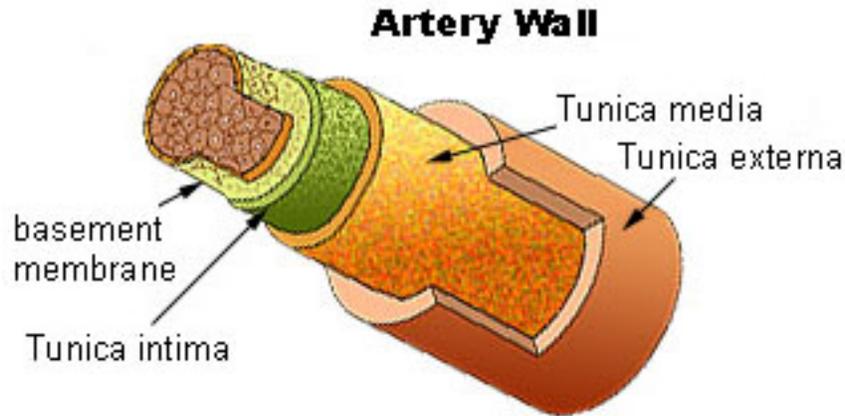


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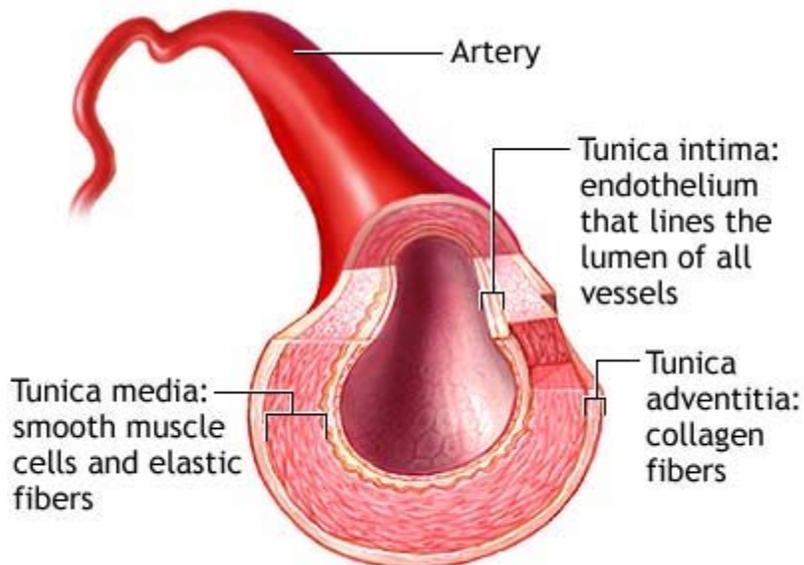


General Structure: ARTERIES and VEINS

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)**, *ENDOTHELIUM* (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*

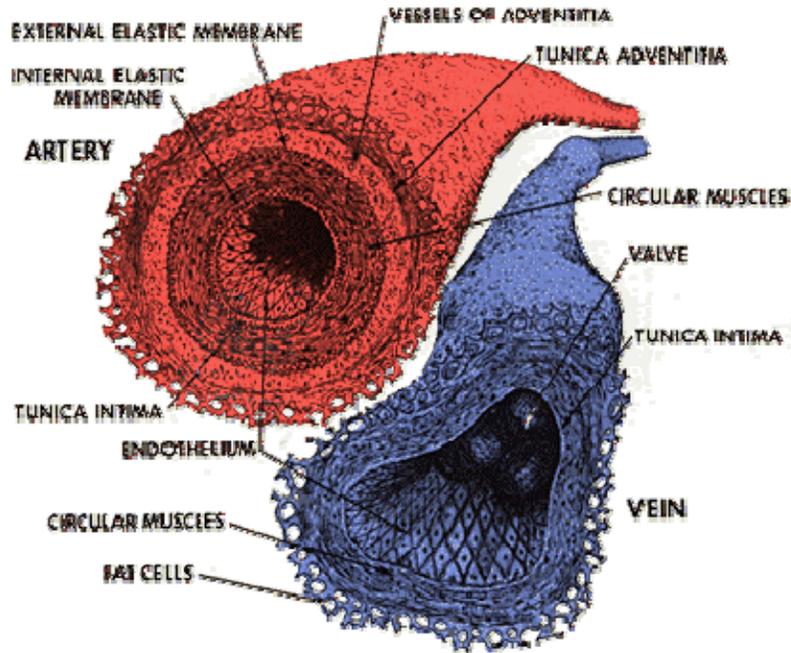


Arteries

- Strong, very Elastic
- Adapted to carry blood under high pressure
- 3 layers

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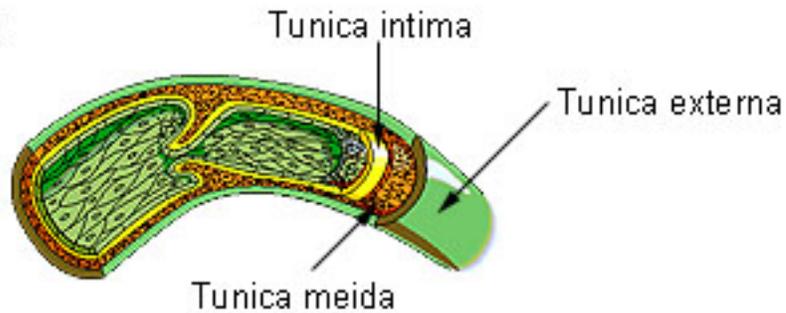
- Endothelium
 - Smooth surface
 - Tunica Media
 - Smooth muscle, Elastic fibers
 - Tunica Adventitia
- Sympathetic branch of ans innervate smooth muscle in artery and arteriole
 - Hold about 20% total blood volume.

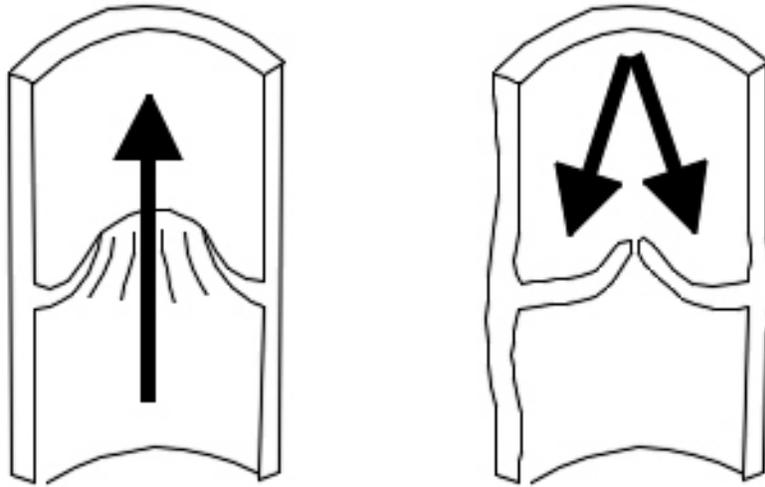


Veins

- 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

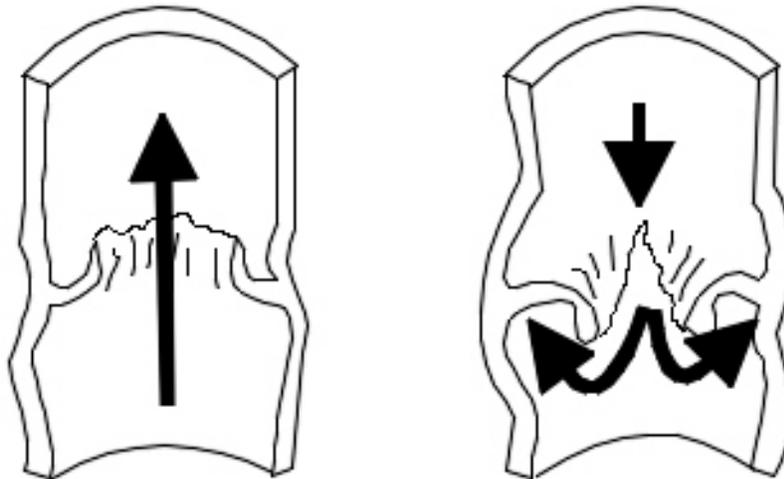
Vein





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.

PHLEBOTOMY

Selected Veins of the Upper Limb – Listed Alphabetically

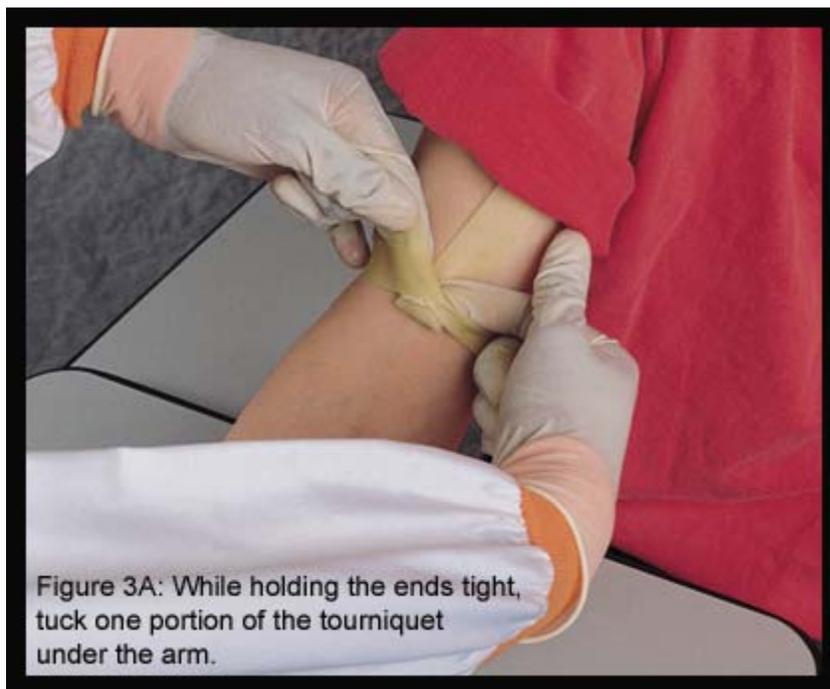
Vein	Tributaries	Drains Into	Regions Drained	Notes
Ante median	brachial, Superficial veins of the palm and anterior forearm	Median cubital v. or basilica	Palm; anterior forearm	Medium antecubital v. is variable in size – it may be large or absent
Basilic v.	Medial end of the dorsal venous arch of the hand; superficial veins of the forearm; median cubital v.	It unites with the brachial vein(s) to form the axillary v.	Superficial parts of the medial side of the hand and medial side of the forearm	Basilica v. communicated with deep veins of the forearm through perforating veins, especially in cubital region.
Brachiocephalic v.	Formed by the union of the subclavian v. and the internal jugular v.; tributaries; vertebral v., thymic v., inferior thyroid v., internal thoracic v., 1 st posterior intercostals v., left superior intercostals v. (to the left brachiocephalic v.)	The left and right brachiocephalic v. unite to form the superior vena cava.	Head; neck; upper limb; anterior chest wall	At its origin, the left brachiocephalic v. receives the thoracic duct; at its origin, the right brachiocephalic v. receives the right lymphatic duct
Cephalic v.	Lateral side of the dorsal venous arch of the hand; superficial veins of the forearm.	Axillary vein	Superficial parts of the lateral hand and lateral forearm	Median cubital vein usually shunts some of the blood collected by the cephalic v. to the basilica v.
Dorsal metacarpal v. of the hand	Dorsal digital vv.	Dorsal venous arch of the hand	Dorsal aspects of the digits of the hand	Dorsal metacarpal v. drains the adjacent sides of the two digits.
Dorsal venous arch of the hand	Dorsal digital vv. And dorsal metacarpal vv.	Cephalic v. laterally, basilica v. medially	Dorsal aspects of the digits and the superficial structures of the dorsal of the hand	Dorsal venous arch is visible through the thin skin on the dorsum of the hand
Median antebrachial v.	Superficial of the palm and anterior forearm	Median cubital v. or basilica v.	Palm; anterior forearm	Median antecubital v. is variable in size- it may be large or absent
Median cubital v.	Cephalic	Basilica	Superficial part of the hand and forearm	A median antebrachial vein occurs occasionally and when present, it may drain into the median cubital vein.

Selected Veins of the Lower Limb – Listed Alphabetically

Veins	Tributaries	Drains into	Regions Drained	Notes
Dorsal metatarsal v. of the foot	Dorsal digital vv.	Dorsal venous arch of the foot	Dorsal aspects of the digits of the foot	Dorsal metatarsal v. drains the adjacent sides of two digits
Dorsal venous arch of the foot	Dorsal digital vv. And dorsal metatarsal vv.	Great saphenous v. medially, small saphenous v. laterally	Dorsum of the digits and the superficial structures of the dorsum of the foot	Dorsal venous arch is visible through the thin skin on the dorsum of the foot
Greater saphenous v.	Medial end of dorsal venous arch of foot, perforating communications with deep veins, superficial circumflex iliac v., superficial external pudental v.	Femoral v.	Skin and superficial fascia of the medial side of the foot and leg; skin and superficial fascia of most of the thigh; lower abdominal wall; perineal region	Greater saphenous v. is frequently used as graft material in coronary bypass surgery
Lesser saphenous v.	Lateral end of the dorsal venous arch of foot	Popliteal v.	Skin and superficial fascia of the lateral side of the foot and leg	Passes deeply into the popliteal fossa
Metatarsal, dorsal of the foot	Dorsal digital vv.	Dorsal venous arch of the foot	Dorsal aspects of the digits of the foot	Dorsal metatarsal v. drains the adjacent sides of two digits

Proper Method for Tying a Tourniquet





ASSEMBLING THE EQUIPMENT

Equipment Used during a Venipuncture



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

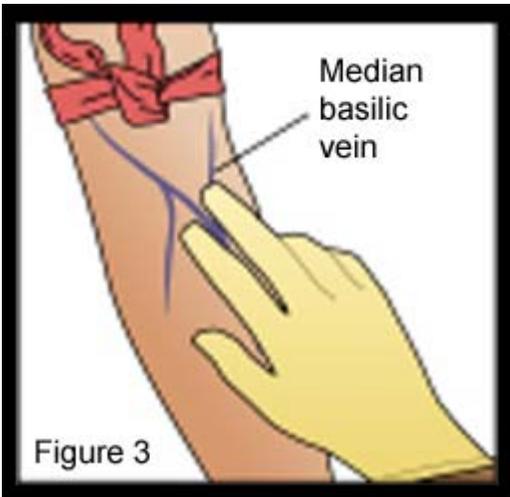


Figure 3

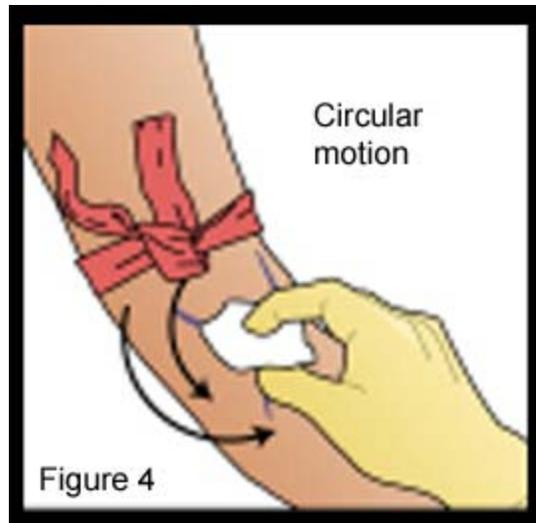


Figure 4

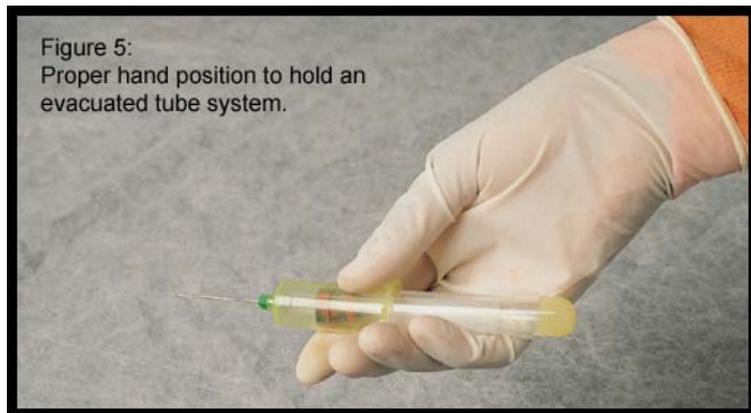
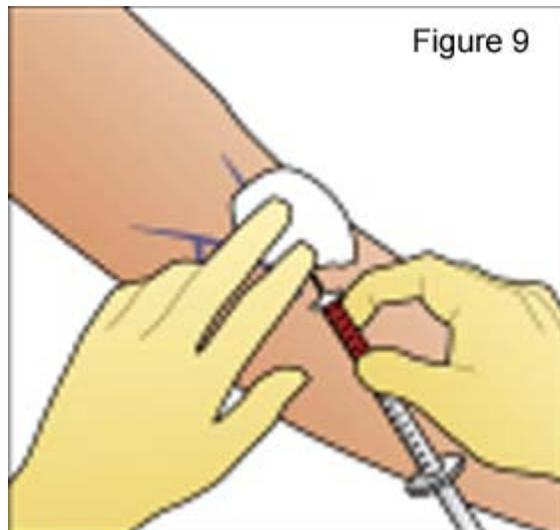
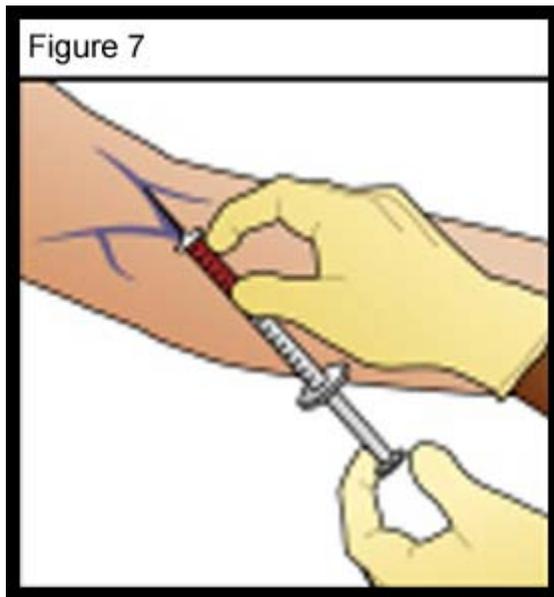


Figure 5:
Proper hand position to hold an evacuated tube system.

PHLEBOTOMY



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

- Describe and perform the venipuncture process including:
 1. Proper patient identification procedures.
 2. Proper equipment selection and use.
 3. Proper labeling procedures and completion of laboratory requisitions.
 4. Order of draw for multiple tube phlebotomy.
 5. Preferred venous access sites, and factors to consider in site selection, and ability to differentiate between the feel of a vein, tendon and artery.
 6. Patient care following completion of venipuncture.
 7. Safety and infection control procedures.
 8. 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 requires 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 the specimens with the requisition to the laboratory.

Equipment

The following are suggested supplies for blood specimen collection.

- Non sterile exam gloves
- Puncture resistant sharps container
- Alcohol wipes
- Tourniquet
- Appropriate specimen collection lab tubes
- 2 x 2 gauze
- Tape
- Evacuated tube holder
- Multisample blood collection needle

ORDER FORM / REQUISITION

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

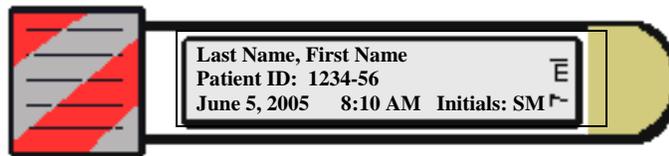
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Figure: An example of a simple requisition form with the essential elements.

Patient Information			Medtexx Medical Corporation		
Medical Record # _____	d.o.b. _____		 <p>P.O. Box 845 Gotha, FL 34734</p> <p>Phone: 407-905-0203 Fax: 321-221-9423</p> <p style="text-align: center;">Phlebotomy Requisition Form</p>		
Patient Name _____					
Address _____					
City _____	State _____	Zip _____			
Home (_____) _____	Work (_____) _____				
Ordering / Referring Physician Name: _____ Ordering / Referring Physician Signature: _____ Signs or Symptoms <i>(Please Note: Diagnosis Codes Necessitating Reason For Visit Must Be Provided Prior To Rendering Lab Service. Do Not Include A "Rule Out" Diagnosis. When Ordering Multiple Tests On The Same Order Form, Please Indicate A Sign Or Symptom/Diagnosis For Each Test/Treatment).</i>					
ICD-9 CODE(S)/Reason for Tests: _____ _____ _____		Routine <input type="checkbox"/> STAT <input type="checkbox"/> Call Results to: _____ Fax Results to: _____			
Test Name	CPT		Test Name	CPT	
ANA	86038		Dilantin	80185	
Alkaline	84075		Electrolytes, Serum	80051	
Amylase	82150		Ferritin, Serum	82728	
Basic Metabolic Prof.	80048		Flu AB A&B, swab	87400	
Bilirubin	82247		Folate, Serum	82746	
Bili, Adult Total	82247		GGTP	82977	
Bili, Neo Direct/Total	82248		Culture, Throat, RAPID		
Blood Culture X1 X2	87040		Culture, Throat, Routine		
BNP	83519		Culture, Stool	87045	
EUN	84520		Stool, Clostridium difficile	87324	
Cardio CRP	86140		Culture, Stool, Hem.E.coli	87045	
CRP (C-Reactive prot.)	86140		Stool, Occult Blood	82270	
Calcium	82310		Stool, Ova & Parasite	87177	
Cardiolipin Antibody	86147		Stool, Rotavirus	87425	
Carbamazepine	80156		Culture, Wound	87070	
CBC w/plts, auto diff	85025		Glucose, Serum	82947	
CBC Manual diff	85007		2 Hr. GTT (Pregnancy)	82947	
Hemagram	85021		3 Hr. GTT (Standard)	82947	
CEA	82378		Glycohemoglobin, A1C	83036	
Cholesterol, Total	82465		HCG Beta Quant	84702	
CK, Total	82550		Hepatitis B surface AB	86706	
Comprehensive Meta	80053		Hepatitis B surface AG	87340	
Coronary Risk Lipids	80061		Hepatitis C AB	86803	
Creatinine	82565		Hepatic Function	80076	
Digoxin	82565		Hepatitis Profile (A, B, C)	80074	
			HIV	87536	
			Homocysteine	82131	
			Immunoglobulin (A, G, M)	82784 83883	
			Immunoelectrophoresis		
			Iron	83540	
			Iron & TIBC	83550	
			LDH	83615	
			Lipase	83690	
			Magnesium	83735	
			Mono Screen	86308	
			Phosphorus	84100	
			Protein Electrophor.	84165	
			Potassium	84132	
			PSA Total & Free	84154	
			PSA	84153	
			PT	85610	
			PTT	85730	
			Reticulocyte Count	85045	
			Sed Rate, ESR	85651	
			SGPT (ALT)	84460	
			SGOT (AST)	84450	
			T3 Total	84480	
			T4, Free	84439	
			TSH	84443	
			Theophylline	80198	

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.



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.
- Needle disposal unit - 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

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

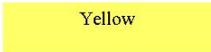
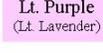
- First - blood culture tube (yellow-black stopper)
- Second - non-additive tube (red stopper or SST)
- Third - coagulation tube (light blue stopper). If just a routine coagulation assay is the only test ordered, then a single light blue stopper tube may be drawn. If there is a concern regarding contamination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

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

NOTE: For plastic tubes, the order of draw for tubes 2 and 3 is reversed.

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)}

<u>Color</u>	<u>Type</u>
 Yellow	Blood Cultures—SPS
 Light Blue	Citrate Tube
 Gold or  Red/Gray	SST Gel Separator Tube
 Red	Serum Tube
 Dark Green	Heparin Tube
 Light Gray or  Lt. Gr/Blk/Gr	PST Gel Separator Tube
 Purple (Lavender) or  Lt. Purple (Lt. Lavender)	EDTA Tube
 Gray	Fluoride (Glucose) Tube

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.

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 is MANDATORY. If an inpatient is able to respond, ask for a full name and always check the armband for confirmation. **DO NOT DRAW BLOOD IF THE ARMBAND IS MISSING.** An outpatient 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 birth date.

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 is 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, wrist and hand veins are also acceptable for venipuncture.

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:
 1. Turn off the IV for at least 2 minutes before venipuncture.
 2. Apply the tourniquet below the IV site. Select a vein other than the one with the IV.
 3. Perform the venipuncture. Draw 5 ml of blood and discard before drawing the specimen tubes for testing.
- 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.

PROCEDURE FOR VEIN SELECTION

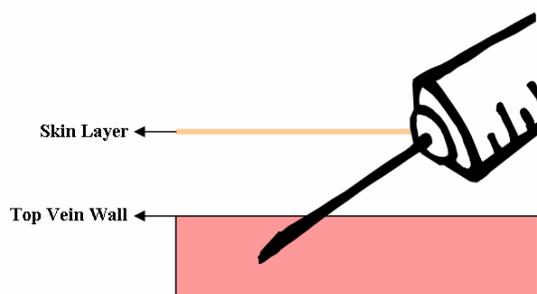
- Palpate and trace the path of veins with the index finger. Arteries pulsate, are most elastic, and have a thick wall. Thrombosed veins lack resilience, feel cord-like, and roll easily.
- If superficial veins are not readily apparent, you can force blood into the vein by massaging the arm from wrist to elbow, tap the site with index and second finger, apply a warm, damp washcloth to the site for 5 minutes, or lower the extremity over the bedside to allow the veins to fill.

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.

PHLEBOTOMY

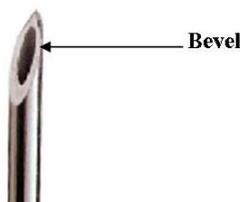
- Verify the patient's condition. Fasting, dietary restrictions, medications, timing, and medical treatment are all of concern and should be noted on the lab requisition.
- Position the patient. The patient should sit in a chair, lie down, or sit up in bed. Hyperextend the patient's arm.
- Apply the tourniquet 3-4 inches above the selected puncture site. Do not place too tightly or leave on more than 2 minutes.
- The patient should make a fist without pumping the hand.
- Select the venipuncture site.
- Prepare the patient's arm using 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 the patient bedside.
- Deliver specimens promptly to the laboratory.

Note: The Bevel

The bevel of a needle is the angled opening at the tip of the needle. The bevel must always face upward, towards the person holding it, so as to obtain a blood return.



It is also very important to remember that if the bevel is exposed during a venipuncture, before manually withdrawing the needle at the completion of the entire procedure, the needle is then considered contaminated, and cannot be re-inserted into the patient. The whole procedure must be stopped, and restarted elsewhere.

Note that when the bevel is exposed, leakage from the site may occur. Never panic, simply release the tourniquet, remove the needle, and apply pressure with cotton. Immediately dispose of the needle in the sharps container. This is another reason it is so important to keep your eyes on the needle, and not on other things around the room!

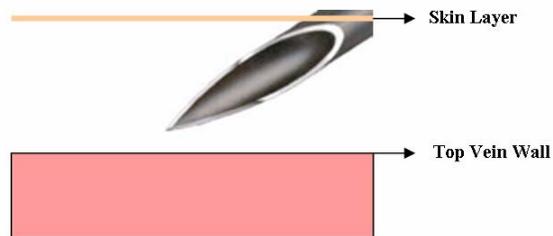
PROTECT THE PATIENT

- 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.

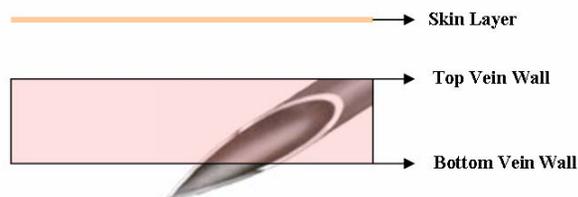
TROUBLESHOOTING GUIDELINES

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. There may be no vacuum in the one being used.
- Re-anchor the vein. Veins sometimes roll away from the point of the needle and puncture site.

Corrective Technique

The corrective technique is performed when there is no blood return. After two unsuccessful attempts, the rule for Phlebotomists is to call in another Phlebotomist to perform the venipuncture. However, you must try to successfully obtain the sample before giving up. The proper procedure to do this is called Corrective Technique.

Corrective Technique

Step 1: Pull the needle out until the bevel is just under the skin.

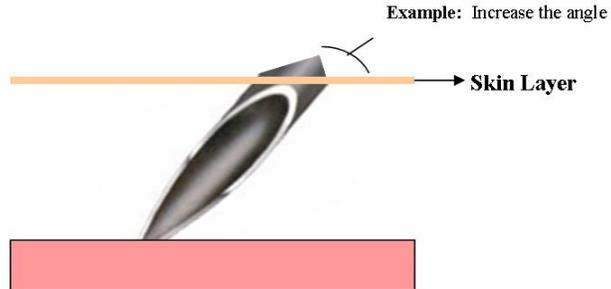


Step 2: Palpate. Gauge the depth and location of the vein. Always palpate above the insertion site (about 1/4" above), not on top of the site! Never press down on the needle!

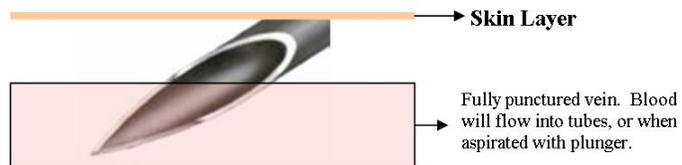


Corrective Technique

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

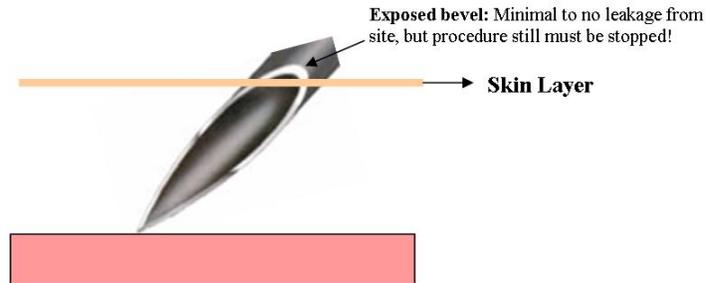


Step 4: Check for a blood return. If using a Vacutainer, the tube will begin to fill as soon as the vein is punctured. If using a syringe, you will have to manually aspirate the plunger to check for a return.

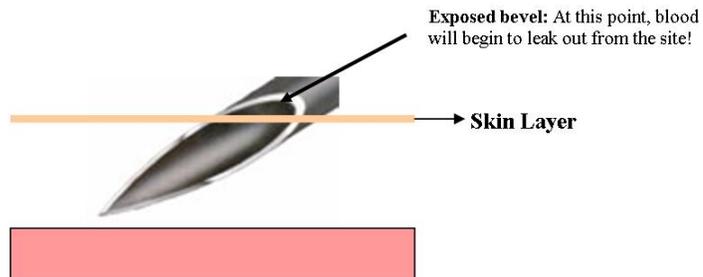


Corrective Technique

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.

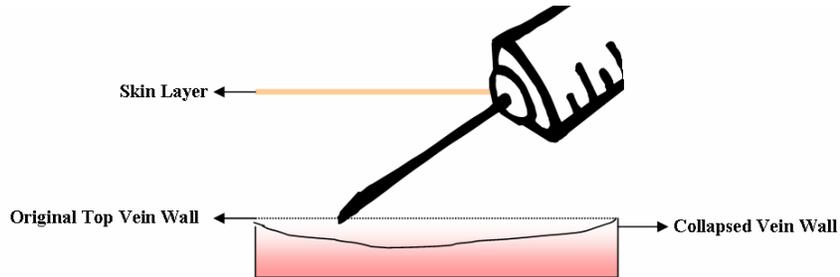


or



IF BLOOD STOPS FLOWING INTO THE TUBE

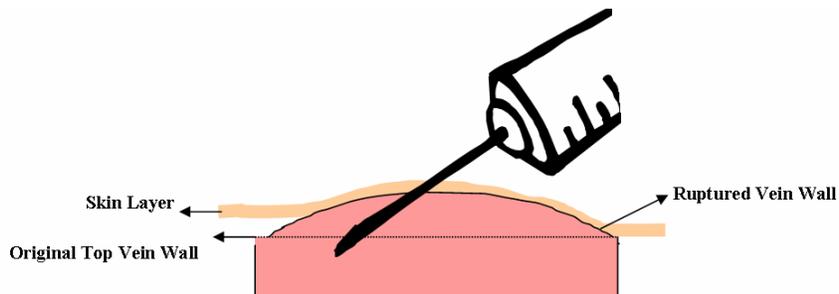
- The vein may have collapsed; re-secure the tourniquet to increase venous filling. If this is not successful, remove the needle, take care of the puncture site, and redraw.



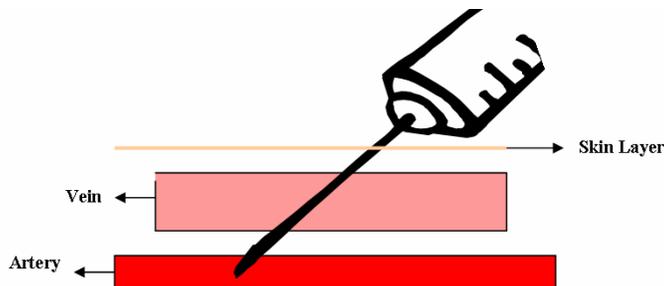
- The needle may have pulled out of the vein when switching tubes. Hold equipment firmly and place fingers against patient's arm, using the flange for leverage when withdrawing and inserting tubes.

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.

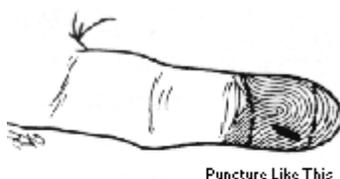


- The blood is bright red (arterial) rather than venous. Apply firm pressure for more than 5 minutes.



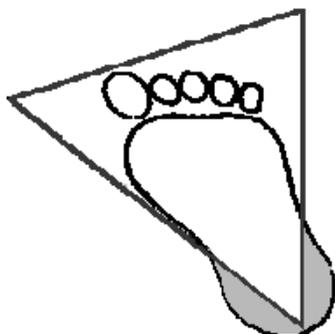
PERFORMANCE OF A FINGERSTICK

- 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.



BLOOD COLLECTION ON INFANTS

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



- Pre-warming 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 area of the heel that is just “off center” from the very center of the heel. 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 puncture the outer sides of the heel, either. Do not use a previous puncture site. Make the cut across the heel print 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

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

- Ø 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.
- Ø 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.

PATIENT COMPLICATION

Problems other than an incomplete collection

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 faint at the thought or sight of blood, this is the most common complication of phlebotomy. It is caused because of a 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 too quickly, he will most likely faint again due to a drop in B/P.

Scarred Vein

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

BLOOD: Samples & Collection

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:	Hemogard™ 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.

PHLEBOTOMY

Mint Green Stopper- PST, Plasma Separator Tube: HOSPITAL PATIENTS ONLY

Additive:	Lithium Heparin, Polymer gel plasma separator
Stopper Type:	Hemogard™
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:	Hemogard™
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:	Hemogard™
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:	Hemogard™
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:	Hemogard™
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:	Hemogard™
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.

Yellow Stopper Tube: (two types)

Additive:	ACD, solution A
Stopper Type:	Conventional
Tube Type/Size:	Glass 16 x 100
Specimen Type:	Whole blood
Draw Amount:	8.5 ml
Inversions:	8
Laboratory Use:	Tissue typing and some Red Cross testing. Refer to specific test for proper tube.

Additive:	ACD, solution B
Stopper Type:	Conventional
Tube Type/Size:	Glass 16 x 100
Specimen Type:	Whole blood
Draw Amount:	6.0 ml
Inversions:	8
Laboratory Use:	Tissue typing. Refer to specific test for proper tube.

COLLECTION TUBES FOR PHLEBOTOMY

Red Top	
ADDITIVE	None
MODE OF ACTION	Blood clots, and the serum is separated by centrifugation
USES	Chemistries, Immunology and Serology, Blood Bank (Crossmatch)

Gold Top	
ADDITIVE	None
MODE OF ACTION	Serum separator tube (SST) contains a gel at the bottom to separate blood from serum on centrifugation
USES	Chemistries, Immunology and Serology

Light Green Top	
ADDITIVE	Plasma Separating Tube (PST) with Lithium heparin
MODE OF ACTION	Anticoagulates with lithium heparin; Plasma is separated with PST gel at the bottom of the tube
USES	Chemistries

PHLEBOTOMY

Red-Gray Top	
ADDITIVE	Serum Separating Tube (SST) with clot activator
MODE OF ACTION	Forms clot quickly and separates the serum with SST gel at the bottom of the tube
USES	Chemistries

Purple Top	
ADDITIVE	EDTA liquid
MODE OF ACTION	Forms calcium salts to remove calcium
USES	Hematology (CBC) and Blood Bank (Crossmatch); requires full draw - invert 8 times to prevent clotting and platelet clumping

Light Blue Top	
ADDITIVE	Sodium citrate
MODE OF ACTION	Forms calcium salts to remove calcium
USES	Coagulation tests (protime and prothrombin time), full draw required

PHLEBOTOMY

Dark Green Top	
ADDITIVE	Sodium heparin or lithium heparin
MODE OF ACTION	Inactivates thrombin and thromboplastin
USES	For lithium level, use sodium heparin For ammonia level, use sodium or lithium heparin

Dark Blue Top	
ADDITIVE	Sodium EDTA
MODE OF ACTION	Forms calcium salts Tube is designed to contain no contaminating metals
USES	For lithium level, use sodium heparin Trace element testing (zinc, copper, lead, mercury) and toxicology

Light Gray Top	
ADDITIVE	Sodium fluoride and potassium oxalate
MODE OF ACTION	Antiglycolytic agent preserves glucose up to 5 days
USES	For lithium level, use sodium heparin Glucoses, requires full draw (may cause hemolysis if short draw)

PHLEBOTOMY

Yellow Top	
ADDITIVE	ACD (acid-citrate-dextrose)
MODE OF ACTION	Complement inactivation
USES	HLA tissue typing, paternity testing, DNA studies

Yellow - Black Top	
ADDITIVE	Broth mixture
MODE OF ACTION	Preserves viability of microorganisms
USES	Microbiology - aerobes, anaerobes, fungi

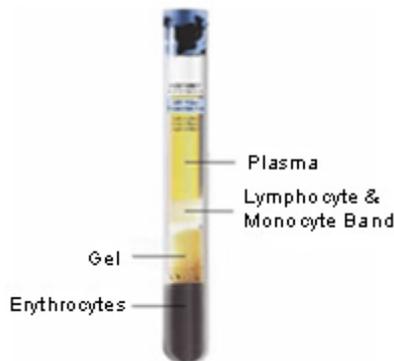
Black Top	
ADDITIVE	Sodium citrate (buffered)
MODE OF ACTION	Forms calcium salts to remove calcium
USES	Westergren Sedimentation Rate; requires full draw

Orange Top	
ADDITIVE	Thrombin
MODE OF ACTION	Quickly clots blood
USES	STAT serum chemistries

Brown Top	
ADDITIVE	Sodium heparin
MODE OF ACTION	Inactivates thrombin and thromboplastin
USES	Serum lead determination

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 may be 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
3. Collect specimen carefully to avoid hemolysis of the red cells
4. 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

PHLEBOTOMY

4. Allow iodine to dry before performing the venipuncture. Once the iodine is dry, do not 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.)

PHLEBOTOMY

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.

CODE

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

TEST	Tube	SPECIAL INSTRUCTIONS
ABO type	R	At least 7.0 ml clot
Acid Phosphate (PAP)	R	Freeze if not delivered before 4 hrs.
Albumin	R	
Alcohol	L / Gr	
Alkaline Phosphate	R	
Amylase	R	
Antinuclear antibodies ANA	R	Avoid lipemic or hemolyzed serum
B-12, vitamin	R	Avoid hemolysis and protect from light
Bilirubin, total or direct	R	Protect from light
Blood urea nitrogen BUN	R	
Calcium	R	
Carcineombrynic antigen CEA	R / L	

PHLEBOTOMY

Cardiac enzymes	R	
CBC	L	
Cholesterol, HDL	R	Collect after 8 – 12 hours fast
Cholesterol, total	R	
Clot retraction	S	Place 3 m in 13x100 mm test tube; place in 37 degree C water bath and allow to clot
Cold agglutinins	R	Incubate blood at 37 degree C until clotted, separate as soon as blood clots.
Complement, C3	R	
Complement, C4	R	Freeze serum
Complement, total (CH50)	R	Let clot in refrigerator, separate immediately and freeze serum.
Cortisol	R/L	
CPK enzymes	R	
C-reactive protein CRP	R	
Creatinine phosphokinase (CPK total)	R	
Digitoxin	R	
Dilantin	R	
Electrolytes (Na, K, CL, CO)	R	Avoid hemolysis
Febrile agglutination	R	
Ferritin	R	
Fibrinogen	B	Maximum Draw (exact draw)
Folate serum	R	Avoid hemolysis
Fungal serologies	R	
Gamma-glutamyl transpepsidase	R	
GGT	R	
Gentamicin	R	
Glucose, fasting	R	
Glucose, 2hr postprandial	R	
Glucose tolerance	R	3 hr: 5 specimens; 5hr: 7 specimens (urine sample for each interval)
Glycosylated hemoglobin	L	
Hematocrit	L	
Hemoglobin	L	
Hemoglobin electrophoresis	L	
Hepatic profiles	R	
Beta-human chorionic gonadotropin HCG	R	
Human Immunodeficiency virus HIV	R	
Human leukocyte antigen	R & Gr	Gn-donor, R-recipient; do not freeze or refrigerate, record date and time collected
Lactodehydrogenase LDH	R	
LDH isoenzyme	R	
Lead	R	
Lipase	L	
Lithium	R	

PHLEBOTOMY

Liver profile	R	
Magnesium	R	Avoid hemolysis
Osmolality, serum	R	
Partial thromboplastin time PTT	B	Maximum draw
Phenobarbital	R	
Phosphorus	R	
Platelet count	L	
Potassium	R	Avoid hemolysis
Procainamide	R	
Prostate specific antigen PSA	R	Freeze specimen if not to lab in 4 hrs
Prostatic acid phosphate PAP	R	Freeze specimen if not to lab in 4 hrs
Prothombin time PT	B	Maximum draw
Quinidine	R	
Rapid plasma regain RPR	R/L	
Reticulocyte count	L	
Rheumatoid arthritis serology RA	R	
Rubella titer	R	
Salicylates	R	
Sedimentation rate	L	
SGOT (AST)	R	
SGPT (ALT)	R	
SMA profiles	R	
Streptozyme	R	
T,T	R	
T4 / t8 ratio	L/Gn	Blood smear needed, do not freeze
Thioridazine (mellaril)	R	Protect from light
Thyroid profiles	R	
Thyroid stimulating hormones	R	
TSH	R	
Total iron binding capacity TIBC	R	
Transferrin	R	
Triglycerides	R	
Uric acid	R	
Viral serologies	R	
Western blot	R	
Zinc	NB	

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 u 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 ¼ 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 lat 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 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

PHLEBOTOMY

- 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. When palpated, the site should feel firm and rebound slightly.
5. Cleanse the site with alcohol. Wipe in a circular motion. Begin in the centre of 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.
4. Allow the alcohol or other skin prep to dry.
5. 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.
6. 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.
7. Remove the lancet. Discard it in the puncture-resistant sharps container.
8. Wipe the first drop of blood away with a sterile 2 x 2 sponge. You will need the rest to fill the containers.

9. 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.
10. 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.
11. Wipe any remaining blood from the skin, and cover with an adhesive bandage.
12. Label the sample while in the patient's room.
13. 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.
4. Apply gloves.
5. 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.
6. Allow the alcohol or other skin prep to dry.
7. 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.
8. Inflate the blood pressure cuff until the gauge reads 40mmHg. You must stat the test within 60 seconds of inflating the cuff.

PHLEBOTOMY

9. 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.
10. 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.
11. 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.
12. 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 straight forward 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 (carboxyhemoglobinemia 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 coagulopathy 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 medial 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 to its 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) Preheparinized 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 palmar 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.

5. 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 {5 μ 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 its 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 (ethylenediaminetetraacetic 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 clot

The conversion of blood from a liquid form to solid through the process of coagulation. A thrombus is a clot which forms inside of a blood vessel. If that clot moves inside the vessel it is referred to as an embolus (embolism).

Blood clotting factor

Any of a number of different protein factors which, when acting together, can form a blood clot shortly after platelets have broken at the site of the wound. The factors have Roman numeral names, like VII, VIII, IX, X, XI, and XIII. Defects in the genes which code for any of these factors result in genetic diseases like hemophilia, which results from a defect in the gene for factor VIII or IX.

Blood count

The determination of the proper number of red blood cells, white blood cells and platelets are present in the patient's blood. Also known as complete blood count (CBC).

Blood culture

A test which involves the incubation of a blood specimen overnight to determine if bacteria are present. Blood is collected in a special media which enhances the growth of both aerobic and anaerobic microorganisms.

Blood film

See: "blood smear"

Blood group

An inherited feature on the surface of the red blood cell. A series of related blood groups make up a blood group system such as the ABO system or the Rh system. See also: ABO blood group.

Blood letting

The act or process of letting blood or bleeding, as by opening a vein or artery, or by cupping or leeches; especially applied to venesection.

Blood smear

A sample of blood is applied to a microscope slide and then studied under the microscope. SYN: blood film

Blood transfer device

A safety device designed to transfer blood from one container into another. In phlebotomy, these devices are most often used in the transfer of blood from a syringe into a blood culture bottle or evacuated sample tube.

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.

C

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 removed.

Complete blood count (CBC)

The number of red blood cells, white blood cells and platelets (per cubic millimeter) that are present in the patients 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.

D

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.

E

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.

H

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 form 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.

I

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, 7-10 μ 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".

M

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:

$$\text{MCH} = (\text{Hgb} \times 10) \div \text{RBC}$$

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:

$$\text{MCHC} = \text{Hgb} \div \text{Hct}$$

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

MCV - Mean Corpuscular Volume

Average volume of red blood cells (erythrocytes), expressed in cubic micrometers (μm^3) or femtoliters. This is the average RBC size. Calculation:

$$\text{MCV} = (\text{Hct} \div \text{RBC}) \times 10$$

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, 13-25 μ in diameter, with an oval to kidney shaped nucleus, lacy 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 or 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.

ParafilmT

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

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.

T

Therapeutic

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

Thrombocyte

See: Platelet

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 Coumadin™ 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

U

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.

V

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.

W

Warfarin sodium

The sodium salt of warfarin, one of the synthetic anticoagulants. Coumadin™.

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

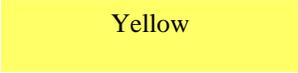
The number of white blood cells (leukocytes) found in the peripheral blood and measured per cubic millimeter. See also complete blood count.

RESOURCES

- The Internet Pathology Laboratory for Medical Education (1994-2005)
- Morbidity and Mortality Weekly Reports 37: No.S-4,1-19. April 1, 1988
- AllRefer Health, a medical and health information resource containing outstanding database of health articles and reference materials.
- Discovery Health
- Heal Central
- Blood Matters, Improving patient outcomes from better transfusion practice.
- AABB advancing transfusion and cellular therapies
- MoonDragon's Health Information
- UHS and UTHSCSA Department of Pathology
- Capital Health
- Arterial Puncture, Dr. David Chong
- Legacy Health System
- Phlebotomy, the art of drawing blood by Jack Gray
- Radial Artery Puncture by Carlos Eduardo Reis, MD
- Deaconess Billings Clinic, Health care and Laboratory Services (2000)
- Becton, Dickinson and Company

Appendix A—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)}

<u>Color</u>		<u>Type</u>
		Blood Cultures—SPS
		Citrate Tube
	or	
		SST Gel Separator Tube
		Serum Tube
		Heparin Tube
	or	
		PST Gel Separator Tube
	or	
		EDTA Tube
		Fluoride (Glucose) Tube

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.

Appendix B—Sample Requisition Form

Patient Information

Medical Record # _____	d.o.b. _____
Patient Name _____	
Address _____	
City _____	State _____ Zip _____
Home (_____) _____	Work (_____) _____

Medtexas Medical Corporation

P.O. Box 845
Gotha, FL 34734

Phone: 407-905-0203
Fax: 321-221-9423



Phlebotomy Requisition Form

Ordering / Referring Physician Name: _____

Ordering / Referring Physician Signature: _____

Signs or Symptoms (Please Note: Diagnosis Codes Necessitating Reason For Visit Must Be Provided Prior To Rendering Lab Service. Do Not Include A "Rule Out" Diagnosis. When Ordering Multiple Tests On The Same Order Form, Please Indicate A Sign Or Symptom/Diagnosis For Each Test/Treatment).

ICD-9 CODE(S)/Reason for Tests:

Routine STAT

Call Results to: _____

Fax Results to: _____

Test Name	CPT	Test Name	CPT	Test Name	CPT
ANA	86038	Dilantin	80185	HIV	87536
Alkaline	84075	Electrolytes, Serum	80051	Homocysteine	82131
Amylase	82150	Ferritin, Serum	82728	Immunoglobulin (A, G, M)	82784 83883
Basic Metabolic Prof.	80048	Flu AB A&B, swab	87400	Immunoelectrophoresis	
Bilirubin	82247	Folate, Serum	82746	Iron	83540
Bili, Adult Total	82247	GGTP	82977	Iron & TIBC	83550
Bili, Neo.Direct/Total	82248	Culture, Throat, RAPID		LDH	83615
Blood Culture X1 X2	87040	Culture, Throat, Routine		Lipase	83690
BNP	83519	Culture, Stool	87045	Magnesium	83735
BUN	84520	Stool, Clostridium difficile	87324	Mono Screen	86308
Cardio CRP	86140	Culture, Stool, Hem.E.coli	87045	Phosphorus	84100
CRP (C-Reactive prot.)	86140	Stool, Occult Blood	82270	Protein Electrophor.	84165
Calcium	82310	Stool, Ova & Parasite	87177	Potassium	84132
Cardiolipin Antibody	86147	Stool, Rotavirus	87425	PSA Total & Free	84154
Carbamazepine	80156	Culture, Wound	87070	PSA	84153
CBC w/plts, auto diff	85025	Glucose, Serum	82947	PT	85610
CBC Manual diff	85007	2 Hr. GTT (Pregnancy)	82947	PTT	85730
Hemagram	85021	3 Hr. GTT (Standard)	82947	Reticulocyte Count	85045
CEA	82378	Glycohemoglobin, A1C	83036	Sed Rate, ESR	85651
Cholesterol, Total	82465	HCG Beta Quant	84702	SGPT (ALT)	84460
CK, Total	82550	Hepatitis B surface AB	86706	SGOT (AST)	84450
Comprehensive Meta.	80053	Hepatitis B surface AG	87340	T3 Total	84480
Coronary Risk Lipids	80061	Hepatitis C AB	86803	T4, Free	84439
Creatinine	82565	Hepatic Function	80076	TSH	84443
Digoxin	82565	Hepatitis Profile (A, B, C)	80074	Theophylline	80198

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
- ❖ Bloating 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
- ❖ 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

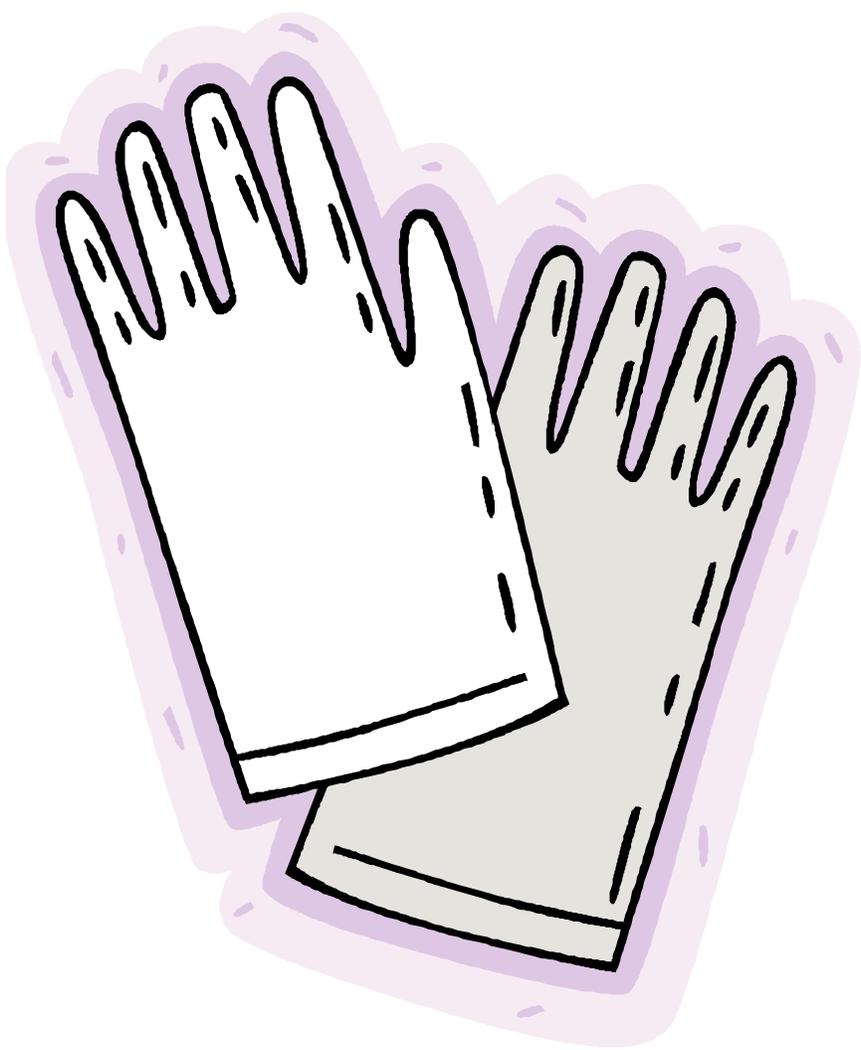
Currently, there is no vaccine to prevent or to cure Hepatitis C. The best way to avoid contracting HCV and to prevent the spread of the virus is to:

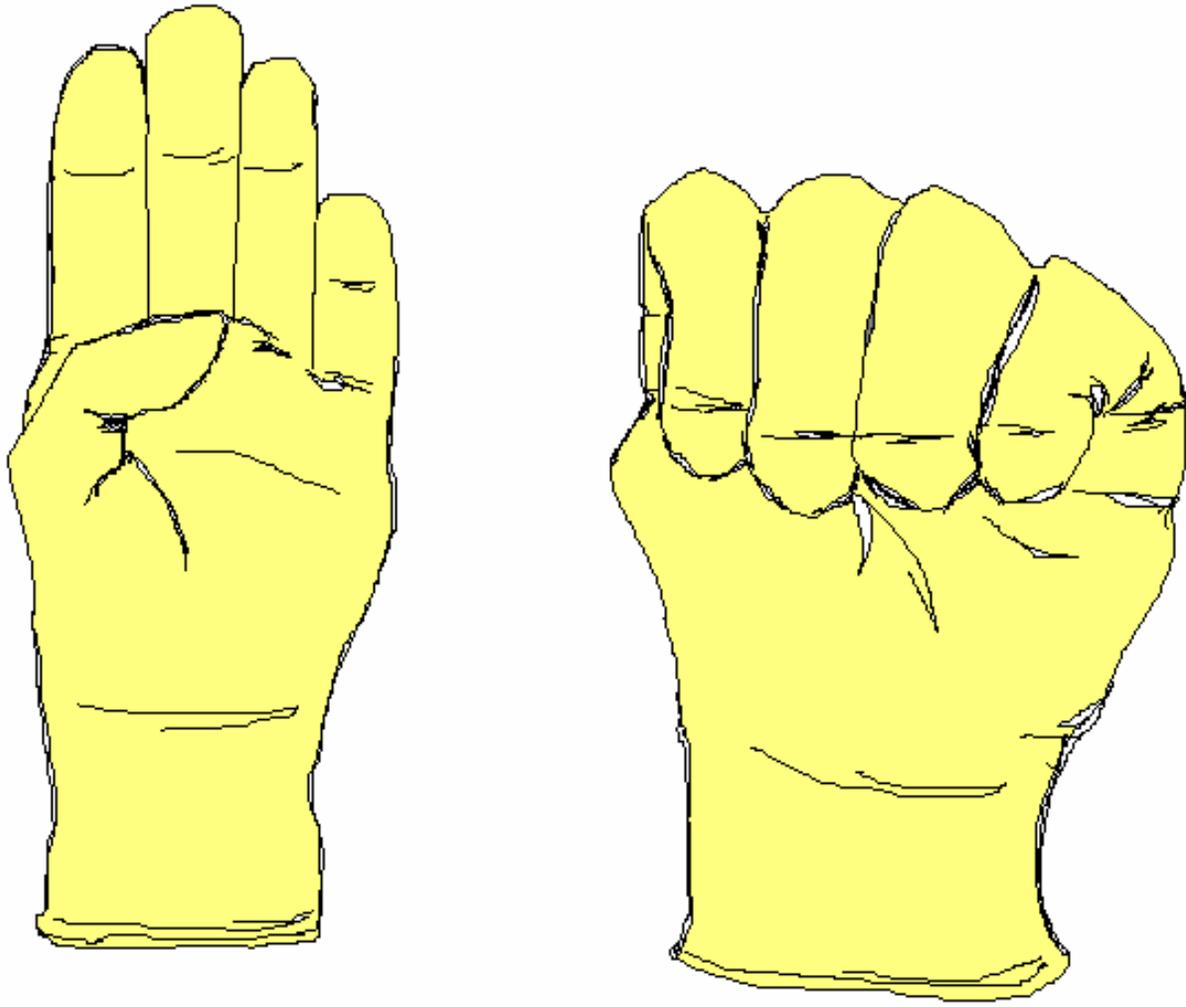
- ❖ Do not shoot drugs; if you do shoot drugs, stop and get into a treatment program; if you can't stop, never share needles, syringes, water, or "works", and get vaccinated against Hepatitis A & B.
- ❖ Do not share personal care items that might have blood on them (razors, toothbrushes, etc.).
- ❖ If 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

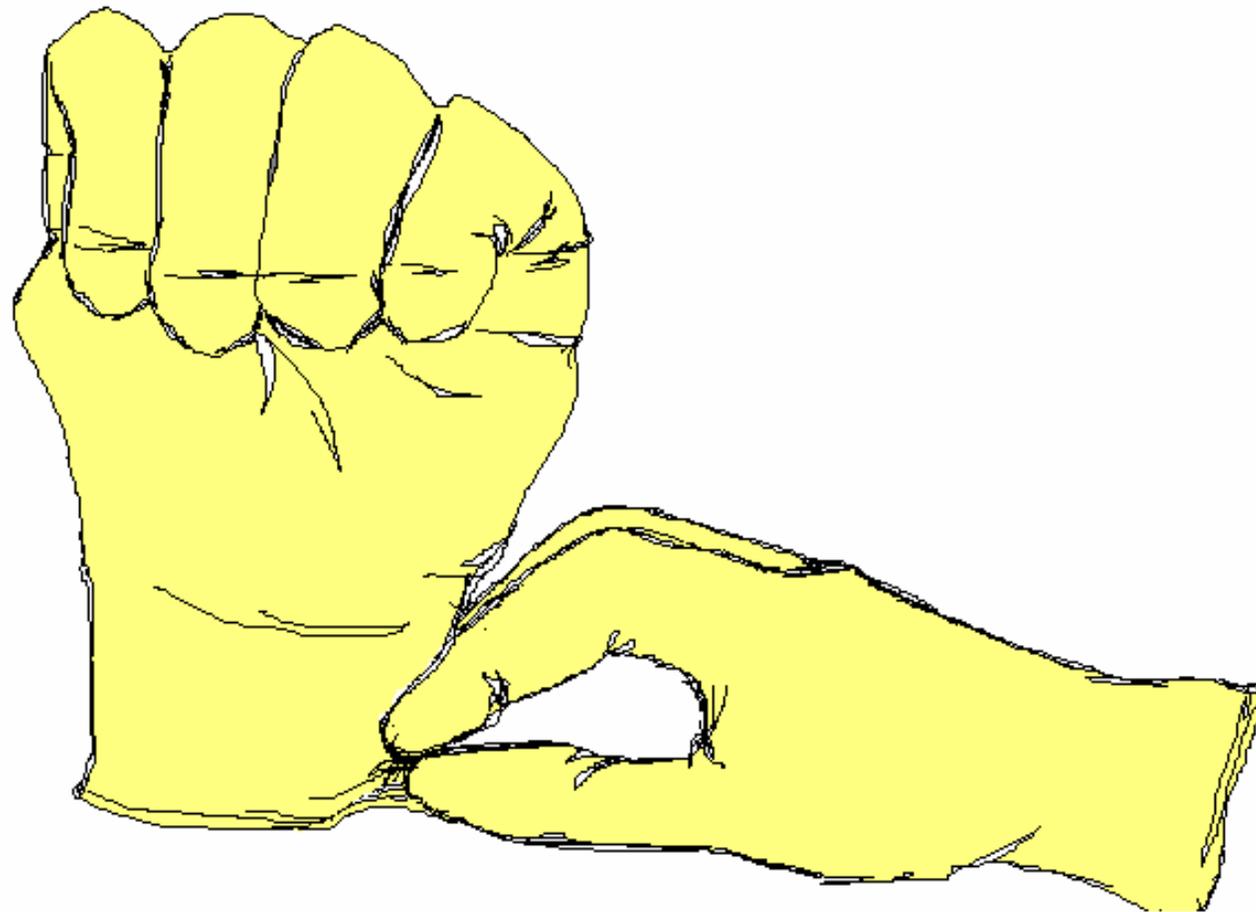
Hepatitis C positive persons should be evaluated by their doctor for liver disease. Interferon and ribavirin are two drugs licensed for the treatment of persons with chronic Hepatitis C. Interferon can be taken alone or in combination with ribavirin. Combination therapy, using pegylated interferon and 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

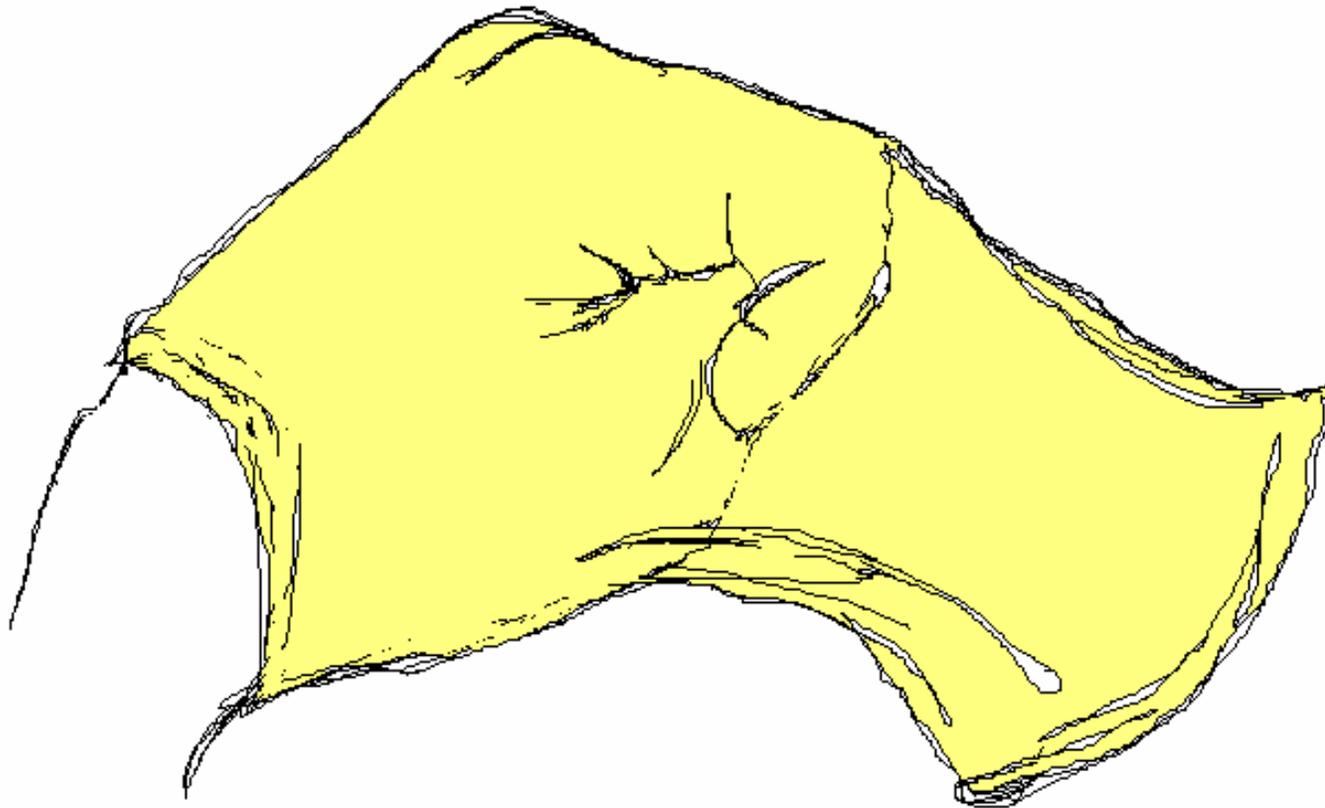




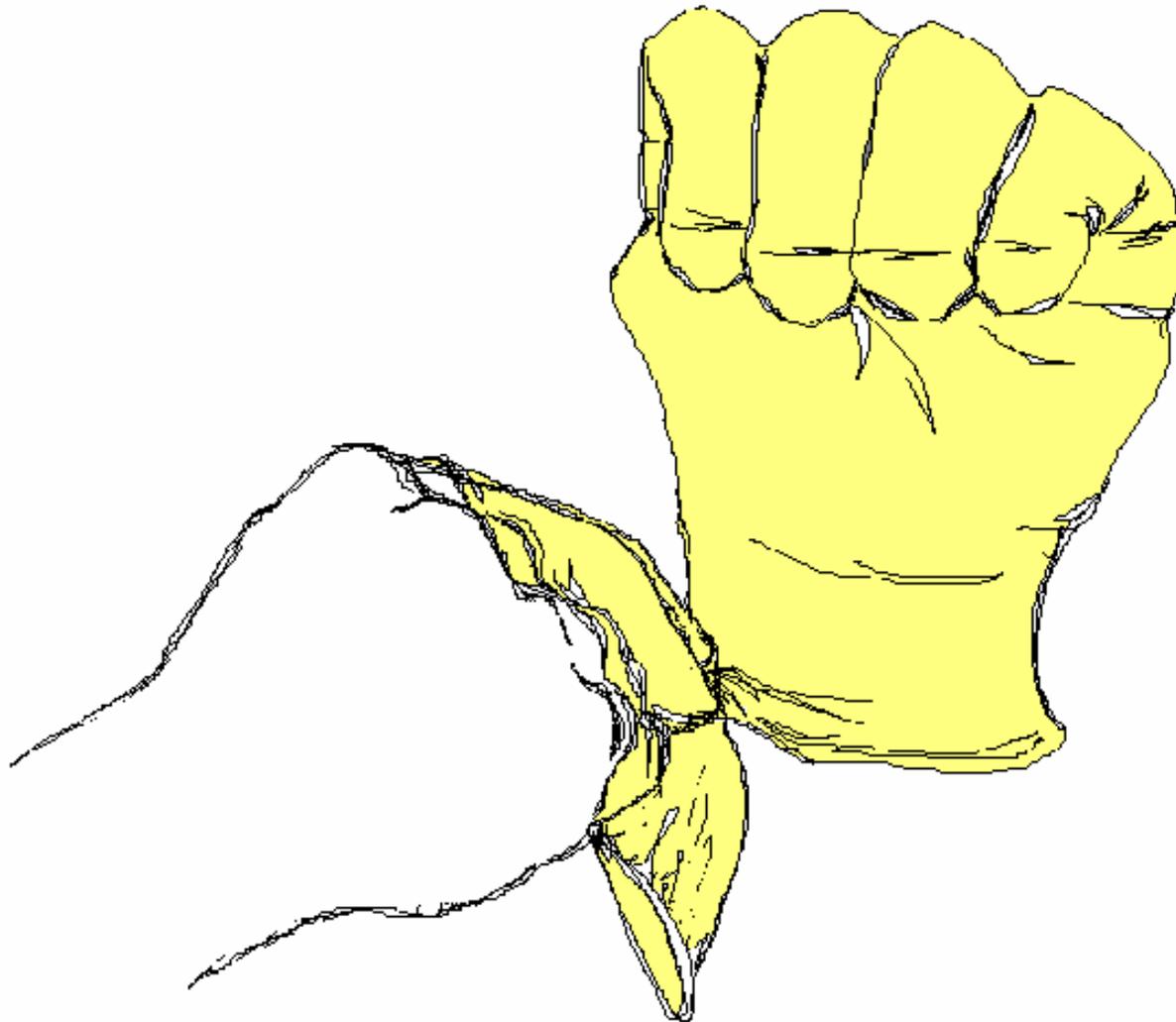
Step 1: First, make a fist with your thumb inside.



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!



Step 3: Pull the glove inside out, but do not remove it completely.



Step 4: With your first glove inside out, but still on protecting your fingers, repeat the removal on the next hand (Steps 1 - 3).



Finally, completely pull the gloves off & properly dispose of them.

