American Medical Certification Association

-A division of the American School of Business-

EKG/Phlebotomy Technician Certification (ETC/PTC)
Study Guide

Dear Student,

American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
The exam consists of 100 multiple choice questions and you will have 2 hours in which to complete the exam. When taking the test, always apply these test taking strategies:

- Look for distracters in the question such as the words, not, always, exactly, first, next, etc.
- Read all the answers
- Eliminate the ones that you know are incorrect
- Narrow it down to 2 possible answers
- Choose the BEST possible answer

ON TEST DAY

1. Please bring a picture ID with you. A valid driver’s license, county ID, and passport are all acceptable forms of ID.
2. Please bring a #2 pencil with you.
3. Fill out all registration and test answer sheets in their entirety. Your full name as you would like it to appear on your certification card, your complete SSN and mailing address are necessary. Failure to provide this information, will delay the processing of your exam.
4. **DO NOT WRITE IN THE TEST BOOKLET!** All of your answers must be recorded on the answer sheet.
5. Cheating of any kind will not be tolerated. If someone is suspected of cheating, they will be removed from the classroom. They will forfeit their right to retake the exam.
6. In order to be successful on the exam, you must achieve a 70% or better on the exam.
7. Once the exam begins, you will not be allowed to access your cell phone or any other electronic device. Please turn them to silent prior to entering the classroom.
8. Once the exam begins, you will not be allowed to use the restroom. Please use the restroom before the exam begins.

Special Accommodations

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AMCA and the American School of Business pledge to comply with the provisions of the Americans with Disabilities Act. as amended (42 USCG Section 12101, et. seq.), and with Title VII of the Civil Rights Act, as amended (42 U.S.C. 2000e, et seq.), to the best of their ability.

If you need special accommodations because of a disabling condition, you may ask for special testing services. This request must be submitted in writing and included with your registration. All requests are handled on an individual basis.

If you are requesting special accommodations you must submit a letter from an appropriate healthcare professional that is licensed to evaluate the disability. The letter must be written on the healthcare professional’s letterhead and include the professional’s title, address and telephone number and date. The letter must also include a diagnosis of the disabling condition and explain why special testing accommodations are necessary. The letter must have an original signature from the professional and be dated no more than 2 years prior to registration of the exam.

Exam Challenges

If you have a question or believe any part of the exam was unfair or misleading, you can email customer service and your concerns will be forwarded to the appropriate department. When emailing, please include “Exam Challenge” in the subject line and email to: info@americanschoolnj.com.

Good luck on your exam!

Anatomy and Electrophysiology of the Heart

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The Heart consists of four chambers: Right and Left Atrium, Right and Left Ventricles. The blood flow through the heart must always go in one direction to make blood follow a certain path the heart consists of four valves: Tricuspid, Pulmonary, Mitral, and Aortic valves. The tricuspid and mitral valves are also known as the atrioventricular valves because of their position in the heart. Also assisting in the direction of blood flow through the heart are arteries and veins: arteries carry blood away from the heart and veins carry blood to the heart.

The heart receives its oxygen and nutrients from the coronary arteries that are located at the base of the aorta and it returns the blood through the coronary veins that empty into the right atrium.

The heart consists of a strong fibrous connective tissue that are considered the skeleton of the heart it protects the valves from opening during a contraction and also separates the atria from the ventricles to ensure separate contractions.

The cardiac cycle consists of two parts: diastole is the relaxation of the heart when the filling of the atria and ventricles occur. Systole is the contraction of the atria and ventricles and is when the blood that has filled the heart is pumped to the pulmonary system and the systemic system. This is when cardiac output occurs normally the heart ejects between 60-100 ml of blood this is called stroke volume. Cardiac output is the person’s heart rate $\times$ the stroke volume over 1 minute and is expressed in liters per minute.

Blood pressure is the force that blood exerts against the walls of the arteries as it passes through them it is obtained by measuring cardiac output $\times$ peripheral vascular resistance.

The autonomic nervous system can influence the rate and strength of contractions. The autonomic nervous system is divided into two divisions they are parasympathetic which slows the heart and is referred to as the feed or breed system; sympathetic nervous systems which speeds up the heart and is referred to as the fight or flight system.

The heart cells have four unique properties that allow them to function they are: automaticity—the ability to produce an electrical impulse; excitability—the ability to respond to an electrical stimulus; conductivity—the ability to transport an electrical stimulus; contractility—the ability to contract when stimulated.

Depolarization of the cells occurs when positive electrolytes move from outside to inside the cell causing the cell to become positively charged. The electrolytes that produce these positive and negative charges are mainly sodium, calcium, and potassium.

The electrical impulse is initiated at the sinoatrial node which has an intrinsic rate of 60-100 beats per minute. It then flows through the atria to the atrioventricular node which slows the impulse down to American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
allow for the filling of the ventricles from the atria and has an intrinsic rate of 40-60 beats per minute. The impulse then goes into the purkinje fibers system which has an intrinsic rate of 20-40 beats per minute, to be distributed throughout the ventricles.

**The Electrocardiogram**

The electrocardiogram is the graphic record or tracing of the heart’s electrical activity; the electrocardiograph is the machine with color coded or numbered lead wires that are placed on the electrodes that are attached to the patient’s skin.

ECG rhythms may be shown on a display called an oscilloscope or printed on graph paper with static tracing. The graph paper used to record ECG’s consists of horizontal and vertical lines that form grids the smallest of the squares represents .04 seconds in duration horizontally or .1 millivolt vertically. The larger squares equal five small squares which read as .20 seconds horizontally or .5 mV vertically. You can use the horizontal figures to get distance and rate of the waveforms. You can use the vertical figures to measure amplitude of the waveforms.

Any abnormal rhythm is called a dysrhythmia. Artifact on a rhythm has no relationship the electrical activity of the heart and can be caused by patient movement, shivering, muscle tremors, or loose electrodes.

Each lead provides a different view of the heart. Impulses that travel toward a positive electrode are recorded as upward deflections. Impulses that travel toward a negative electrode are recorded as a downward deflection.

**Reading an ECG**

The ECG technician should read and ECG in a systematic manner. Always remember to compare your ECG findings to the patient: some dysrhythmias can be life threatening and some can be no problem to the patient.

The five steps in analyzing an ECG are: heart rate, regularity, P-waves, QRS complex, and P-R interval.

Heart rate- normal rate for an adult is between 60-100 bpm. Heart rates above 100 are called Tachycardia, heart rates below 60 are called bradycardia. There are four methods for obtaining a heart rate: 6-second interval X 10 method- involves counting the number of QRS complexes on a 6 second rhythm and multiplying that number by 10, this is the only method that can be used on an irregular rhythm. The 300,150,100,75,60,50 method- involves locating an R-wave on a bold line on the ECG paper then finding the next consecutive R wave and counting down from 300 on the subsequent bold lines to determine the rate. 1500 method- you count number of small squares between two consecutive R-waves and divide that number by 1500, it is the most accurate method of obtaining the heart rate but can only be used on regular rhythms. Rate calculators are devices that you use to measure between R-waves and it gives you the rate.

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You count the QRS complexes to get the Ventricular rate and count the P-waves to determine the atrial rate.

Regularity is the second step in analyzing and ECG. To find this you measure the distance between all the R-R waves on the strip and if they are all the same the rhythm is called regular if not the rhythm is called irregular and irregular rhythms are considered abnormal. You can also measure the P-waves and this is called the P-P interval to see if they are regular.

Methods used to measure these intervals are calipers- which involves using a device called a caliper to measure the intervals, which is the quickest and easiest method. Paper and pen method- which involves using a piece of paper and marking an R-wave then marking the next R-wave and using that to judge the R-waves of the rest of the rhythm. The last method is to count the small squares between each R-R interval and see if they are all the same, this method takes longer but does not require any equipment to use.

Types of irregularities that you may find are irregularly (totally) irregular- which means there is no consistency to the rhythm such as atrial fibrillation, patterned irregularity- is where the irregularity repeats over and over such as AV-heart blocks, slightly irregular- is where there is an abnormality that does not occur very often such as one PVC in a rhythm strip, and very irregular rhythms-which means there are multiple occurrences of an abnormality such as a PVC or PAC in one rhythm strip.

- Upright, round P waves occurring at regular intervals at a rate of 60 to 100 beats per minute
- PR interval of normal duration (0.12 to 0.20 seconds) followed by a QRS complex of normal upright contour, duration (0.06 to 0.12 seconds) and configuration
- Flat ST segment followed by an upright, slightly asymmetrical T wave

**P- waves**
A normal P-wave is upright and rounded in Leads I, II, avF, and V2 thru V6, they should have a duration of .06 to .10 sec. and an amplitude of .5 to 2.5mm. P-waves signify the pulse initiating at the SA node and depolarizing the atria. Abnormal P-waves are called P prime waves (P') and may come from an irritated part of the atria and have a different morphology from normal P-waves.

You can separate the P-wave into two parts the first half of the P-wave is the depolarization of the right atrium and the second half is the depolarization to the left atrium. If there is a dilation of the right atrium then the P-wave will have higher amplitude and be tall and rounded, if there is a dilation of the left atrium then the P-wave will be notched or elongated.

Inverted P-waves indicate that the impulse started in or around the AV node. If you have more P-waves than ORS complexes then the impulse was blocked at the AV junction and you have a AV heart block.

**QRS complexes**

Normal ORS complex should be .06 to .12 sec. in duration and 5mm to 30mm in amplitude. A normal QRS complex indicates the impulse originated above the ventricles and traveled through the ventricles in a normal fashion.

The Q-wave is the first negative deflection from the base line after the P-wave. The R-wave is the first positive deflection from the base line after the P-wave. The S-wave is the first negative deflection that extends below the base line after the R-wave. These definitions are literal and if one wave is missing then you drop that wave from the complex name (i.e. no negative deflection before the R-wave then you have a RS complex).

Abnormal QRS complexes are produced by abnormal depolarization of the ventricles. The duration of abnormal complexes is usually greater than .12 sec. abnormal QRS complex varies widely and can have strange, wide, and bizarre shapes. Very tall QRS complexes are usually caused by hypertrophy of one or both ventricles. Abnormally small or low-voltage complexes are seen in obese patients, hyper-thyroid patients, and pleural effusion.

**P-R intervals**

The P-R interval is the distance from the beginning of the P-wave to the beginning of the Q-wave or R-wave. It signifies the depolarization of the heart from the SA node through the atria and AV node. The duration of the P-R interval should be .12 to .20 sec.

P-R intervals are considered abnormal if they are shorter, longer, or absent. Shorter P-R intervals indicate the impulse originated in or around the AV node. Longer P-R intervals indicate the impulse was slowed down more than it should have been usually in the AV node. Absent P-R intervals indicate that there are too many impulses in the atria to signify a P-R interval (i.e. atrial fibrillation or flutter).
Sinus Dysrhythmia

Sinus dysrhythmias originate from the SA node with that being the case there are only four dysrhythmias that are associated with the SA node: Tachycardia (heart rate over 100bpm), Bradycardia (heart rate under 60bpm), sinus arrest (the total absence of the p-wave, QRS-complex, and T-wave), sinus dysrhythmia (is the same as sinus rhythm except there is the presence of a patterned irregularity that can be described as slowing the speeding up then slowing again) this will usually happen with the inspiration and exhalation cycle (normal finding in children, athletes, and older patients)

Atrial Dysrhythmia

Atrial dysrhythmias originate outside the SA node in the atrial tissue or in the intermodal pathways.

The three mechanism responsible for atrial dysrhythmias are:

Increased automaticity-the atrial cells spontaneously depolarize and initiate impulses before the SA node can generate its pulse.

Triggered activity- injured cells sometimes only partially repolarize and this can sometimes lead to repetitive ectopic firing that may lead to atrial or ventricular tachycardia.

Reentry- occurs when an impulse is delayed along a slow conduction pathway and the impulse is able to remain active long enough to produce another impulse during myocardial repolarization.

Key characteristics of atrial dysrhythmia are shortened or prolonged P-R intervals p-waves that differ in appearance from normal p-waves, and normal QRS-complexes.
Types of atrial dysrhythmias and characteristics:

**Premature Atrial Complexes**

Rate: Depends on the underlying rhythm

Regularity: depends on the number of PAC’s present

P-waves: may be upright or inverted, will appear different than those of the underlying rhythm

QRS complexes: Normal

PR interval: may be normal, shortened, or prolonged

**Atrial tachycardia**

Rate: 150-250 beats per minute

Regularity: regular

P-waves: may be upright or inverted will appear different from underlying rhythm

QRS-complex: Normal

PR interval- may be normal, shortened, or prolonged
Wandering Atrial Pacemaker

Rate: Usually between 60-100bpm

Regularity: Slightly irregular

P-waves: continuously change in appearance

QRS-complex: Normal

PR interval: varies

Multifocal atrial tachycardia

Rate: 100-150

Regularity: irregular

P-wave: constantly changing

QRS-complex: normal

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PR interval: varies

**Supraventricular Tachycardia**

Rate: usually above 250bpm

Regularity: regular

P-wave: cannot be identified

QRS-complex: normal

PR-interval: absent

**Atrial flutter**

Rate: atrial between 250-350, ventricular rate can vary

Regularity: may be regular or irregular

P-wave: absent (flutter waves)

QRS-complex: normal

PR-interval: absent

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Atrial fibrillation

Rate: atrial rate over 350bpm, ventricular rate can vary

Regularity: irregularly (totally) irregular

P-wave: absent (chaotic baseline)

QRS-complex: normal

PR-interval: absent

Junctional dysrhythmias

Junctional dysrhythmias originate in the AV junction around the AV node or Bundle-of-His.

Major characteristics of Junctional complex are P-waves that may be inverted, follow the QRS-complex, or absent and PR-intervals that will be shortened or absent.

Types of Junctional dysrhythmias:

Premature Junctional Complex

Rate: depends on the underlying rhythm

Regularity: occasional or frequently irregular depends on the number of PJC

ORS-complex: normal

PR Interval: short or absent

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Junctional escape rhythm

Rate: 40 to 60 bpm
Regularity: Regular
P-wave: inverted, absent, or occur after the QRS-complex
QRS-complex: normal
PR-interval: short or absent

Accelerated Junctional Rhythm

Rate: 60 to 100 bpm
Regularity: regular
P-wave: inverted, absent, or occur after the QRS-complex
QRS-complex: normal
PR-interval: short or absent

Junctional Tachycardia

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Rate: 100 to 180bpm

Regularity: regular

P-wave: inverted, absent, or occur after the QRS-complex

PR-interval: short or absent

**Ventricular dysrhythmias**

Ventricular dysrhythmias originate in the ventricles below the Bundle of His. Some may be benign while some may be life threatening.

Major characteristics of ventricular dysrhythmias are absent P-waves and wide bizarre QRS-complexes.

Types of ventricular dysrhythmias are:

**Premature ventricular complexes**

Rate: depends on the underlying rhythm

Regularity: occasionally irregular or very irregular depends on the number of PVC’s

P-wave: absent at the PVC

QRS-complex: the PVC will have a wide bizarre looking QRS

PR-interval: absent

Two PVC’s in a row are called a couplet

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Three PVC’s in a row are called a salvo, run, or burst and are considered ventricular tachycardia.

PVC’s occurring on or near the previous T wave (R on T) are likely to precipitate ventricular tachycardia or fibrillation.

**Idioventricular rhythm**

![Idioventricular Rhythm Diagram]

- **Rate:** 20-40 bpm
- **Regularity:** regular
- **P-wave:** absent
- **QRS-complex:** wide and bizarre
- **PR-interval:** absent

**Accelerated Idioventricular rhythm**

![Accelerated Idioventricular Rhythm Diagram]

- **Rate:** 40-100 bpm
- **Regularity:** regular
- **P-wave:** absent
- **QRS-complex:** wide and bizarre
- **PR-interval:** absent

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**Ventricular tachycardia** (may have a pulse or may not)

Rate: 100-250bpm

Regularity: regular

P-wave: absent

QRS-complex: wide and bizarre

PR-interval: absent

**Polymorphic ventricular tachycardia (Torsades de Pointes)** QRS complexes alternate between upright and downward deflections.

**Ventricular fibrillation** (produces no effective cardiac output)

Rate: 200-500bpm

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Regularity: totally chaotic

P-wave: absent

QRS-complex: wavy line

PR-interval: absent

The only effective treatment for Ventricular fibrillation is defibrillation

**Asystole**

Total absence of cardiac activity (Flat line)

**Pulseless Electrical Activity** - organized electrical activity that should result in a pulse but there is no pulse.

**Atrioventricular Heart Blocks**

1**st** degree - not a true block is only significant if it occurs suddenly in a person (may precede a heart block), noticed by a PR-interval that is consistently more than .20sec. in duration.

2**nd** degree, Type I

Rate: depends on underlying rhythm

Regularity: Patterned irregularity

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P-wave: more p-waves than QRS-complexes

ORS-complex: normal

PR-interval: progressively longer until a QRS-complex is dropped then the pattern starts over

2nd Degree, Type II

Rate: depends on the underlying rhythm

Regularity: may be patterned irregularity or irregular

P-wave: more p-waves than QRS-complexes

QRS-complex: normal

PR-interval: normal for all conducted beats

3rd Degree (total dissociation of the atria and ventricles)

Rate: normal atrial rate, slow ventricular rate

Regularity: atrial and ventricular rate are regular but not working together

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P-wave: more p-waves than QRS-complexes

QRS-complex: normal or wide and bizarre depends on where the impulse is from

PR-interval: absent

**Hypotrophy**- condition, in which the muscular wall enlarges to increase the strength of the contraction, usually happens in the ventricles.

**Dilation**- condition, in which the muscular wall thins and expands to accommodate more blood, usually happens in the atria.

**Preexcitation Syndromes**

**Wolff-Parkinson-White Syndrome (WPW)**- condition in which the impulse takes a different path than the AV-node (bundle of Kent), and is characterized by the slurring of the R-wave called the Delta wave. Patients with this are prone to SVT.

**Lown-Ganong-Levine Syndrome (LGL)**- impulse travels through the James fibers rather than the AV-node. Only indication of this in the ECG will be a shortened PR-interval.

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**PRACTICE QUESTIONS**

1. What is the most accurate method for acquiring heart rate?
   
   A. 6X10 method
   
   B. 1500 method
   
   C. QRS method
   
   D. 300, 150, 100, 75, 50 method
2. As an impulse moves toward a positive electrode it produces what type of deflection?
   A. Upward
   B. Downward
   C. Flat
   D. Negative

3. On ECG papers horizontal measurements are used to determine what?
   A. Electrical voltage of the waveforms
   B. Amplitude of the waveforms
   C. Cardiac output
   D. Heart rate

4. The initiation of the impulse in the SA node and its movement through the atria produce?
   A. P-wave
   B. PR interval
   C. QRS complex
   D. T-wave

5. Repolarization of the ventricles is represented by the?
   A. P-wave
   B. ORS complex
   C. T wave
   D. R wave

6. Artifact is?
   A. Produced by chaotic electrical activity found in the heart

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B. An easier way to interpret rhythms
C. Usually consistent across the rhythm strip
D. Problematic because it can mimic life-threatening dysrhythmias

7. Two PVC’s in a row are called a?
   A. Double
   B. Couplet
   C. Trigeminal
   D. Salvo

8. The heart valve that is situated between the right atrium and the right ventricule is called?
   A. The pulmonic valve
   B. The mitral valve
   C. The aortic valve
   D. The tricuspid valve

9. Automaticity means
   A. The ability of the myocardial cell to contract when stimulated by an electrical impulse
   B. The ability of certain cells to produce an electrical impulse without the need for outside nerve stimulation
   C. The ability to transmit an electrical stimulus from cell to cell throughout the myocardium
   D. The ability to respond to an electrical stimulus
10. Each small square running horizontally represents?
   A. 3 seconds
   B. .04 seconds
   C. 5mm
   D. 0.1mv

11. How many electrodes are used as part of a 12-lead ECG?
   A. 8
   B. 10
   C. 12
   D. 5

12. The third step of analyzing an ECG rhythm is?
   A. Evaluate the QRS complex
   B. Determine the heart rate
   C. Determine the regularity
   D. Evaluate the P-wave

13. The PR intervals get progressively longer in
   A. 1\textsuperscript{st} degree AV heart block
   B. 2\textsuperscript{nd} degree AV heart block, Type I
   C. 3\textsuperscript{rd} degree AV heart block
   D. Sinus dysrhythmia

14. A heart rate below 60 is called?
A. NSR
B. Bradycardia
C. Tachycardia
D. Fast

15. Atrial fibrillation has
   A. Longer PR intervals
   B. A regular rhythm
   C. No P-waves
   D. No QRS complex

Answers
1. B
2. A
3. D
4. A
5. C

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AMCA National Phlebotomy Review

The History of Phlebotomy

Hippocrates (the father of modern medicine) thought that disease was excess fluid in the body. Bloodletting became a common practice in his time. Barber surgeons were allowed to do certain practices such as bloodletting, leaching, cupping, shaving and enemas. The Greek term for phlebotomy literally translates into *phlebos*, meaning vein, and *tome*, meaning an incision.

Phlebotomy Today

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Phlebotomy is now practiced to:

- Obtain blood for patient monitoring, and diagnostic purposes
- Remove blood from patients for blood banking and transfusion purposes
  - Remove blood for therapeutic purposes
  - Venipuncture procedures
  - Capillary punctures

**Job Settings for Phlebotomist**

1.) Hospital (Inpatient) Settings
   - A.) Acute-care hospitals
   - B.) Specialty hospitals
   - C.) Urban or rural hospitals
   - D.) Hospital-based clinics
   - E.) Hospital-based emergency centers

2.) Ambulatory Care (Outpatient) Settings
   - A.) Health department clinics
   - B.) Community health centers
   - C.) Community-based mental health centers
   - D.) Prison health clinics
   - E.) Dialysis centers
   - F.) Home health agencies
   - G.) Home hospice agencies
   - H.) HMO’s
   - I.) Rehabilitation centers

**Professionalism Traits**
1.) Code of ethics
2.) Compassion and Sincerity
3.) Maturity and emotional stability
4.) Accountability
5.) Dedication
6.) Respect
7.) Good personal hygiene and sterile techniques
8.) Pride
9.) Team work
10.) Communication and education

**Communication**

A.) Feedback loop
   1.) Sender
   2.) Receiver
   3.) Feedback

B.) Basics:
   1.) Empathy
   2.) Respect
   3.) Gaining patient trust
   4.) Active listening
   5.) Feedback
   6.) Use simple terms patients can understand

C.) Verbal Communication
   1.) Language
   2.) Impairments

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3.) Cultural differences

4.) Tone

5.) Bedside manner

D.) Nonverbal Communication

1.) Kinesics – the study of nonverbal communication
   a.) kinesic slip – where verbal and nonverbal messages do not match

2.) Zones of comfort
   - intimate space (18 inches or closer)
   - personal space (18 in. to 4 ft)
   - social space (4 ft to 12 ft)
   - public space (12 ft or more)

3.) Active listening

4.) Culture

E.) Telephone Etiquette

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**Quality assurance**

A.) *Pre-analytical Phase Outside the Laboratory*

1.) Patient ID and information

2.) Isolation procedures

3.) Standard precautions

4.) Correct techniques for capillary or venipuncture

5.) Correct transportation and handling of specimens

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B.) Pre-analytical Phase Inside the Laboratory
   1.) Patient ID and information
   2.) Specimen registration and distribution
   3.) Correct centrifuge process
   4.) Correct storing for specimens
C.) Analytical Phase
   1.) Specimen testing
D.) Post-analytical Phase
   1.) Recording and reporting results
   2.) Follow up procedures

Legal Issues
A.) Assault – an act or threat causing another to be in fear of immediate battery
B.) Battery – intentional harmful or offensive touching or use of force on a person without consent or legal justification

C.) Litigation Process
   1.) Phase 1: Incident Occurs
   2.) Phase 2: Consultation with Attorney
   3.) Phase 3: The Trial
   4.) Phase 4: The Appeal
D.) Standard of Care
   -an implied concept that the health care worker will provide adequate care to patients

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E.) Malpractice

1.) Improper care of a patient from a health care worker
2.) Responsibility can fall on health care worker or physician

F) Confidentiality

1.) All information discussed about a patient should be on a need to know basis.
2.) The most common place confidentiality is breached is in elevators.
3.) All patient records and lab results should be in a secure location beyond the site of other patients or visitors.

HIPPA

A.) Patients must have written consent to have information to be disclosed to another party.

B.) All information will be kept confidential

C.) Informed Consent

1.) Voluntary consent by patient for health care provider to examine or perform procedures.
2.) Patient must be informed about procedures and given option to have procedure done.
3.) Patient will usually sign a consent form.

CLIA

A.) Agency that provides regulations to ensure the accuracy and quality of lab testing.

B.) Requires laboratory certifications by the federal government

C.) Blood collection procedures inspected regularly due to improper techniques causing false test results.

Infection Control

A.) Bloodborne Pathogens
1.) The most common occurring laboratory infection is **Hepatitis B**

2.) HIV (AIDS)

### B.) Universal Precautions

1.) OSHA Standards

2.) Needlestick and Safety Prevention Act

3.) PPE

### C.) Exposure Control

1.) Needlestick injury

2.) Incident report

3.) Follow up procedures

### D.) Chain of Infection

1.) Infectious agent – bacteria, fungus, protozoa, and viruses

2.) Reservoir – animal, human, equipment, food, soil, water

3.) Exit pathway – blood, exudates, excretions, and secretions

4.) Means of transmission – airborne, contact, droplet, vector, and vehicle

5.) Entry pathway – body orifices, mucous membranes, and broken skin

6.) Susceptible host – elderly, newborns, acute/chronically ill, immune suppressed, and unvaccinated

### E.) Breaking the Chain

1.) Proper hand hygiene

2.) Isolation Procedures

3.) Immunizations

4.) Proper nutrition

5.) Adequate rest
6.) Stress management

**Fire Safety**

A.) Classification of Fires

1.) Class A fire – wood, paper, or clothing and use a water based solution to extinguish

2.) Class B fire – flammable liquids and must block the source to extinguish

3.) Class C fire – electrical equipment and require nonconducting agents to extinguish

4.) Class D fire – combustible or reactive metals and must be extinguished with dry powder agents

B.) Fire Extinguishers

1.) Class A extinguishers use soda and acid or water to cool the fire

2.) Class B extinguishers use foam, or dry chemicals to smother the fire

3.) Class C extinguishers use dry chemical or nonconducting agents to smother the fire

4.) Class ABC extinguishers use dry chemical reagents to smother the fire. Can be used on Class A, B, or C fires.

C.) RACE

R – rescue
A – alarm
C – confine
E – extinguish

D.) PASS

P – pull pin
A – aim nozzle
S – squeeze trigger
S – Sweep base of fire

**Electrical Safety**

A.) Using Electrical Equipment
   1.) avoid using damaged power chords
   2.) avoid using any extension chords
   3.) avoid any electrical equipment while collecting blood
   4.) when available, try and use three pronged plugs

**Radiation Safety**

A.) Amount of radiation is determined by:
   1.) time: exposed to source
   2.) shielding: if anything is between you and the source of radiation
   3.) distance: how far person of object is away from source

**First Aid**

A.) External Hemorrhage
   1.) apply direct pressure to wound until bleeding stops or EMS arrives
   2.) if bleeding continues, keep applying cloth or gauze over the ones already on the wound

B.) Shock
   1.) common symptoms:
      a.) clammy, pale, cold skin

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b.) rapid weak pulse

c.) shallow or increased breathing rate

d.) staring eyes and expressionless face

2.) first aid for shock:

a.) maintain open airway

b.) call for assistance

c.) keep patient lying down with head lower than the rest of body

d.) attempt to control bleeding or other cause of shock if known

e.) keep patient warm until help arrives

C.) AHA Chain of Survival

1.) early access to care

2.) early CPR

3.) early defibrillation

4.) advanced care

Basics of Medical Terminology

A.) Word Elements

1.) Prefix – comes before the root word

2.) Root word - relating to specific body parts

3.) Suffix – comes after the root word

4.) Combining vowel- makes the word easier to say

B.) Body Direction Terms

American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
1.) Ventral – front part of body
2.) Dorsal – back part of body
3.) Anterior – in front of
4.) Posterior – toward the back part of body
5.) Medial – towards the midline of the body
6.) Lateral – towards the side of the body
7.) Proximal – closest to the point of origin
8.) Distal – away from the point of origin
9.) Frontal plane – divides the body into front and back portions
10.) Transverse plane - divides the body into upper and lower portions

D) Body Positions

1. Normal anatomic position – standing with arms lank and palms forward
2. Supine position – lying on back
3. Prone position – lying on stomach
4. Lateral recumbent position – lying on the side

**The Human Body**

**Homeostasis** – the human body strives to maintain its internal environment in a state of equilibrium or balance. “Steady State”

A.) The cardiovascular system

1.) Heart
   a.) A muscular organ the size of a fist
   b.) Has four chambers, and is slightly left of the midline in the thoracic cavity
   c.) Has three layers, the epicardium, myocardium, and endocardium
2. Blood
   a.) Blood is composed of water, solutes, and cells.
   b.) Adult humans contain 5 liters of blood.
   c.) Also referred to as the “river of life”
   d.) Fluid portion of blood is called plasma (55%) and the cellular portion is called formed elements (45%).

3. Formed Elements (Cells)
   a.) Erythrocyte – red blood cell (RBC)
   b.) Leukocyte – white blood cell (WBC)
   c.) Thrombocyte – also called platelets

4. Plasma (anticoagulated)
   a.) Plasma is the liquid portion of blood
   b.) Blood cells surrounded and encased by plasma
   c.) Plasma is composed of 10% dissolved solutes, and 90% water
   d.) Clear, to pale yellow colored fluid
   e.) Contains fibrinogen

5. Serum (clotted)
   a.) When a specimen is allowed to clot the blood cells mesh together in a fibrous substance.
   b.) Has the same chemical composition as plasma except does not contain fibrinogen
   c.) Blood cells contained within the fibrin clot.
   d.) Serum can be separated from the blood clot by centrifugation.
   e.) Clear, to pale yellow fluid

B) The Vessels and circulation

6. Arteries
American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
a.) Carry oxygenated blood away from heart in systemic flow

b.) Branch into arterioles and capillaries

c.) Normally bright red, have a pulse, and have thick elastic walls

7. Veins

![Diagram of blood vessels]

a.) Return blood to the heart

b.) Every vein but pulmonary veins contain deoxygenated blood and are normally dark red.

c.) Have thinner walls than arteries

d.) Antecubital area of the forearm is used for venipuncture

e.) Veins of the arm

1. Median cubital is the first vein of choice

2. The cephalic is the second vein of choice. This is the vein used for most obese patients.

3. The Basilic vein is the third vein of choice due to the location of the nerves by the vein.

f.) There are variations in venous patterns

8. Capillaries

American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
a.) Are microscopic one cell-thick vessels that link arterioles and venules that form a bridge between arteries and veins

b.) Only vessels that permit the exchange of CO2 and O2 between blood and other tissues

c.) Blood in the capillary bed is a mix of arterial and venous blood

II) Hemostasis and coagulation

1. Hemostasis

   a.) Hemostasis is the maintenance of circulating blood in the liquid state and the retention of blood in the vascular system by preventing blood loss.

   b.) Primary hemostasis

      1. Vasoconstriction - a rapid constriction of the vessel to decrease blood flow to the injured area.

      2. Platelet plug formation - Platelets degranulate, mesh together, and stick to injured vessel to form a plug and stop bleeding.

   c.) Secondary hemostasis

      1. Fibrin clot formation - coagulation factors are released and interact to form a blood clot. This seals off the damaged portion of the vessel.

      2. Common pathways:

         a.) Intrinsic pathway

         b.) Extrinsic pathway

            - Hemostatic plug

      3. Fibrinolysis - Final regeneration and repair of injured vessels. The clot slowly begins to dissolve while other cells continue to repair vessel.

2. Coagulation issues that affect phlebotomy

   a.) Drugs like heparin and Coumadin suppress clotting and may result in patient bleeding more than normal

Documentation, specimen handling, and transportation

I) Documentation basics
a. Components of medical or clinical record

b. Why is documentation so important
   i. Monitoring care
   ii. Coordination
   iii. Accreditation and licensing
   iv. Legal protection
   v. Research

c. Tips for documenting clinical information
   i. Accuracy
   ii. Objectivity
   iii. Briefly and legibility
   iv. Avoiding errors
   v. Timeliness

d. The college of American pathologists (CAP) an accrediting agency for clinical laboratories, requires a specimen manual be available for reference at all sites where specimens are collected.

II) Laboratory test requisition forms

a. Laboratory test requisitions
   i. Online interactive computer system
   ii. Manual system
      1. Multiple requisition forms serve as both laboratory request and report forms.
      2. The forms are easily detached and have clear copies
      3. Color coding can be used for different request forms
   iii. Barcodes and radio frequency identification (RFID)
1. Barcodes represent alphanumeric symbols in the form of light and dark bands

2. When bands are placed together they can correspond to a name or number

3. RFID does not require “line of sight” readers, it transmits data to wireless receivers

4. RFID are very fast and accurate

b. Specimen labels and blood collection lists

   i. Regardless of the method for submitting a lab test request. The info must include:
      1. Patient I.D. (name, registration, or I.D. number, location)
      2. Name of physician or person ordering the test
      3. Tests required
      4. Time and date of specimen collection
      5. Other pertinent clinical information when appropriate

c. Specimen handling and transport

   i. Specimen integrity
      1. Transport method
      2. Timing delays
      3. Temperature
      4. Movement or agitation
      5. Exposure to light
      6. Centrifugation methods

   ii. Centrifugation – must be balanced with same volume on both sides
      1. Serum
      2. Plasma
iii. Rule of thumb for processing blood samples

iv. Transportation of blood specimens
   1. Chilled specimens
   2. Photosensitive specimens
   3. Microbiological specimens
   4. Warmed specimens

d. Specimen delivery methods
   i. Courier
   ii. Hand delivery
   iii. Pneumatic tube
   iv. Automated transport vehicles

e. Specimen rejection

Blood collection equipment

I) Introduction to blood collection equipment

a. Venipuncture equipment
   i. Vacuum tube system (ETS), double pointed needle, and a safety plastic holder that covers needle.

   ii. Parts of the vacuum tube system

   iii. Blood collection tubes and additives

      1) Vacuum tube size defined by external tube diameter and length plus the maximum amount of the specimen being drawn

      2) Many coagulation factors create blood clotting, and coagulation can be stopped by different types of coagulants

      3) These coagulants often contain preservatives that extend the lifespan of Red Blood Cells

      4) Tops/closure codes for additives

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iv. Serum, plasma or whole blood for various assays

1) Gray topped tubes
   a. Contain potassium oxalate, and sodium fluoride, sodium fluoride and EDTA, sodium fluoride, or lithium iodoacetate and heparin
   b. Primarily used for glycolytic inhibition tests

2) Green topped tubes
   a. Contain the anticoagulants sodium heparin, ammonium heparin, or lithium heparin
   b. Used in various laboratory assays requiring plasma or whole blood
   c. Should not be used for collection for blood smears to be stained by Wright's stain

3) Lavender topped and light blue topped tubes
   a. The lavender topped vacuum tubes are used for most hematology procedures
   b. The lavender topped vacuum tubes are used for molecular diagnostic testing
   c. Many coagulation procedures such as APTT, and PT are done on blood collected in light blue topped vacuum tubes.
   d. If a light blue topped tube is under filled, coagulation results will be wrong.

4) Red and royal blue topped tubes
   a. A red topped tube indicates a tube without a coagulant
   b. The royal blue topped tubes are used for nutritional studies, toxicology, and therapeutic drug monitoring
   c. The royal blue is the trace element tube

5) Yellow topped tubes
   a. The additive is sodium polyanethol sulfonate (SPS)
b.) Mostly used in the microbiology department for blood cultures

6.) Blood culture bottles
   a. Anaerobic – with out air – Needles
   b. Aerobic – with air – butterfly needles

7.) Serum separator tubes (SST)
   a.) contain thixotropic gel
   b.) will be a red tiger topped tube or a gold tube

**Needles**

A.) Parts of a multi-sample needle
   1.) Bevel
   2.) Shaft
   3.) Threaded hub
   4.) Rubber sleeve over needle

B.) Needle size
   1.) The smaller the number of the needle the bigger it is.
      a.) most butterfly needles are usually a 23 to 25

C.) Parts of a syringe system
   1.) Bevel
   2.) Shaft
   3.) Hub
   4.) Graduated barrel
   5.) Plunger

**Clinical Analysis Areas**
A.) Hematology – department performs lab tests that identify diseases associated with blood and blood forming tissues. The most common test associated with this department is a CBC.

B.) Coagulation – the study of the ability of blood to form and dissolve clots. Tests are used to discover, identify, and monitor defects in the blood clotting mechanism. The most common test for this department is a PTT.

C.) Chemistry – performs most lab tests. This department is capable of performing discrete tests or metabolic panels from a single sample. Common chemistry tests are ALT, ABG, UA and CK.

D.) Serology or Immunology – tests deal with the body’s response to the presence of bacterial, fungal, or parasitic diseases that stimulate antigen-antibody reactions. Most common tests are ANA, cold agglutinins, and anti-HIV.

E.) Microbiology – analyzes the body fluids and tissues for the presence of microorganisms. Most common tests include Blood cultures, occult blood, and C&S.

F.) Blood bank or Immunohematology – department that prepares blood products to be used for transfusion purposes.

G.) Reference Laboratories – large independent labs that receive different specimens from other facilities located in the same area that provide routine analysis of blood, urine, tissues, and other patient specimens.

**CLSI Order of Draw**

A.) Sterile tube

B.) Light Blue coagulation tube

C.) Red

D.) SST – Red tiger top or gold top

E.) PST- Light green top – Lithium Heparin

F.) Green – Dark green top – Sodium Heparin

G.) EDTA – Lavender

H.) Glycolytic inhibitor tube – Gray

**Venipuncture Steps**

1.) Review Test Request
2.) Approach, Identify, and Prepare Patient – 3 way id system, and explain procedures

3.) Verify Diet Restrictions and Latex sensitivity

4.) Sanitize Hands and put on gloves

5.) Position Patient, Apply Tourniquet, and Ask Patient to make a fist

6.) Select Vein, Release Tourniquet, and Ask Patient to Open Fist

7.) Clean and Air-Dry Site

8.) Prepare Equipment

9.) Reapply Tourniquet, Uncap and Inspect Needle

10.) Ask Patient to Make a Fist, Anchor Vein, and Insert Needle

11.) Establish Blood Flow, Release Tourniquet, and Ask Patient to Open Fist

12.) Fill, Remove, and Mix Tubes in Order of Draw or Fill Syringe

13.) Remove Needle, Apply Gauze, Activate Needle Safety Device, and Apply Pressure

14.) Discard Collection Unit, Syringe Needle, or Transfer Device

15.) Label Tubes
   a.) patient’s first and last names
   b.) patient’s id number or date of birth
   c.) date and time of collection
   d.) phlebotomist initials
   e.) additional information (ex. fasting)

16.) Observe Special Handling Instructions
   a.) ammonia in a crushed ice slurry
   b.) cold agglutinin in 37 degree C or other warming device
   c.) bilirubin needs to be protected from light

17.) Check Patient’s Arm and Apply Bandage

18.) Dispose of Contaminated Materials

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19.) Thank Patient, Remove Gloves, and Sanitize Hands

20.) Transport Specimen to the Lab

Preanalytical Considerations

A.) Basal State – refers to the resting metabolic state of the body, usually early in the morning after fasting for at least 12 hours

B.) Physiologic Variables

   1.) Age
   2.) Altitude
   3.) Dehydration
   4.) Diet
   5.) Diurinal Variations
   6.) Drug Therapy
   7.) Exercise
   8.) Fever
   9.) Gender
   10.) Jaundice
   11.) Position
   12.) Pregnancy
   13.) Smoking
   14.) Stress
   15.) Temperature and Humidity

VADS and SITES

A.) Arteriovenous Shunt or Fistula - permanent surgical fusion of an artery and a vein that is typically created to provide access for dialysis

B.) Heparin or Saline Lock - catheter or cannula connected to a stopcock or cap with a diaphragm that provides access for administering medications.

C.) Intravenous Sites – When a patient has an IV in one arm, try the other arm. If a patient has an IV in both arms try a capillary puncture if possible. If not possible then specimen may be collected below the IV site.

Capillary Puncture Equipment and Procedures

A.) Puncture Equipment
1.) Lancet

B.) Collection Devices

1.) Microcollection Containers

2.) Microhematocrit Tubes and Sealants

C.) Tests That Can Not be Preformed on Capillary Punctures

1.) ESR

2.) Coagulation studies

3.) Blood cultures

4.) Tests that require large volumes of serum or plasma

D.) Order of Draw

1.) EDTA specimens

2.) Other additive specimens

3.) Serum specimens

E.) Capillary Puncture Steps

1.) review test request

2.) approach, id, and prepare patient

3.) verify diet restrictions and latex sensitivity

4.) sanitize hands and put on gloves

5.) position patient

6.) select the puncture site – must be warm and usually middle or ring finger for adults and children over 1 year old, and the heel of infants

7.) Clean and air-dry site

8.) prepare equipment

9.) puncture site and discard lancet

a.) on finger must puncture perpendicular to finger print whirls
b.) on heel do not puncture more than 2mm.

10.) wipe away the first drop of blood
11.) fill and mix tubes/containers in order of draw
12.) place gauze and apply pressure
13.) label specimens and observe special handling instructions
14.) check site and apply bandage
15.) dispose of used and contaminated materials
16.) thank patient, remove gloves, sanitize hands
17.) transport specimen to lab

Special Procedures

A.) 2-hour Post prenatal Glucose – (PP) means after a meal. Glucose specimen is collected 2 hours after a patient eats a meal

B.) Glucose Tolerance Test – (GTT) used to diagnose carbohydrate metabolism problems. Patient must eat well balanced meals 3 days prior to test and must fast at least 12 hours before the test. Patients must drink glucose prior to testing and have 5 minutes to finish the drink. Levels will peak within 30 minutes to an hour following glucose ingestion.

C.) Lactose Tolerance Test - same procedures as GTT but patient must drink lactose rather than glucose

D.) Bleeding Time Test - (BT) test is preformed on the forearm and uses a blood pressure cuff inflated to 40 mm Hg. Phlebotomist will use an automated incision device to puncture skin and will use filter paper to blot the blood drops. This is a timed test and phlebotomist will blot blood every 30 seconds until patient stops bleeding.

E.) Arterial Blood Gas (ABG) - most common site radial artery. Must use Modified Allen Test to see if patient has adequate circulation. Must cleanse the site with alcohol and then clean with iodine. Insert syringe needle at a 45 degree angle. When complete must apply pressure for at least 3 to 5 minutes.

Non-blood Specimens and Tests

A.) Urine- collection in temp measured cups. Check for clarity, specific gravity, color and odor. Usually a regular voided specimen is acceptable for a common UA. C&S testing is used for UTI symptoms. Must be a mid-stream clean catch specimen. Drug screening is random sample in clean covered American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
Pregnancy testing is used to identify the presence of HCG usually present in body after 10 days of conception. First morning specimen is preferred

1.) regular voided specimen
2.) midstream specimen
3.) midstream clean catch specimen
4.) catheterized specimen
5.) suprapubic specimen

B.) Cerebrospinal Fluid- (CSF) mostly obtained through a lumbar puncture and looks for cell counts, chloride, glucose, and total protein

Computers

A.) Computer networks
B.) Computer components
C.) Elements of the Computer
D.) General Computer Skills
E.) Computerization Trends
1. Which of the following is not a phlebotomist's duty?

   A.) Collecting blood specimens
   B.) Performing laboratory computer operations
   C.) Starting intravenous (IV) lines
   D.) Transporting specimens to the laboratory

2. A national organization that sets standards for phlebotomy procedures is the:

   A.) ASCP
   B.) NAACLS
   C.) NCA
   D.) CLSI

3. Which type of contact infection transmission involves transfer of an infective microbe to the mucous membranes of a susceptible individual by means of a cough or sneeze?

   A.) Direct
   B.) Droplet
   C.) Fomites
   D.) Indirect

4. Which of the following is a test of the respiratory system?

   A.) ABGs
   B.) CSF
   C.) TSH
   D.) UA
5.) The receiving chambers of the heart are the:
   A.) Atria
   B.) Chordae tendineae
   C.) Vena cavae
   D.) Venticles

6.) An individual's blood type is determined by the presence or absence of a certain type of
   A.) Antibody present on the red blood cells
   B.) Antibody present on the white blood cells
   C.) Antigen present on the red blood cells
   D.) Antigen present on the white blood cells

7.) Which of the following veins is not an antecubital vein?
   A.) Basilic
   B.) Cephalic
   C.) Femoral
   D.) Median cubital

8.) Which needle gauge has the largest lumen?
   A.) 18
   B.) 20
   C.) 21
   D.) 22

9.) Which government agency regulates the quality of gloves worn when performing phlebotomy
    procedures?
   A.) CDC/HICPAC

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B.) FDA  
C.) JCAHO  
D.) OSHA

10.) The tests performed in the following department are collected in a tube with a light blue stopper:
   A.) Chemistry  
   B.) Hematology  
   C.) Coagulation  
   D.) Microbiology

11.) Never leave a tourniquet on for more than
   A.) 30 seconds  
   B.) 45 seconds  
   C.) 1 minute  
   D.) 3 minutes

12.) You must draw a protime specimen from a patient with IVs in both arms. Which of the following is the best thing to do? Draw the specimen
   A.) Above an IV  
   B.) Below an IV  
   C.) From an ankle vein  
   D.) From an IV

13.) What is PKU?
   A.) A contagious condition caused by lack of phenylalanine  
   B.) A hereditary inability to metabolize phenylalanine  
   C.) An acquired condition caused by lack of phenylalanine

American Medical Association Certification, EKG/Phlebotomy Combo (EKG Certification and Phlebotomy Technician Certification Study Guide, 1/2011)
D.) An inherited condition caused by lack of thyroid hormone

14.) Which test requires strict skin antiseptic procedures before specimen collection?
   A.) Blood culture
   B.) Blood urea nitrogen
   C.) Complete blood count
   D.) Type and crossmatch

15.) Which of the following tests may require special “chain of custody” documentation when collected?
   A.) Blood culture
   B.) Crossmatch
   C.) Drug screen
   D.) TDM

16.) The hormone detected in positive urine pregnancy tests is:
   A.) ACTH
   B.) GH
   C.) HCG
   D.) TSH

17.) When performing the Allen test, which artery is released first?
   A.) Brachial
   B.) Femoral
   C.) Radial
   D.) Ulnar
18.) Which fluid is obtained by lumbar puncture?
   A.) Cerebrospinal
   B.) Peritoneal
   C.) Pleural
   D.) Synovial

19.) A urine C & S is typically ordered to detect:
   A.) Abnormal urine pH
   B.) Glucose spillage into the urine
   C.) Kidney damage
   D.) Presence of UTI

20.) Which statement describes proper centrifuge operation?
   A.) Centrifuge serum specimens before they have a chance to clot
   B.) Never centrifuge both serum and plasma specimens in the same centrifuge
   C.) Place tubes of equal size and volume opposite one another
   D.) Remove stoppers before placing tubes in the centrifuge
Answer Key

1.) C  
2.) D  
3.) B  
4.) A  
5.) D  
6.) C  
7.) C  
8.) A  
9.) B  
10.) C  
11.) C  
12.) B  
13.) B  
14.) A  
15.) C  
16.) C  
17.) D  
18.) A  
19.) D  
20.) C