

Diagnostic Tests and Laboratory Values



ANBLPN Self-Study Course



ANBLPN

Association of New Brunswick Licensed
Practical Nurses

AIAANB

L'Association des Infirmier(ère)s Auxiliaires
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Diagnostic Tests and Laboratory Values

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Introduction to Diagnostic Tests & Laboratory Values

Licensed Practical Nurses (LPNs) are responsible for providing safe, competent, compassionate, and ethical care to clients. It is an expectation of practice that they will use critical inquiry to review all assessment data to determine the best nursing care for each client. This course provides information and learning activities related to diagnostic tests and laboratory (lab) values, which are sources of client assessment data.

An LPN should understand the rationale for specific diagnostic and laboratory tests when providing care, as well as the implications from test results. This course lists common diagnostic and lab tests and values, with opportunities for participants to test their knowledge through case studies and quizzes.

Purpose

According to New Brunswick's legislated scope of practice and the *Entry Level Competencies for Licensed Practical Nurses*, LPNs possess the knowledge requirement for obtaining, assessing, and monitoring diagnostic tests and lab values through researching and responding to relevant clinical data, comprehending and responding to assessment findings, and using their critical thinking and clinical judgement for decision making (CCPNR, 2019). This course is intended to review and extend an LPNs knowledge pertaining to diagnostic tests and lab values to ensure safe and timely care to clients.

Course Outcomes

Upon completion of this course participants will:

- identify and describe commonly used diagnostic procedures and lab tests;
- describe commonly ordered diagnostic procedures and lab values;
- recognize principles of client teaching for the preparation and management of clients undergoing diagnostic and lab testing;
- differentiate normal from abnormal results; and
- implement appropriate action as it relates to results to maintain safe, competent, and ethical care to clients.

Course Outline

This course consists of four modules:

Module 1: Introduction and overview of diagnostic tests. This section gives the learner a brief overview of commonly ordered diagnostic tests used in a variety of settings where an LPN provides client care.

Module 2: Nursing implications for diagnostic tests. This module encourages the learner to apply knowledge of diagnostic tests through responding to nursing case studies.

Module 3: Overview of lab values. The topics discussed in this section focuses on values limited to the most ordered chemistry, hematology, and urine tests.

Module 4: Nursing implications for lab tests. This section provides an opportunity to integrate information from Module 3 to check the LPNs competence through quizzes.

Module 1: Diagnostic Procedures

Introduction

Diagnostic testing enables health care providers to diagnose, monitor, and treat conditions or anticipate changes in the health statuses of individuals. LPNs are involved in both direct and indirect care of clients where diagnostic procedures are anticipated (long-term care, maternity, pediatrics, community and public health, medical and surgical units in hospitals). Regardless of the practice environment, client teaching is vital to encourage collaboration with procedures and facilitate obtaining the most accurate results. The LPN is proactive in assisting clients undergoing diagnostic testing.

The following diagnostic tests will be discussed in this module:

Angiography	Electromyography (EMG)
Arthroscopy	Endoscopy
Bone Scan	Magnetic resonance imaging (MRI)
Bronchoscopy	Myelography
Computed tomography (CT scan or CAT scan)	Pulmonary function tests (PFT)
Cystoscopy	Radiography (X-ray) chest, abdomen
Doppler studies	Thallium scan
Echocardiography	Tilt-table test
Electrocardiogram (ECG, EKG)	Transesophageal echocardiogram (TEE)
Electroencephalogram (EEG)	Ultrasound (Sonography)

Module Outcomes

Upon completion of this module, the participant will be able to:

- list commonly used diagnostic tests;
- identify the indications for various diagnostic tests;
- explain the procedure(s) for various diagnostic tests;
- recognize interfering factors in diagnostic testing; and
- state the nursing implications of diagnostic tests.

Angiography

(Urden, Stacy & Lough, 2022)

Description

This x-ray test involves the injection of a radiopaque contrast medium and the use of a camera (fluoroscopy) to take pictures and trace the blood flow in an artery (e.g., aorta) or a vein (e.g., vena cava).

Common angiograms look at arteries close to the heart, lungs, brain, head or neck, legs or arms, and the aorta. The information obtained helps to inform surgeons on choosing which operative approach to take and provides information for medical management decisions.

Indications

- To find the cause of chest pain or pressure (e.g., from myocardial infarction, angina, or pericarditis).

Procedure

1. A thin tube (catheter) is placed into a blood vessel in the groin or wrist (femoral or radial artery or vein) or just above the elbow (brachial artery or vein) and guided to the specific area.
2. The contrast medium is injected into the vessel to make the area show clearly on X-ray pictures.

Interfering Factors

- Movement during the procedure can distort the X-ray picture.

Nursing Implications

- Make sure the consent form is signed.
- Explain the procedure to the client and provide support.
- Instruct the client to be NPO for 8–12 hours before the test (check facility policies).
- Discontinue anticoagulants before the test.
- Monitor for excessive bleeding post-test.
- Record vital signs pre- and post-test.
- Adjust vascular closure devices.

Arthroscopy

(Lewis, Bucher Heitkemper, Harding, Barry, Lok, Tyerman & Goldsworthy, 2019 and Pagana & Pagana, 2018)

Description

A small fibre optic tube (arthroscope) is inserted into a joint (most commonly the knee) which examines the interior of the joint cavity. Other structures that may be visualized include the shoulder, elbow, wrist, jaw, hip, or ankle.

Indications

- Evaluate the knee for meniscus cartilage or ligament injury.
- To diagnose abnormalities of the meniscus, articular cartilage, ligaments, or joint capsule;
- To detect foreign bodies associated with gout, pseudogout, and osteochondromas;
- To obtain a biopsy of the synovium or cartilage.

Procedure

1. Local anesthetic is administered, and an incision is made in the skin surrounding the joint. The arthroscope is inserted into the joint to visualize the area.
2. Photographs and videos are then taken throughout the procedure to allow for extensive visualization of the joint cavity.
3. After the procedure, the joint is irrigated, the arthroscope is removed, and pressure is applied to the area to remove the irrigating solution.

Interfering Factors

- None reported.

Nursing Implications

- Make sure the consent form is signed.
- Ensure client fasts after midnight the day before the procedure.
- Shave the area 6 inches above and below the joint.
- Watch for fever and swelling, increased pain, and localized inflammation at the incision site.
- Administer analgesics as ordered.
- Cover wound with sterile dressing following the procedure.
- Monitor client's circulation and sensation in the leg.
- Instruct the client to report fever, bleeding, drainage, or increased joint swelling or pain.
- Tell the client that showering is permitted after 48 hours, but baths should be avoided until the postoperative visit.
- Apply ice to reduce any swelling or pain.

Bone Scan

(RSNA, 2022 and Pagana & Pagana, 2018)

Description

A bone scan (skeletal scintigraphy) creates images of your bones by injecting a small amount of radioactive material (radiotracers) into the blood stream. The radiotracer travels to the area to be examined which creates images of your bones.

Indications

- Detect bone cancer or determine if cancer in another area of the body has spread to the bones.
- Diagnose cause or location of unexplained bone pain.
- Diagnose broken bones (stress fractures or hip fractures not clearly seen on an x-ray).
- Detect bone damage caused by infection or other conditions.

Procedure

1. The client will lay on an exam table and the technologist will administer the radiotracers into the vein of the hand or arm.
2. Client will drink several glasses of water between the time of the injection and scanning to facilitate renal clearance of any circulating tracer that did not adhere to the bone.
3. The radiotracer will circulate throughout the body and bind to the bones to allow pictures to be taken. Clients may need to change positions in between images.

Interfering Factors

- If bladder is not emptied urine may block the view of pelvic bones during the scan.
- Movement may impact the ability of the scanner to take pictures.

Nursing Implications

- Make sure the consent form is signed and client has emptied bladder before the procedure.
- Advise the client to drink lots of fluids in the interval between injection and actual scanning (about two to four hours).
- Inform client they will need to lay still while the scanner takes pictures.
- Check injection site for redness and swelling.
- Instruct client to increase their fluid intake after the procedure and to void regularly as isotopes will be excreted within 6 – 24 hours.

Bronchoscopy

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

Procedure that visualizes the larynx, trachea, and bronchi through a fiberoptic bronchoscope.

Indications

- To obtain sputum specimens, remove foreign bodies, and biopsy specimens.
- To aspirate excessive sputum or mucous plugs.
- View and assess for abnormalities of the mucosa, abscesses, strictures, and tumors
- May also be used for laser ablation of endotracheal lesions.

Procedure

1. The test is conducted while the client is lying supine or in Semi-Fowler's position with head hyperextended.
2. Local anesthetic is applied to the nasopharynx and oropharynx, and the bronchoscope is coated with lidocaine. The bronchoscope will be inserted through the client's nose or mouth and into the pharynx. It is performed by a surgeon or pulmonary specialist and takes approximately 30 to 45 minutes.

Interfering Factors

- Improper labelling of specimens.

Nursing Implications

- Make sure the consent form is signed.
- Explain the procedure to the client and provide support.
- Instruct client to be NPO for 4 - 8 hours before the test to reduce the risk of aspiration.
- Administer pre-medications as ordered (e.g., atropine to dry the mouth).
- Monitor vital signs and pulse oximetry pre and post-test.
- Advise the client that the procedure takes approximately one hour.
- Recognize complications post-test: fever, infection, hypoxemia, hypotension, laryngeal edema, bronchospasm, pneumothorax, and bleeding from the biopsy site.
- Monitor client's gag reflex before giving food or liquids.
- Inform client that warm saline gargles and lozenges may help if sore throat develops.

Computed Tomography (CT scan or CAT Scan)

(Potter, Perry, Stockert & Hall, 2019 and Pagana & Pagana, 2018)

Description

A radiographic examination of the abdominal organs and pelvis taken from various angles using a scanner. The images obtained are then analyzed by a computer.

Indications

- To diagnose pathological conditions in the abdomen and pelvis (tumors, cysts, abscesses, inflammation, calculi, perforation of the bowel, ureteral obstructions) and monitoring diseases.
- To guide needles during biopsy of a tumor and aspirating fluid.
- To stage neoplasms.

Procedure

1. Client lies on CT table, table advances through a ring-shaped scanner, which take hundreds of images of the abdomen and pelvis.
2. The images are then displayed onto a computer screen and recorded digitally. Client is instructed to hold their breath during x-ray exposure.
3. If better visualization is required, an oral or IV contrast dye is administered to the client.

Interfering Factors

- Client must lay still throughout the procedure. Motion will blur the images.
- Presence of metal objects (watch, jewelry).
- Large presence of fecal material or gas in bowel (an enema may be ordered).
- **Pregnant women must not undergo a CT scan due to high exposure of radiation that could damage the fetus.*

Nursing Implications

- Ensure consent form is signed and explain the procedure to the client.
- Instruct client to remove any metal objects and obtain history of allergies to contrast dye or allergies to seafood or iodine.
- Ensure client is NPO 4 hours before the test (contrast dye causes nausea) and IV site is patent before the test.

- Advise the client that if contrast dye is used, a warm, flushed sensation may be felt in the face or body.
- Inform the client that the test may take approximately 30 minutes to one hour to complete.
- Encourage fluids after the procedure to avoid dye-induced renal failure and to promote the excretion of the dye.
- Inform client that diarrhea may occur after ingesting the oral contrast.
- Monitor client for delayed allergic reaction to the contrast dye (rash, hives, dyspnea); treat with antihistamine or steroids if this occurs.

Cystoscopy

(Lewis et al., 2019)

Description

A radiological diagnostic test to inspect the bladder and urethra using a tubular lighted endoscope called a cystoscope. Usually performed by a urologist.

Indications

- To detect calculi (stones).
- To obtain biopsy specimens of bladder lesions.
- To determine bladder disorders (UTI, dysuria, and hematuria).

Procedure

1. The test is conducted under local anesthesia (inserted into the urethra) or general anesthesia.
2. Check with the specialist regarding NPO status before the test.
3. The client lays in the lithotomy position (lying flat with legs and feet in stirrups).
4. The scope is entered through the urethra, and a saline solution is instilled slowly to distend the bladder, making it easier to visualize.

Interfering Factors

- None reported.

Nursing Implications

- Ensure consent form is signed, explain the procedure, and provide support.
- Offer sedation up to an hour before the test.
- Assess urinary patterns (amount, colour, odour).
- Take vital signs pre-and post-test. Client may experience orthostatic hypotension afterwards so should not let them walk alone immediately following the procedure.
- Explain that burning upon urination, pink-tinged urine, and urinary frequency are expected after the procedure. Inform client to report any *bright red* bleeding or *clots* as this would not be normal.
- Following the procedure ensure that the client stays well hydrated, offer warm sitz bath, heat, or mild analgesics to relieve any discomfort afterwards.

Doppler Studies

(Pagana & Pagana, 2018)

Description

Doppler ultrasonography evaluates blood flow in the major blood vessels of the arms and legs and within the extracranial cerebrovascular system.

Indications

- To identify occlusion or thrombosis of the veins.
- To detect abnormal carotid blood flow.
- Evaluate patency of the venous system in clients with a swollen painful leg, venous varicosities of the upper and lower extremities, or edematous extremities.

Procedure

1. A gel lubricant is applied to the areas and a handheld transducer directs high-frequency sound waves to the artery or vein being tested (usually ankle, calf, thigh, or groin of lower extremities).
2. The sound waves strike moving red blood cells and are reflected back to the transducer at frequencies that correspond to blood-flow velocity through the vessel.
3. The transducer then amplifies the sound waves to permit direct listening and graphic recording of blood flow. A “swishing” sound indicates a patent venous system, failure to hear this sound indicates an occlusion.

Interfering Factors

- Nicotine use may cause constriction of the peripheral arteries and alter the results.

Nursing Implications

- Make sure the consent form is signed.
- Explain the procedure to the client and provide support.
- Instruct client not to smoke for at least 30 minutes before the test.
- Remove clothing from extremity to be examined.
- Apply water-soluble conductive jelly to the tip of the transducer to provide coupling between the skin and the transducer.
- After the procedure, remove the conductive jelly from the skin.
- Take vital signs pre-and post-test.

Echocardiography

(Lewis et al., 2019)

Description

Provides ultrasound imaging of cardiac activity. A transducer is placed in 4 positions on the chest above the heart. The transducer emits and receives ultrasound waves and records the waves that are bounced off the heart.

Indications

- To evaluate cardiac structures and function.
- To measure cardiac output (volume of blood).
- To identify the cause of abnormal heart sounds.
- To assess damage to muscles, dysfunction of valves, and abnormalities of blood flow.
- To evaluate myocardial disease.

Procedure

1. Performed with the client positioned supine on their left side.
2. EKG leads are placed and an acoustic gel applied to the skin over the chest.
3. Transducer moved over chest and upper abdomen to obtain images.

Interfering Factors

- Dressings and scarring of the chest may adversely affect results.
- Images can be hard to capture in clients who are obese, have barrel chest from COPD, or if they are on a respirator. Contrast may need to be used to overcome this difficulty.

Nursing Implications

- Explain the procedure to the client and provide support.
- Remove gel from the client's chest.
- Inform the client that the test usually takes 15 to 45 minutes to complete.

Electrocardiogram (ECG, EKG)

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

A test that records the electrical activity of the heart. The activity is shown on paper as “waves”. The letters P, QRS, T and U are used to identify and separate the wave forms.



Indications

- To find the cause of chest pain or pressure (e.g., from myocardial infarction, angina, or pericarditis).
- To find the cause of symptoms related to cardiac health (arrhythmias, hypertrophy, conduction defects).
- To determine the effectiveness of medications and check on implanted devices (pacemaker).

Procedure

1. Performed with client lying in a supine position with head of bed no higher than 30 degrees.
2. Certain areas on the arms, legs, and chest may be cleaned with alcohol swabs and shaved to improve electrode adhesion.
3. ECG leads are affixed to the client’s chest wall by means of an electrode pad that has had electrode conductive gel applied to it.

Interfering Factors

- If ECG leads and electrodes are not firmly placed a distortion of the wave forms may be seen.
- Muscle activity or electrical interference from another source may also distort the sound waves.
- Electrolyte imbalances.

Nursing Implications

- Explain the procedure to the client and provide support.
- Assist in removing all jewelry from the neck, arms, and wrists.
- Inform the client that tests usually take 5 to 10 minutes to complete.
- Remove electrodes and wipe off electrode gel.

Electroencephalogram (EEG)

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

A test that measures and records the electrical activity of the brain using scalp electrodes. Test normally takes between 20-40 minutes.

Indications

- Diagnose coma, encephalopathies, and brain death.
- Detect pathologic conditions of the brain cortex (tumors, infarction).
- Identify and evaluate clients with seizures (epilepsy).

Procedure

1. Client is placed in the supine position while electrodes (16 or more) are placed on the scalp with a conductive gel/paste.
2. Electrodes are then attached to individual wires that extend to a computer.
3. Computer records the brain's electrical activity.

Interfering Factors

- Certain medications (e.g., stimulants, sedatives, and hypnotics) may need to be held as can affect the results.
- Stimulants such as coffee, tea, or pop should not be taken before testing due to stimulating effects.
- Oily hair and hairspray.
- Movement can create interference and alter the EEG recording.

Nursing Implications

- Make sure the consent form is signed.
- Explain procedure to the client and provide support (painless, no risk of electric shock).
- Instruct to wash hair the night before the test (oils, sprays or lotion should not be used).
- Assist client to wash electrode paste out of hair post-test.
- Ensure safety until the effects of any sedatives have worn off (i.e., bed rails up).
- If EEG is conducted under little or no sleep, plan to have client get a ride home after the test.

Electromyography (EMG)

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

Records the electrical activity associated with nerves and skeletal muscles.

Indications

- To detect muscle and peripheral nerve disease.
- Evaluate clients with diffuse or localized muscle weakness/atrophy.

Procedure

1. Needle electrodes are inserted percutaneously into a muscle.
2. The muscle's electrical discharge (or motor unit potential) is recorded and displayed on an oscilloscope screen.
3. Client contracts the muscle slowly and progressively.

Interfering Factors

- Drugs that affect myoneural junctions, such as cholinergic, anticholinergics, and skeletal muscle relaxants, will interfere with EMG results.
- Edema, hemorrhage, or thick subcutaneous fat can interfere with electrical waves.

Nursing Implications

- Make sure the consent form is signed.
- Explain the procedure to the client and provide support.
- Restrict cigarettes, coffee, tea, and cola for two to three hours before the test.
- Check for a history of medications that may interfere with test results.
- Observe the needle site for hematoma or inflammation post-procedure.

Endoscopy

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

A test that provides direct visualization of internal body organs and cavities through an endoscope (lighted fiber-optic instrument).

Indications

- Visualization of gastrointestinal structures (esophagus, stomach, duodenum, colon, and pancreas).
- To obtain biopsy of suspicious tissues.
- Removal of polyps.

Procedure

1. This test is conducted under local anesthesia and/or with IV sedation.
2. Attached cameras will take photos and videos.

Interfering Factors

- Barium from previous GI testing can interfere with visualization of the mucosa.

Nursing Implications

- Make sure the consent form is signed, explain the procedure to the client and provide support.
- Client may need to be NPO at least 8 hours prior depending on the type of endoscopy performed (i.e., gastroscopy).
- Administer short-acting IV sedatives.
- Dentures, eyeglasses, jewelry, and clothing should be removed from the neck to the waist.
- Encourage the client to void before the test.
- Record pre-and post-test vital signs.
- Depending on the type of endoscopy, client may be NPO after the procedure until the gag reflex returns.

Magnetic Resonance Imaging (MRI)

(Lewis et al., 2019 and Pagana & Pagana, 2018)

Description

Scanner that provides detailed images of the brain, spinal cord and spinal canal, neck, bones and joints, heart, and the breasts by using strong magnetic fields and radio waves.

Indications

- To detect head trauma (bleeding or swelling), benign or malignant neoplasms in the brain, renal disease, cardiac disease, biliary disease, multiple sclerosis, tumors, trauma, herniation, and seizures.
- To stage disease in the spine, head, heart, bone/joints, and abdomen.

Procedure

1. The client must lie still on a narrow table that slides into a cylinder-shaped tubular magnet for scanning.
2. A contrast medium may need to be administered via IV if required.
3. The procedure takes approximately 45 minutes to an hour to perform.

Interfering Factors

- Movement during the procedure can distort images.
- Metal in the body could cause critical injury to the client.
- **MRIs are contraindicated for clients who have pacemakers, implanted cardiac defibrillators, insulin or infusion pumps, aneurysm clips, cochlear or ear implants, IUDs or diaphragms, or implanted drug infusion devices.*

Nursing Implications

(Potter et al., 2019)

- Consent form must be signed.
- Ensure client remains NPO 4 – 6 hours before the examination and ensure they void before the test for comfort.
- Remove all metallic objects (jewelry, hair pins, retainers, metal in clothing). Inquire if client has any metal prosthetics.
- If client is wearing a patch with a metallic foil backing (i.e., nicotine patch) it must be removed as these patches will become intensely hot during the MRI and can cause burns.
- Ask the client about any concerns related to claustrophobia; relaxation techniques or sedative might be used.

Myelography

(CLPNA, 2018 and Pagana & Pagana, 2018)

Description

Myelography combines fluoroscopy and radiography to evaluate the spinal subarachnoid space of the spinal canal after injection of a contrast medium. The contrast medium should flow freely through the subarachnoid space, showing no obstruction or structural abnormalities.

Indications

- To locate a spinal lesion, herniated disk, spinal stenosis, or abscess.
- To detect arachnoiditis, spinal nerve root injury, and skull tumors.

Procedure

1. Client lies prone for lumbar puncture; under fluoroscopy a needle is inserted to remove 15-ml sample of cerebral spinal fluid. Equal amount of a water-soluble contrast dye is injected into spinal canal and table is tilted to distribute the contrast dye.
2. The fluoroscope allows visualization of the flow of the contrast medium and the outline of the subarachnoid space to determine if there are any lesions or obstructions.
3. After views are obtained the needle is removed and the site is dressed.

Interfering Factors

- *Anticoagulants or medications that lower seizure threshold may be withheld 48 hours prior to test.

Nursing Implications

- Make sure the consent form is signed.
- Instruct the client to restrict food and fluids for eight hours before the test.
- Check for hypersensitivity to iodine and iodine-containing substances, contrast media, and drugs associated with the procedure.
- If the client received a water-based contrast medium, elevate the head of the bed 30 to 45 degrees for six to eight hours following the test.
- Monitor vital signs, neurologic status, and intake and output.
- Encourage the client to drink extra fluids following the procedure to help excrete contrast.
- If fever, back pain, or signs of meningeal irritation (headache, fever, or neck stiffness) develop, keep the room quiet and dark, and provide an analgesic or antipyretic as ordered.
- Client may resume usual diet and activities the day after the test.

Pulmonary Function Tests (PFT)

(Potter et al., 2019)

Test that measures lung volume (amount of air moving in and out of lungs) and capacity (how much air the lung can hold). The test is usually performed by a respiratory therapist.

Indications

- To diagnose pulmonary diseases (COPD, asthma, emphysema).
- To monitor the disease progression.
- Evaluate response to bronchodilators.
- Evaluate postoperative lung conditions.

Procedure

Spirometry	Exercise Stress Test
The most common lung function test. Client's age, sex, height, and weight are entered into the PFT computer to calculate predicted values.	Client either walks on a treadmill or rides a stationary bike to show how the heart works during physical activity.
Client forcefully exhales as hard and fast as possible into the spirometer mouthpiece several times.	While exercising the clients heart rate, blood pressure, and breathing is monitored.
PFT computer determines the actual value achieved, predicted value, and percentage of the predicted value.	A spirometry reading is taken before, during, and after exercise and again when the client is at rest.

Interfering Factors

- The use of bronchodilators before the PFT may return false results.
- Lack of client cooperation or misunderstanding instructions.

Nursing Implications

(Lewis et al., 2019)

- Make sure the consent form is signed, explain the procedure, and provide support.
- Avoid scheduling the test immediately after a meal and avoid administering bronchodilators for 6 hours prior to the test.
- Advise the client not to smoke for at least four hours before the test.
- Provide verbal coaching to ensure client blows out until exhalation is complete.
- Assess for signs and symptoms of respiratory distress.
- Record vital signs pre-and post-test.

Radiography (X-Ray) Chest, Abdomen

(RadiologyInfo, 2022 and Pagana & Pagana, 2018)

Description

Radiography is the most common x-ray study. A small dose of radiation is used to produce pictures of the heart, lungs, airways, blood vessels, and bones of the spine and chest.

X-Ray Chest

Indications

- To evaluate the lungs, heart, and chest wall and detect any tumors in these areas.
- Diagnose shortness of breath, inflammation or infection in the lungs, persistent cough, chest pain or injury.
- Assess the progression of a disease and response to treatment (pneumonia, emphysema, cancer).

Procedure

1. Clothing removed to the waist, and the client is either sitting or supine.
2. Client should take a deep breath and hold it until the images are obtained.
3. Food and fluids are not restricted.

Interfering Factors

- Incorrect positioning and inability to hold breath (due to COPD, severe pain, or shortness of breath) can affect image quality.
- Pacemaker, jewelry, or other metallic components can obstruct identification of radiographic findings.

Nursing Implications

- Explain the purpose and procedure and reassure the client.
- Instruct client to undress to the waist and put on gown. Remove all jewelry and metal objects.
- Ensure testicles in men and ovaries in women are protected with a lead shield to prevent radiation exposure.
- Inform the client that the procedure takes approximately 10–15 minutes to complete.

X-Ray Abdomen

(Pagana & Pagana, 2018)

Indications

- To assess the cause of abdominal pain
- To identify masses of the stomach, bowel obstructions, abdominal tissues, ascites, kidney stones, appendicitis, or paralytic ileus.
- To evaluate the size of the liver and kidney for size, shape, and position.

Procedure

1. Client lies supine on an x-ray table.
2. Clothes are removed to uncover the abdomen; males will have their testicles shielded and females will have their ovaries shielded.
3. Inform the client that they will need to take a deep breath and hold it or exhale for 2-3 seconds while pictures are taken. The procedure takes approximately 15–20 minutes.

Interfering Factors

- Incorrect positioning of the client could produce distorted images.
- Obesity and ascites may distort images.

Nursing Implications

- No special care is required, same as chest x-ray.

Thallium Scan

(CLPNA, 2018)

Description

This test evaluates blood flow after an intravenous injection of the radioisotope thallium-201 or cardiolite. Areas with poor blood flow and ischemic cells fail to take up the isotope and appear as cold spots on the scan.

Indications

- To assess the location and extent of an MI.
- To evaluate graft patency.
- To assess the effectiveness of antianginal therapy or balloon angioplasty.

Procedures

- **Resting imaging:** Within the first few hours of MI symptoms, the client receives an injection of thallium. Scanning begins after 10 minutes, with the client positioned in anterior, left anterior oblique, and left lateral positions.
- **Stress imaging:** The client, wired with electrodes, walks on the treadmill at a regulated pace that is gradually increased while the ECG, blood pressure and heart rate are monitored. When client reaches peak stress, thallium is injected into the antecubital vein. The client exercises an additional 45 to 60 seconds to permit circulation and uptake of the isotope and then lies on his back under the camera. Scanning begins after 10 minutes, with the client in anterior, left anterior oblique, and left lateral positions. Additional scans may be taken after rests or after 24 hours.

Interfering Factors

- Cold spots may result from sarcoidosis, myocardial fibrosis, cardiac contusion, attenuation caused by soft tissue and artifacts (diaphragm, implants, breast, or electrodes), apical cleft, or coronary spasm.
- Absence of cold spots in a client with coronary artery disease may result from an insignificant obstruction, inadequate stress, delayed imaging, or collateral circulation.

Nursing Implications

- Make sure the consent form is signed, explain the procedure, and provide support.
- For stress imaging, no alcohol, tobacco, and non-prescription medications for 24 hours and nothing by mouth after midnight.
- For stress imaging, instruct the client to wear walking shoes during the treadmill exercise and report fatigue, pain, or shortness of breath immediately.
- Monitor client during testing for critical signs such as pale, clammy skin, confusion, or staggering.

Tilt-Table Test

(HealthLink BC, 2021 and Pagana & Pagana, 2018)

Description

This test is used to evaluate vasopressor and vasovagal syncope for individuals who have fainted or who often feel light-headed.

Indications

- To diagnose tachyarrhythmia, overmedication for hypertension or heart diseases, hyper-reactive vagal activity, and various forms of vasomotor instability.

Procedure

1. Small pads are attached to client's skin that will monitor the heart, and a blood pressure cuff is applied.
2. Client lays flat on a table, is securely strapped in, and the table slowly tilts them into an upright position (60-90 degrees for 45 minutes). While the client is being tilted, monitoring of how their body responds to the change in position takes place.
3. Results:
 - *Normal findings* will reveal that systolic blood pressure drops minimally, diastolic blood pressure rises, and heart rate increases. If no fainting occurs the test is considered negative.
 - *Abnormal findings:* If clients have vasodepressor syncope these readings are exaggerated, and they become lightheaded and dizzy once tilted. If client faints the table will be laid flat, and the client will be monitored.

Interfering Factors

- Clients with dehydration or hypovolemia show similar changes in blood pressure and heart rate, especially the elderly.
- Clients taking antihypertensive medications or diuretics also may demonstrate similar changes when placed in a tilted position.

Nursing Implications

- Make sure the consent form is signed, explain the procedure, and provide support.
- Ask whether the client has had any excessive fluid loss in the previous 24 hours and document any antihypertensive or diuretic medications the client may be taking.
- Position client supine on a horizontal tilt table and obtain baseline blood pressure and pulse rate.
- Ask about the presence of dizziness and light-headedness.
- Monitor vital signs as client adjusts to positioning changes.

Transesophageal Echocardiogram (TEE)

(Lewis et al., 2019)

Description

In this test, ultrasonography is combined with endoscopy to provide a better view of the heart's structures. As the esophagus is closer to the heart, the TEE can provide better images.

Indications

- To evaluate cardiac structures, cardiac functioning, and blood flow.
- To evaluate valvular disease and repairs.

Procedure

1. Client lies on left side; IV sedation is administered, and the pharynx is sprayed with local anesthetic.
2. A probe with a transducer at the tip is inserted into the mouth. The client swallows while the physician controls the angle and depth.
3. The probe passes through the esophagus and collects images of the heart size, valvular abnormalities, and possible sources of thrombi.

Interfering Factors

- Inability of the client to cooperate or remain still may impair clear imaging.
- Improper adjustment of the equipment to accommodate obese or thin clients may impair clear imaging.
- Clients with chronic obstructive pulmonary disease and those on mechanical ventilators are *not* good candidates because excess air in the lungs impedes movement of ultrasound waves.

Nursing Implications

- Make sure the consent form is signed, explain the procedure, and provide support.
- Client must be NPO for 6 hours before the test, medications may be taken with small sips of water.
- Have client remove dentures or oral prostheses.
- Administer IV sedative and local anesthetic to throat.
- Monitor vital signs and oxygen saturation, perform suctioning as required.
- After the test, keep the client in a supine position until the sedative wears off.
- Encourage the client to cough after the procedure while lying on side or sitting upright.
- No food or water until gag reflex returns. Clients must not drive themselves home.

Ultrasound (Sonography)

(Pagana & Pagana, 2018)

Description

Test used to visualize the abdomen and organs contained within the abdomen, without the use of radiation. Ultrasounds use high frequency sound waves to obtain images of the internal structures.

Indications

- To evaluate the size, structure, and position of body organs.
- To evaluate the blood flow in arteries and veins.
- To detect cysts, tumors, and calculi.
- To guide needle-directed biopsies.
- In obstetrics, they are used to monitor fetal development.

Procedure

1. The client's position may vary from supine to oblique, prone, semi-recumbent, and erect.
2. Conductive gel is applied to the skin surface at the site to be examined.
3. A transducer is pressed against the area to be examined, which sends a pulse of ultrasound waves into the tissues. The ultrasound waves then bounce back as a series of echoes which are picked up by the transducer and displayed on a monitor.

Interfering Factors

- Air and gas will not transmit the ultrasound beam.
- The ultrasound must be performed before barium studies as barium will interfere with image quality.
- Pelvic ultrasounds require a full bladder so client may need to drink a lot of fluid and not void before the test.

Nursing Implications

- Make sure the consent form is signed.
- Explain the procedure to the client and provide support.
- Check with the department regarding specific dietary requirements or NPO status.
- Administer pre-medications as ordered (e.g., enema for the prostate exam).
- Advise the client that the procedure takes approximately 30 minutes to one hour.

Good to know!



Disclosing test results to clients are subject to restrictions. In Canada there are three laws that protect the privacy of health records; the *Privacy Act*, the *Personal Health Information Act*, and the *Personal Information Protection and Electronic Documents Act*. It is recommended that LPNs familiarize themselves with these documents.

Summary

This module has provided an overview of the most ordered diagnostic tests. The LPN has a vital role to play in ensuring accurate results for these procedures through client teaching, effective preparation both before and after testing, and interpreting and reporting test results.

LPNs should always refer to the facility's policies and procedures for diagnostic testing and verify the role that LPNs play regarding these tests.

Module 2: Application of Nursing Knowledge to Diagnostic Tests

Introduction

This module will provide participants with the opportunity to apply the knowledge they have learned in Module 1.

Case studies with corresponding questions have been created and participants can check their responses with the answer key provided once complete. This section of the module will allow participants to self-assess their own knowledge. A selection of short answer questions is also provided.

Module Outcomes

Upon completion of this module, participants will be able to:

- identify the indications for the use of diagnostic tests;
- explain various test procedures;
- verbalize client teaching before/during/after diagnostic procedures; and
- recognize complications of diagnostic testing and suggest appropriate interventions.

Complete the following questions and case studies. The answers may be found at the end of this module.

Scenarios

Scenario A

A client who is 2.5 months pregnant is being evaluated for pancreatitis. An ultrasound examination of her gallbladder and pancreas has been ordered. The client is concerned that the test may harm her unborn child.

- 1. Ultrasound may harm the unborn child through radiation delivered by the device and should be advised against.**
 - a. True
 - b. False

- 2. The client does not understand how the ultrasound can examine her gallbladder and pancreas. What information can the practical nurse give the client to inform her about the test?**
 - a. This test involves the use of X-rays to produce images related to bone structure and tissue in the body.
 - b. This test is used to visualize soft-tissue organs, blood vessels, and tissues using high-frequency sound waves.
 - c. This test involves the direct visualization of the bladder wall and urethra with the use of a cystoscope (lighted telescopic lens). Usually performed by a urologist.
 - d. This test evaluates blood flow after an intravenous injection of the radioisotope thallium-201 or cardiolite. Areas with poor blood flow and ischemic cells fail to take up the isotope and thus appear as cold spots on the scan.

- 3. What outcomes are possible from the ultrasound test?**
 - a. Evaluate the size, structure, and position of body organs.
 - b. Evaluate the blood flow in arteries and veins.
 - c. Detect cysts, tumors, and calculi.
 - d. All of the above

Scenario B

A client is being evaluated for lung surgery. Pulmonary function tests (PFT) are ordered. The client has an order for Ventolin for bronchospasm.

- 1. This drug should be given to optimize the results of the test.**
 - a. True
 - b. False

- 2. What measures can the PFT provide?**
 - a. How much and how quickly air is inhaled and exhaled from the lungs
 - b. To aspirate excessive sputum or mucous plugs
 - c. To find the cause of chest pain or pressure
 - d. To evaluate cardiac structures and function

Case Studies

Case Study 1

Megan is a 35-year-old female patient who has a nine-month history of epigastric discomfort. She tells the physician that this always happens about two hours after she eats. She also says that her sleep is disturbed most nights. She states that she has been able to manage the pain somewhat by taking antacids or eating more food.

The physician decides to order an upper GI series of X-rays and endoscopy.



Questions

1. Describe the nursing care for this client in preparation for each of these tests.
2. What are the rationales for ordering these tests for Megan?
3. What factors could interfere with these tests and affect their outcomes?
4. Describe the nursing responsibilities to the client after each of the tests is completed.

Case Study 2

Joe Paranelli is a 48-year-old man admitted to the coronary care unit complaining of substernal chest pain. He is married to Jane, and they have two high school-age children. Joe works in a factory that produces cloth dyes for the fabric industry. He has told the admitting doctor that, in the last five months, he has been having chest pain that radiates to his neck and jaw during exercise or when he feels stressed. The pain dissipates when he can stop what he is doing and relax for a bit.

The results of his physical examination were normal, other than a mid-systolic murmur that was heard over the aortic area.



Questions

1. Which diagnostic tests are likely to be ordered for Joe?
2. What preparations does the LPN anticipate that they will need to do before Joe's tests?
3. What care will the LPN provide to Joe after the diagnostic tests?
4. What rationale can the LPN give Joe's family for why these tests were ordered?

Answers

Scenario A

1. b. False
2. b. This test is used to visualize soft-tissue organs, blood vessels, and tissues using high-frequency sound waves.
3. d. All of the above

Scenario B

1. b. False. Ventolin, a bronchodilator, will provide a false positive on this test.
2. a. How much and how quickly air is inhaled and exhaled from the lungs

Case Study 1

Question 1: Describe the nursing care for this client in preparation for each of these tests.

X-rays

- Clothes are removed to uncover the abdomen.
- Instruct the client to lie in a supine position on the X-ray table.
- Inform the client that the procedure takes approximately 15–20 minutes to complete.

Endoscopy

- Provide client and family teaching.
- Have the client sign the consent form.
- Remove dentures, eyeglasses, jewelry, and clothing from the neck to the waist.
- Encourage the client to void before the test.
- Record pre-test vital signs.

Question 2: What are the rationales for ordering these tests for Megan?

X-rays

- Study consists of a series of X-ray films of the lower esophagus, stomach, and duodenum using barium contrast medium. The purpose of this exam is to detect ulcers, tumors, inflammations.

Endoscopy

- Enables direct visualization of the upper GI tract using a long fiber-optic scope. The esophagus, stomach, and duodenum are examined for tumors, varices, mucosal inflammations, hiatal hernias, polyps, ulcers, and obstruction.

Question 3: What factors could interfere with these tests and affect their outcomes?

X-rays

- Incorrect positioning of the client could produce distorted images.
- Obesity and ascites may distort images.

Endoscopy

- Barium from previous GI testing can interfere with visualization of the mucosa.

Question 4: Describe the nursing responsibilities to the client after each of the tests is completed.

X-rays

- Client aftercare consists of monitoring symptoms and providing reassurance.

Endoscopy

- Record post-test vital signs.
- Check gag reflex post-test before offering food and fluids.

Case Study 2

Question 1: Which diagnostic tests are likely to be ordered for Joe?

- EKG, chest X-ray, exercise stress test, echocardiography, cardiac catheterization.

Question 2: What preparations does the LPN anticipate that they will need to do before Joe's tests?

EKG

- Explain the procedure to the client and provide support.
- Assist in removing all jewelry from the neck, arms, and wrists.
- Inform the client that tests usually take 5–10 minutes to complete.

Chest X-ray

- Explain the purpose and procedure and reassure the client.
- Remove all jewelry and metal objects from the chest area.
- Inform the client that the procedure takes approximately 10–15 minutes to complete.

Exercise stress test

- Have the client sign the consent form.
- Explain the procedure to the client and provide support.
- Advise the client not to smoke for at least four hours before the test.
- Assess for signs and symptoms of respiratory distress.
- Record vital signs pre-and post-test.

Echocardiography

- Explain the procedure to the client and provide support.
- Inform the client that tests usually take 15–45 minutes to complete.

Cardiac catheterization

- Explain the procedure to the client and provide support.
- Check blood pressure and pulse.
- Encourage the client to void before the test.
- Assist client in removing all jewelry.
- Inform the client that cardiac catheterization usually takes 30 minutes to 1 hour to complete.

Question 3: What care will the LPN provide to Joe after the diagnostic tests?

EKG

- If EKG is conducted under little or no sleep, plan to have the client get a ride home after the test.

Exercise stress test

- Record vital signs post-test.

Cardiac catheterization

- Monitor patient's vital signs after procedure.

Question 4: What rationale can the LPN give Joe's family for why these tests were ordered?

- To assess cardiovascular functioning and injury, determine what is going on, and design a treatment plan.

Module 3: Overview of Laboratory Tests (Chemistry, Hematology, and Common Urine Tests)

Introduction

Laboratory (lab) tests aid in the evaluation of a client's health needs and provide health care providers with vital information. Requests for lab tests are ordered to screen for disease, evaluate drug therapy, confirm a diagnosis, or rule out a clinical problem. This module is intended to give the LPN a foundational knowledge of commonly ordered lab tests.

The outcomes of lab tests affect clinical decision-making as well as client assessment and revisions to client care plans. Interpretation of lab data is vital to safe, efficient, and competent care by the LPN. The LPN's role in infection control measures, collection of specimens, preparing clients for various tests, and teaching can encourage collaboration with procedures and facilitate obtaining the most accurate results.

Module Outcomes

Upon completion of this module, the participant will be able to:

- define and describe the purpose of common laboratory tests;
- identify the normal range values for common laboratory tests;
- understand the interfering factors that may affect test results;
- describe critical values and report findings appropriately; and
- state the implications of laboratory test results for client health and nursing interventions.

Good to know!



You should familiarize yourself with terminology commonly used related to lab tests.

Normal Range vs. Reference Range

- *Normal ranges* are established by testing a large group of healthy individuals to determine what a typical "normal" result is.
- Lab results must be interpreted based on *context*. For example, an average normal heart rate is between 60-100, however, athletes (such as runners) may have a lower heart rate of 55 which is "normal" for them.
- *Reference ranges* can vary depending on age and gender. For example, males have a higher level of hemoglobin than females.

Critical Values

- These values indicate that immediate action must be taken as the results are dangerously abnormal and may be life-threatening if corrective action is not taken.

Post-Test Considerations

- Based on tests performed, follow-up assessment may need to be performed. For example; client remains NPO until the gag reflex returns.

Common Lab Tests

The following table lists common lab tests in three categories.

Chemistry	Hematology	Urine
Albumin (AL) Ammonia (AMM, NH ₃) Amylase (AMY) Aspartate transaminase (AST) Blood urea nitrogen (BUN) Chloride (Cl) Creatine kinase (CK) Creatinine (Cr) D-dimer (DDIMER) Glucose (GLU) Ischemia-modified albumin (IMA) Lactate dehydrogenase (LDH) Potassium (K) Sodium (Na) Troponins (cTnT & cTnI)	Complete blood count and differential: CBC, Hgb, PCV, Mb, BNP, thrombocytes, WBC, WBC differential Coagulation studies: prothrombin time (PT) partial thromboplastin time (PTT) international normalized ratio (INR) Diabetes testing: FBS, OGTT, HbA1c	Urinalysis (UA) Culture and sensitivity Urine toxicology

Note: The above-mentioned labs represent those frequently requested for the scope and practice of the LPN. There are lab studies that may be required in your work environment not listed in this module.



CHEMISTRY TESTS (Pagana & Pagana, 2018)

Chemistry tests measure the level of chemical components in body fluids and tissues to detect abnormalities. The most common specimens used are blood and urine. In the following tables, key information is provided for each chemical element.

Albumin (AL)		
Normal Range	35–50 g/L *	
Indications	Used to diagnose and monitor diseases of the liver, impaired nutrition, chronic edema, and cancer.	
Test Explanation	Component of total serum protein (pre-albumin, albumin, and globulins). Albumin is a protein that is made in the liver. Albumin maintains colloidal osmotic pressure. Blood Tube: Red Urine: 24-hour urine collection.	
Purpose	Used to check liver and kidney function. Find out if diet contains enough protein. Helps determine cause of edema to extremities, abdomen.	
Interfering Factors	Drugs that interrupt normal serum electrophoretic patterns (e.g., Aspirin, bicarbonates, corticosteroids, salicylates).	
Results and Significance	<p>Lower</p> <ul style="list-style-type: none"> Indicative of malnutrition Liver disease Ascites Inflammatory disease Autoimmune disorder GI malabsorption syndromes Pregnancy 	<p>Higher</p> <ul style="list-style-type: none"> Severe dehydration

* All lab values are shown in **SI** format. To ensure accuracy and to maintain optimal level of care for individuals receiving any lab tests or specimen collection, please refer to your workplace policies and procedures manual or contact the laboratory.

Ammonia (AMM, NH₃)		
Normal Range	6–47 mcmol/L	
Indications	Used to diagnose severe liver diseases.	
Test Explanation	<p>Measures the amount of ammonia in the blood. Ammonia in the body is created by the breakdown of protein. The liver converts ammonia to urea, which is excreted as urine in the kidneys.</p> <p>Blood Tube: Green</p>	
Purpose	<p>Check liver function.</p> <p>Check success of treatment for severe liver disease (e.g., cirrhosis).</p> <p>Check levels in a person receiving total parenteral nutrition.</p>	
Interfering Factors	<p>Smoking.</p> <p>Eating high-protein or low-protein diet.</p> <p>Drugs that increase blood ammonia (e.g., Loop diuretics, narcotics, thiazides, alcohol).</p> <p>Drugs that decrease blood ammonia (e.g., broad spectrum antibiotics, levodopa, potassium salts)</p> <p>Strenuous exercise before test.</p>	
Results and Significance	<p>Lower</p> <p>Essential or malignant hypertension</p>	<p>Higher</p> <p>Liver disease (cirrhosis or hepatitis)</p> <p>Reye syndrome</p> <p>Heart failure</p> <p>Kidney failure</p> <p>Severe bleeding from stomach or intestines</p>

Amylase (AMY)		
Normal Range	Serum Amylase <160 U/L	Urine Amylase 2–34 U/hr
Indications	Used to diagnose or treat diseases in the pancreas (cystic fibrosis, pancreatitis). Can be conducted by obtaining a blood or urine sample.	
Test Explanation	Amylase is produced by the pancreas, salivary glands, and liver and is excreted by the kidneys. When there is an inflammation of the pancreas or salivary gland, more amylase goes into the blood and more amylase is excreted in the urine.	
Purpose	Diagnose pancreatic disease. See if treatment for pancreatic disease is working. Diagnose client with acute abdominal pain.	
Interfering Factors	Opiates, diuretics, and blood thinners will affect results. For urine amylase specimen: presence of fecal material or toilet paper can contaminate results. Prolonged urine collection time. For serum blood: Narcotic drugs. IV fluids containing glucose. Wait two hours after eating to draw blood (sugar can decrease serum amylase).	
Results and Significance	Lower Cystic fibrosis Acute alcoholism Cirrhosis of liver Extensive destruction of pancreas	Higher Acute pancreatitis Cancer of pancreas Inflammation of salivary glands (mumps) Severe damage to intestines Stomach ulcer Diabetic ketoacidosis Kidney failure

Aspartate Aminotransferase (AST)		
Normal Range	Adult: 0–35 U/L	
Indications	This test is used in the evaluation of clients with suspected hepatocellular diseases.	
Test Explanation	<p>This enzyme is found in very high concentrations with highly metabolic tissue, such as the heart muscle, liver cells, skeletal muscle cells, and, to a lesser degree, in the kidneys, pancreas, and red blood cells. When disease or injury affects the cells of these tissues, the cells lyse. AST is released and picked up by the blood, and the serum level rises. The amount of AST elevation is related directly to the number of cells affected by the disease or injury. The degree of elevation depends on the length of time between the injury and when the blood is collected.</p> <p>Blood Tube: Red</p>	
Purpose	Used to detect diseases such as acute hepatitis, gallstones, cirrhosis, liver congestion, metastatic tumor of the liver, infectious mononucleosis, acute pancreatitis, acute renal disease, musculoskeletal diseases or trauma.	
Interfering Factors	<p>Pregnancy can cause decreased AST levels.</p> <p>Exercise may increase AST levels.</p> <p>Levels decreased by liver disease, uremia, or diabetic ketoacidosis.</p> <p>Some drugs may cause increases in AST (e.g., antihypertensives, cholinergic agents, anticoagulants, contraceptives, opiates, and statins).</p>	
Results and Significance	<p>Lower</p> <p>Acute renal disease</p> <p>Beriberi</p> <p>Diabetic ketoacidosis</p> <p>Pregnancy</p> <p>Chronic renal dialysis</p>	<p>Higher</p> <p>Liver diseases such as hepatitis, hepatic cirrhosis, drug-induced liver injury, hepatic metastasis, mononucleosis</p> <p>Skeletal muscle diseases such as muscle trauma, surgery, burns, muscular dystrophy, heat stroke</p> <p>Other diseases such as acute hemolytic anemia and acute pancreatitis</p>

Blood Urea Nitrogen (BUN)		
Normal Range	3.6–7.1 mmol/L	
Indications	Check for kidney function.	
Test Explanation	<p>A test that measures the amount of nitrogen in your blood, which comes from the waste product urea.</p> <p>Urea is made when protein is broken down in the body. Urea is made in the liver and excreted by the kidneys.</p> <p>Blood Tube: Red or Green</p>	
Purpose	The BUN test is used to see how well your kidneys are working, to see if kidney treatment is working, and to check for severe dehydration.	
Interfering Factors	<p>Decreases</p> <p>Low-protein and high-carbohydrate diet</p> <p>Low muscle mass</p> <p>Early pregnancy</p> <p>Medications</p> <p>Over hydration</p>	<p>Increases</p> <p>High-protein diet</p> <p>Late pregnancy</p> <p>Old age</p> <p>Medications</p> <p>(The nursing professional should check the specific medications that the client is taking at the time of the test.)</p>
Results and Significance	<p>Lower</p> <p>Liver disease or damage to liver</p>	<p>Higher</p> <p>Heart failure</p> <p>Dehydration</p> <p>Diet high in protein</p> <p>Shock</p> <p>Kidney injury or disease</p>

Chloride (Cl)		
Normal Range	98–106 mmol/L	
Indications	<p>This test is usually included as one element in the test for electrolytes.</p> <p>In conjunction with the other elements, chloride can provide an indication of acid-base balance and hydration status.</p>	
Test Explanation	<p>Chloride’s purpose is to maintain water balance in the body and acid-base balance.</p> <p>Blood Tube: Red or Green</p>	
Purpose	To check the chloride level in relation to potassium, sodium, and bicarbonate balance. This helps form a differential with regard to acid-base balance.	
Interfering Factors	<p>Infusions of saline solutions can increase chloride levels.</p> <p>Drugs that may cause increased serum chloride levels (e.g., cortisone, estrogens, hydrochlorothiazide, and NSAIDS).</p>	
Results and Significance	<p>Lower</p> <p>Heart failure</p> <p>Ongoing vomiting</p> <p>Over hydration</p>	<p>Higher</p> <p>Dehydration (diarrhea or vomiting)</p> <p>Increased sodium intake</p> <p>Renal disease</p>

Creatine Kinase (CK)		
Normal Range	Male: 55–170 U/L	Female: 30–135 U/L
Indications	Cardiac enzyme study: This test is used to support diagnosis of myocardial infarction. Performed when client exhibits chest pain.	
Test Explanation	CK is found in the cardiac muscle, skeletal muscle, and brain. Serum CK levels are elevated when these muscle or nerve cells are injured. Blood Tube: Red	
Purpose	Used to diagnose myocardial infarction or skeletal muscle disease.	
Interfering Factors	Drugs can cause increased levels of CK (e.g., ampicillin, anesthetics [some], anticoagulants, aspirin, Decadron, Lasix, and morphine). Strenuous exercise, recent surgery may cause increased levels.	
Results and Significance		Higher Acute myocardial infarction Skeletal muscle disease Cerebrovascular accident (CVA) Severe angina

Creatinine (Cr)		
Normal Range	Male: 53–106 mcmol/L Female: 44–97 mcmol/L	
Indications	Test is usually performed along with BUN to investigate liver and kidney function.	
Test Explanation	Creatinine is a by-product formed by the breakdown of muscle creatine phosphate in the body. Creatinine is filtered by the glomerulus and excreted in the urine. Blood Tube: Red or Green	
Purpose	Best measure of renal function.	
Interfering Factors	Eating red meat in large amounts may affect results.	
Results and Significance	<p>Lower</p> <p>Severe liver disease</p> <p>Diet low in protein</p>	<p>Higher</p> <p>Acute and chronic renal failure</p> <p>Shock</p> <p>Systematic lupus erythematosus</p> <p>Cancers</p> <p>Leukemias</p> <p>Muscle injury (rhabdomyolysis, muscular dystrophy)</p>

D-dimer (DDIMER)	
Normal Range	<250 mcg/L
Indications	To check for blood-clotting problems.
Test Explanation	Blood tests used to measure a substance that is released when a blood clot breaks up. Can be ordered in combination with imaging scans to help with blood-clotting problems. D-dimer assesses both thrombin and plasmin activities that help with the clotting process.
Purpose	To diagnose dangerous blood-clotting problems, such as deep vein thrombosis and pulmonary embolism.
Interfering Factors	<p>False-positive tests are obtained with high titres of rheumatoid factor.</p> <p>Inflammation.</p> <p>Liver disease.</p> <p>Advancing ovarian cancer.</p> <p>Post-op or post-trauma.</p> <p>Pregnancy.</p>
Results and Significance	<p>Higher</p> <p>Disseminated intravascular coagulation (DIC)</p> <p>Serious bleeding disorder from abnormally accelerated clotting</p> <p>DVT</p> <p>PE</p> <p>Surgical complication</p>

Glucose (GLU) (Fasting Blood Sugar, Random Blood Sugar)		
Normal Range	Fasting Blood 4.0–7.0 mmol/L	Random Glucose <7.0 mmol/L
Indications	To control blood glucose levels. Used for persons with diabetes taking oral hypoglycemic medication or insulin.	
Test Explanation	Test that measures the amount of glucose in the blood. Glucose comes from carbohydrates, which are the main source of energy used by the body. Blood Tube: Grey	
Purpose	Used to check for diabetes, monitor treatment of diabetes.	
Interfering Factors	Vigorous exercise, stress, trauma, infection. Use of cortisone drugs. Intravenous fluids that contain dextrose.	
Results and Significance	Lower Excessive doses of insulin Inadequate food intake Hypoglycemia Liver disease Malnutrition Eating disorder Hypothyroidism Addison disease Starvation	Higher Hyperglycemia Diabetes Prolonged corticosteroid therapy Severe stress

Ischemia-Modified Albumin (IMA)	
Normal Range	<85 IU/mL
Indications	This test is performed on individuals with chest pain to determine whether the pain is caused by cardiac ischemia.
Test Explanation	<p>When albumin is exposed to an ischemic environment, this causes an alteration of the albumin, called ischemia-modified albumin (IMA). The presence of IMA has become particularly helpful in identifying cardiac ischemia. Blood levels of IMA appear and begin rising with ten minutes of the initiation of the ischemic event and stay elevated for six hours after ischemia has resolved.</p> <p>Blood Tube: Yellow</p>
Purpose	When combined with other diagnostic tests, the diagnosis of an ischemic cardiac event can be corroborated or ruled out.
Interfering Factors	False positives can occur in other clinical situations such as advanced cancers, acute infections, and end-stage renal or liver disease.
Results and Significance	<p>Higher</p> <ul style="list-style-type: none"> Myocardial ischemia Brain ischemia Pulmonary ischemia

Lactate Dehydrogenase (LDH)	
Normal Range	<p>Total lactate dehydrogenase levels:</p> <p>Newborn: 160–450 U/L Infant: 100–250 U/L</p> <p>Child: 60–170 U/L Adult: 100–190 U/L</p> <p>Isoenzymes (electrophoresis) for adults:</p> <p>LDH-1: 0.17–0.27 LDH-2: 0.27–0.37</p> <p>LDH-3: 0.18–0.25 LDH-4: 0.03–0.08</p> <p>LDH-5: 0–0.05</p>
Indications	LDH is an intracellular enzyme used to diagnose injury or disease of the heart, liver, red blood cells, kidneys, skeletal muscle, brain, and lungs.
Test Explanation	<p>Because LDH is widely distributed through the body, the total level is not a specific indicator of any one disease or injury. When disease or injury affects the cells containing LDH, the cells lyse, and LDH is spilled into the bloodstream, in which it is identified in higher-than-normal levels. Five separate fractions (isoenzymes) make up the total LDH. Each tissue contains a predominance of one or more LDH enzymes.</p> <p>Blood Tube: Red</p>
Purpose	<p>A higher level of LDH-1 indicates myocardial injury.</p> <p>Isolated elevation of LDH-5 indicates hepatocellular injury or disease.</p> <p>Elevation of LDH- 2 and LDH-3 indicates pulmonary injury or disease.</p> <p>Elevation of all LDH isoenzyme levels indicates multi-organ injury.</p>
Interfering Factors	<p>Hemolysis of blood elevates LDH level.</p> <p>Strenuous exercise may elevate LDH.</p> <p>Some drugs (alcohol, anesthetics, aspirin, clofibrate, fluorides) may increase LDH levels.</p> <p>Ascorbic acid may decrease LDH levels.</p>

Results and Significance		Higher Myocardial infarction (LDH-1, LDH-2) Pulmonary disease (LDH-2, LDH-3) Hepatic disease (LDH-5) RBC disease (LDH-1) Skeletal muscle disease/injury (LDH-5) Renal parenchymal disease (LDH-1) Intestinal ischemia and infarction (LDH-5) Testicular tumors (LDH-1) Lymphoma (LDH-3, LDH-2) Pancreatitis (LDH-4)
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Potassium (K)		
Normal Range	3.50–5.0 mmol/L	
Indications	<p>Routine blood test that checks for cardiac and muscle function.</p> <p>Can be used to diagnose disease in conjunction with sodium.</p>	
Test Explanation	<p>Potassium is essential in keeping the water and electrolyte balance of the body. Potassium is vital to how nerves and muscles work.</p> <p>Potassium levels can change with sodium levels.</p> <p>Blood Tube: Red or Green</p>	
Purpose	<p>Used to check potassium level, detect the presence of hypo- or hyperkalemia.</p> <p>Monitor potassium levels during renal insufficiency, with cancers, and with certain drugs (diuretics).</p>	
Interfering Factors	<p>Taking potassium supplements.</p> <p>Certain medications (e.g., antibiotics that contain potassium, NSAIDs, heparin, inulin, corticosteroids, non-potassium-sparing diuretics).</p> <p>Overuse of laxatives.</p> <p>Severe vomiting.</p>	
Results and Significance	<p>Lower</p> <p>Overuse of diuretics</p> <p>Hyperaldosteronism</p> <p>Severe burns</p> <p>Cystic fibrosis</p> <p>Alcoholism</p> <p>Dehydration</p>	<p>Higher</p> <p>Damage or injury to the kidneys</p> <p>Severe burns</p> <p>Crushing injuries</p> <p>Heart attack</p> <p>Overconsuming potassium supplements</p> <p>Medications (e.g., ACE inhibitors)</p>

Sodium (Na)		
Normal Range	135–145 mmol/L	
Indications	A blood test performed in conjunction with potassium and chloride (serum electrolytes) to monitor fluid and electrolyte activity.	
Test Explanation	<p>Sodium plays a major role in how nerves and muscles work. Sodium is controlled by the hormone aldosterone in the body.</p> <p>When aldosterone levels rise, the kidneys hold on to sodium and excrete water.</p> <p>Blood Tube: Red or Green</p>	
Purpose	Blood test used to check sodium levels related to water and electrolyte balance.	
Interfering Factors	<p>Taking medications (birth control pills, corticosteroids, antibiotics, NSAIDS, diuretics, and heparin).</p> <p>Elevated levels of glucose or protein.</p> <p>Receiving Intravenous fluids.</p>	
Results and Significance	<p>Lower (Hyponatremia)</p> <p>Excessive sweating</p> <p>Severe vomiting and diarrhea</p> <p>Drinking too much water</p> <p>Poor nutrition</p> <p>Kidney disease</p> <p>Cirrhosis</p> <p>Underactive adrenal or thyroid glands</p>	<p>Higher (Hypernatremia)</p> <p>Increased salt or sodium intake</p> <p>Dehydration</p> <p>Severe vomiting and diarrhea</p> <p>Diabetic ketoacidosis</p>

Troponins (cTnT and cTnI)		
Normal Range	Troponin T (cTnT) <0.2 mcg/L	Troponin I (cTnI) <0.03 mcg/L
Indications	Cardiac enzyme study: Performed with presenting chest pain or possible heart attack. Can be performed in conjunction with CK.	
Test Explanation	Troponins are specific markers for cardiac injury. Levels of troponin will increase in the presence of myocardial infarction. Blood Tube: Yellow	
Purpose	To diagnose myocardial infarction or injury to the heart from other causes, such as myocarditis or unstable angina pectoris. May also be used when presenting with chest pain, shortness of breath, nausea, sweating, and abnormal ECG results.	
Interfering Factors	False-positive results. Elevation in acute and chronic renal failure or chronic muscle disease. Other heart conditions (cardiomyopathy and myocarditis). Kidney injury. Excessive substance abuse. Other diseases (e.g., hypothyroidism, muscular dystrophy).	
Results and Significance		Higher Myocardial injury Myocardial infarction

Summary

Chemical tests provide critical information to the LPN, which can inform the client assessment. They also provide indicators for the development of nursing care plans specific to the client’s health concerns. LPNs should remain current in this knowledge domain.

HEMATOLOGY TESTS (Pagana & Pagana, 2018)

Blood tests are used to detect various diseases and helps diagnose certain conditions. As part of the LPNs role and responsibilities, you may be required to provide clients with education regarding these tests. In addition, the LPN monitors specific blood tests for individuals throughout their health journeys and should understand how these results may affect aspects of nursing care and medications.

Complete Blood Count (CBC, Diff)

Components of Complete Blood Count (CBC)		
Normal Range	Erythrocyte count	Male: 4.7–6.1 x 10 ¹² /L Female: 4.2–5.4 x 10 ¹² /L
	Mean corpuscular volume (MCV)	80–95 mm ³
	Mean corpuscular hemoglobin (MCH)	27–31 pg
	Mean corpuscular hemoglobin concentration (MCHC)	320–360 g/L
Test Explanation	This test provides information about the kinds and numbers of cells in the blood. It is used to both determine general health status and detect a wide range of disorders (e.g., infection, anemia, inflammation, and bleeding disorders). Blood Tube: Lavender	
Interfering Factors	Exercise. High altitudes for prolonged periods. Hydration status. Leukemias. Medications. Pregnancy.	

Results and Significance	LOWER	HIGHER
	Erythrocyte count	
	Anemia Leukemia Post hemorrhage	Dehydration High altitudes Polycythemia vera Severe diarrhea
	Mean corpuscular volume (MCV)	
	Microcytic anemia	Folic acid and vitamin B ₁₂ deficiency Liver disease Macrocytic anemia
	Mean corpuscular hemoglobin (MCH)	
	Microcytic anemia	Macrocytic anemia
	Mean corpuscular hemoglobin concentration (MCHC)	
	Hypochromic anemia	Intravascular hemolysis Spherocytosis



Hemoglobin (Hgb)		
Normal Range	Male: 135–180 g/L	Female: 120–160 g/L
Test Explanation	<p>Hgb is the protein in RBC that carries oxygen.</p> <p>There are millions of hemoglobin molecules in each red cell.</p> <p>Blood Tube: Lavender</p>	
Results and Significance	<p>Lower</p> <p>Chronic blood loss</p> <p>Decreased dietary intake</p>	<p>Higher</p> <p>Chronic obstructive pulmonary disease</p> <p>High altitudes</p> <p>Polycythemia</p>

Hematocrit or Packed Cell Volume (PCV)		
Normal Range	Male: 0.42–0.52 volume fraction	Female: 0.37–0.47 volume fraction
Test Explanation	<p>The test for hematocrit measures the volume of cells as a percentage of the total volume of cells and plasma in whole blood. This percentage is usually three times greater than the hemoglobin.</p> <p>Blood Tube: Lavender</p>	
Results and Significance	<p>Lower</p> <p>Hemorrhage</p> <p>Anemia</p> <p>Excessive intravenous fluid infusion</p>	<p>Higher</p> <p>Dehydration</p> <p>COPD</p> <p>Congenital Heart Disease</p>

Myoglobin (Mb)		
Normal Range	1.0–5.3 nmol/L	
Test Explanation	<p>This test is used in the early evaluation of a client with suspected acute myocardial infarction. It is also used to assist in the diagnosis of disease or injury in skeletal muscles.</p> <p>Blood Tube: Red</p>	
Interfering Factors	<p>Recent administration of radioactive substances.</p> <p>Myoglobin levels can increase after intramuscular injections.</p>	
Results and Significance	<p>Lower</p> <p>Polymyositis</p>	<p>Higher</p> <p>Myocardial infarction</p> <p>Skeletal muscle inflammation (myositis)</p> <p>Malignant hyperthermia</p> <p>Muscular dystrophy</p> <p>Skeletal muscle ischemia/trauma</p> <p>Rhabdomyolysis</p>

Natriuretic Peptides: BNP/or NP-proBNT42	
Normal Range	<p>Atrial natriuretic peptide (ANP): 22–77 mcg/L</p> <p>Brain natriuretic peptide (BNP): <100 mcg/L</p> <p>Critical values: >100 mcg/L</p>
Test Explanation	<p>Natriuretic peptides are used to diagnose and categorize clients with congestive heart failure (CHF).</p> <p>Blood Tube: Lavender</p>
Interfering Factors	<p>BNP levels are higher in women than in men.</p> <p>Levels are higher in older clients.</p> <p>Levels are higher after cardiac surgery.</p> <p>May vary due to methods of measurement of BNP.</p>
Results and Significance	<p>Higher</p> <ul style="list-style-type: none"> Congestive heart failure Myocardial infraction Systemic hypertension Heart transplant rejection Cor pulmonale

Platelet Count (Thrombocytes)		
Normal Range	150–400 x 10 ⁹ /L	
Test Explanation	<p>This test measures the number of platelets in the blood and is often included in the CBC when there are signs and symptoms of a bleeding disorder or excessive clotting.</p> <p>Blood Tube: Lavender</p>	
Results and Significance	<p>Lower (Thrombocytopenia)</p> <ul style="list-style-type: none"> Acute leukemia Chemotherapy Hemorrhage Toxic effect of medications Systemic lupus erythematosus Viral infections 	<p>Higher (Thrombocytosis)</p> <ul style="list-style-type: none"> Acute infections Chronic pancreatitis Cirrhosis Collagen disorders Iron deficiency Polycythemia vera Post splenectomy

White Blood Cell Count (WBC)			
Normal Range	Critical Value: $<2.5 \times 10^9/L$		
	Newborn (0–6 weeks) 9–30 $\times 10^9/L$	Child ≤ 2 years 6.2–17 $\times 10^9/L$	Adult/Child >2 years 5–10 $\times 10^9/L$
Test Explanation	<p>To detect the presence of infection. Supports diagnosis of inflammation.</p> <p>WBC are cells that fight foreign bodies and infection. WBC, also known as leukocytes, are larger in size and less numerous than red cells. They develop from stem cells in the bone marrow. WBC function involves the response to an inflammatory process or injury.</p> <p>Blood Tube: Lavender</p>		
Results and Significance	<p>Lower (Leukopenia)</p> <p>Indicates the body is fighting infection</p> <p>Indicates a viral or bacterial infection</p> <p>Inflammation</p> <p>Leukemia</p>	<p>Higher (Leukocytosis)</p> <p>Bone marrow disorders or damage</p> <p>Autoimmune disease, HIV</p> <p>Sepsis</p> <p>Cancer that spreads to bone marrow</p>	

White Blood Cell Types (WBC Differential)		
Normal Range	Segmented neutrophils	2.5–7.5 x 10 ⁹ /L
	Band neutrophils	0–1 x 10 ⁹ /L
	Lymphocytes	0.1–0.4 x 10 ⁹ /L
	Monocytes	0.02–0.07 x 10 ⁹ /L
	Eosinophils	0.01–0.04 x 10 ⁹ /L
	Basophils	0.0–0.01 x 10 ⁹ /L
Test Explanation	<p>The measurement of the total and differential WBC counts is a routine laboratory test to aid in the evaluation of clients with infection, neoplasm, allergy, and immunosuppression.</p> <p>The WBC differential consists of major types of WBC. Each type of WBC plays a different role in the body, and the numbers give information about the immune system.</p>	
Results and Significance	Lower	Higher
	Neutrophils	
	Neutropenia Aplastic anemia Dietary deficiency Bacterial infection Viral infection	Neutrophilia Trauma Inflammatory disorders Metabolic disorders
	Lymphocytes	
Leukemia Sepsis Immunodeficiency diseases Lupus erythematosus Chemotherapies	Chronic bacterial infection Viral infection Multiple myeloma	

Monocytes		
	Aplastic anemia Medications (e.g., prednisone)	Monocytosis Chronic inflammatory disorders Viral infections Tuberculosis
Eosinophils		
	Increased adrenosteroid production	Parasitic infections Allergic reactions Eczema Leukemia
Basophils		
	Acute allergic reactions Hyperthyroidism Stress reactions	Myeloproliferative disease Leukemia

Summary

Hematology tests are helpful to diagnose, treat, and manage blood disorders. The LPN can aid in providing education for individuals receiving the above-mentioned tests and collaborate with interdisciplinary health teams to provide safe care.

Coagulation Studies

The following lab tests refer to blood-clotting studies and are used to diagnose bleeding and clotting disorders. These include prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR).

Prothrombin Time (PT)	
Normal Range	<p>11.0–12.5 seconds</p> <p>Full anticoagulant therapy: >1.5–2.0 times control value in seconds</p> <p>Normal international normalized ratio (INR): 0.8–1.2</p> <p>Critical values: >20 seconds (for clients not taking anticoagulants)</p>
Test Explanation	<p>A measurement used to test clotting times. Both PT and PTT are used to check for bleeding problems or the chances of excessive bleeding during surgery.</p> <p>PT is a blood test that measures how long it takes blood to clot. PT is also used to check whether medicine to prevent blood clots is working.</p> <p>Blood Tube: Light blue</p>
Interfering Factors	<p>Prolonged PT can be caused by treatment with blood-thinning medications (warfarin and Coumadin, vitamin K), or the use of alcohol.</p> <p>Diet high in fat or leafy vegetables may shorten PT times.</p>
Results and Significance	<p>Higher</p> <p>Lack of or low level of one or more blood-clotting factors</p> <p>Lack of vitamin K (due to liver disease, cirrhosis, or liver injury)</p> <p>Indication of DIC (disseminated intravascular coagulation), which is life threatening</p>

Partial Thromboplastin Time (PTT)	
Normal Range	<p>Activated partial thromboplastin time (aPTT): 30–40 seconds</p> <p>Partial thromboplastin time (PTT): 60–70 seconds</p> <p>Clients receiving anticoagulant therapy: 1.5–2.5 times control value in seconds</p> <p>Critical values</p> <p>aPTT: 70 seconds</p> <p>PTT: > 100 seconds</p>
Test Explanation	<p>PTT might be used if you take a blood-thinning medicine called Heparin. This test measures other clotting factors or checks if Heparin dose is therapeutic. Also checks the effects of anticoagulants (e.g., Heparin, warfarin).</p> <p>Blood Tube: Light blue</p>
Interfering Factors	<p>Increased consumption of alcohol.</p>
Results and Significance	<p>Higher</p> <p>Deficiency of factors I, II, V, VIII, IX and X, XI, XII</p> <p>Hemophilia</p> <p>Heparin therapy</p> <p>Liver disease</p> <p>Low Vitamin K</p>

International Normalized Ratio (INR)	
Normal Range	0.8–1.2
Test Explanation	<p>INR is a way of standardizing the results of prothrombin time tests, no matter the testing method. It lets the physician understand results regardless of different test methods.</p> <p>Blood Tube: Light blue</p>
Results and Significance	<p>Higher</p> <p>Lack of or low level of one or more blood-clotting factors</p> <p>Lack of vitamin K (due to liver disease, cirrhosis, or liver injury)</p> <p>Indication of DIC (disseminated intravascular coagulation), which is life threatening</p>

Diabetes Studies

Fasting Plasma Glucose Test (FBS)			
Normal Range	4.0–6.0 mmol/L		
Test Explanation	<p>Screens for diabetes.</p> <p>A fasting plasma glucose test is used when the person has not had any caloric intake for at least eight hours.</p> <p>Blood Tube: Grey</p>		
Interfering Factors	<p>Stress may elevate blood glucose levels temporarily.</p> <p>Certain medications (cortisone, thiazide, and loop diuretics).</p> <p>Trauma increases blood sugar.</p>		
Results and Significance	<p>Lower</p> <p>Observe for signs and symptoms of hypoglycemia</p>	<p>Prediabetes</p> <p>Blood glucose level between 6.0–7.0 mmol/L</p>	<p>Higher</p> <p>Blood glucose level of higher than 7.0 mmol/L indicates diabetes</p>

Oral Glucose Tolerance Test (OGTT)		
Normal Range	<11.1 mmol/L	
Test Explanation	<p>Screens for diabetes.</p> <p>For the oral glucose tolerance test, the person drinks a solution containing 75 grams of glucose. Two hours later, a blood glucose level is taken.</p> <p>Blood Tube: Grey</p>	
Interfering Factors	<p>Stress may elevate blood glucose levels temporarily.</p> <p>Certain medications (cortisone, thiazide, and loop diuretics).</p> <p>Trauma increases blood sugar.</p>	
Results and Significance	<p>Lower</p> <p>Hyperinsulinism</p>	<p>Higher</p> <p>>11.1 mmol/L indicates diabetes</p>

Hemoglobin A1C (HbA1c)		
Normal Range	<6.5%	
Test Explanation	<p>HbA1c is used to diagnose diabetes. HbA1c results give an estimate of the average blood glucose level over the past two to three months. Thus, it is useful in checking how well a person is controlling his or her diabetes.</p> <p>HbA1C test is used to evaluate long-term blood glucose control in people with known diabetes or diagnose prediabetes.</p> <p>Blood Tube: Lavender</p>	
Interfering Factors	<p>Stress may elevate blood glucose levels temporarily.</p> <p>Certain medications (cortisone, thiazide, and loop diuretics).</p> <p>Trauma increases blood sugar.</p>	
Results and Significance	<p>Lower</p> <p>Nondiabetic hyperglycemia</p> <p>Poorly controlled diabetes mellitus</p>	<p>Higher</p> <p>>6.9% = diabetic</p>

URINE TESTS

The LPN is involved in obtaining urine samples such as urinalysis, urine for culture and sensitivity, and urine toxicology to determine the presence of infection or help diagnose disease. Following your workplace policies and procedures manual will ensure accurate specimen retrieval.

Urinalysis (UA)				
Normal Range	Appearance: Clear Colour: Amber yellow Odour: Aromatic pH: 4.6–8.0	Protein At rest: <50–80 mg/24 hr During exercise: <250 mg/24 hr	Specific Gravity Newborn: 1.001–1.020 Adult: 1.005–1.030 Older adult: Values decrease with age	
Test Explanation	Tests the urine for colour, clarity, odour, concentration, and pH (acidity or alkalinity). It also checks for abnormal levels of protein, sugar, and blood cells or other substances that may contribute to an illness or disease in the body.			
Purpose	To screen for a disease or infection of the urinary tract. To monitor the treatment of certain medical conditions (e.g., diabetes, kidney stones, UTI, or kidney disease).			
Interfering Factors	Foods that can colour the urine (blackberries, beets, and rhubarb). Menstruating or starting menstrual period. Certain medications that can colour the urine (vitamin B, Pyridium).			
Results and Significance	Appearance and Colour	Odour	pH	Protein
	Changes in colour may be due to drug therapy. Infection: note a foul smell of the urine. Gross hematuria: RBCs in the urine cause red colour. Tumours, trauma, stones, and infection anywhere in the urinary tract can cause urine to be red.	Ketonuria (smell will be fruity) UTI (foul smell) Phenylketonuria (urine will smell musty)	Lower Acidemia (excess hydrogen ion excreted) Diabetes Starvation Higher UTI Vomiting	Higher Glomerulonephritis Malignant hypertension Trauma

Urine C & S (Culture and Sensitivity)		
Normal Range	<p>No bacteria or other organisms (such as fungi) grow in the culture. The culture result is positive.</p> <p>Negative: <10,000 bacteria/ml urine</p> <p>Positive: >100,000 bacteria/ml urine</p>	
Test Explanation	<p>The urine C & S identifies the specific bacteria and tests its susceptibility to different antibiotic agents. This ensures that the proper antibiotic can be prescribed to clear up the infection.</p>	
Purpose	<p>To detect UTI.</p>	
Interfering Factors	<p>A urine specimen that has been sitting for an hour or longer at room temperature (should be kept in refrigerator until assessed by lab).</p> <p>Feces or toilet paper in the urine specimen.</p> <p>Drugs and food.</p> <p>Use of antibiotics.</p>	
Results and Significance	<p>Lower</p> <p>< infection is unlikely</p>	<p>Higher</p> <p>>100,000 or more bacteria per milliliter (mL) of urine may indicate an infection</p>



Urine Toxicology		
Normal Range	No unexpected drugs are found in the sample.	
Test Explanation	This test can detect hundreds of drugs and drug metabolites.	
Purpose	Urine screening to check for one certain drug or for multiple drugs at once.	
Interfering Factors	<p>Poppy seeds and dextromethorphan have been reported to lead to a false-positive result for amphetamines.</p> <p>Decongestants (ephedrine) and ibuprofen also have been found to cause false-positive results for amphetamines.</p>	
Results and Significance	<p>Normal Values</p> <p>Levels of prescription or non-prescription medicines found in the sample are within the effective (therapeutic) range.</p>	<p>Abnormal Values</p> <p>Unexpected drugs are found in the sample.</p> <p>Levels of prescription or non-prescription drugs are below therapeutic range or above the therapeutic range or toxic.</p>

Summary

The information provided in this module assists the LPN in understanding the most commonly ordered lab tests and their implications for the client’s health and well-being. Care must be taken to obtain accurate lab results. The LPN is knowledgeable and can relay information regarding the test and initiate appropriate nursing interventions before, during, and after the testing period.

Knowledge related to lab tests and values includes an understanding of how laboratory data is used in the nursing process, preparing the client for bloodwork, and supporting the client after tests. Factors that affect tests results negatively should be identified and avoided whenever possible. Finally, an awareness of complications that may occur and identifying critical lab values is essential for safe client care.

Module 4: Nursing Implications and Applications of Lab Values

Introduction

Laboratory values continue to be an area of difficulty for nursing professionals to comprehend and apply in their nursing practice. The nursing implications must be considered when delivering care for clients – assessment before, during, and after any laboratory test as well as monitoring for signs and symptoms of complications. As always, client teaching is a top priority and can encourage collaboration and prevent harm. With continued education and practice with lab values, the LPN will strengthen nursing practice and support clients through their health care experiences. This part of the course provides the opportunity, through the learning activities, to challenge and expand your knowledge base in this regard.

Module Outcomes

Upon completion of this module, the participant will be able to:

- select the correct lab tests appropriate to client health challenges;
- differentiate among chemistry, hematology, and urine test lab values;
- recognize the significance of lab results; and
- recognize critical values.

Questions

Before proceeding to the final test, attempt to answer the following questions accurately.

1. The LPN is caring for a client who has vomiting and diarrhea that has lasted for 48 hours. He is complaining of dizziness and leg cramps. Which lab test(s) will the LPN anticipate being ordered for this client?
2. The LPN is managing care for a client with hematuria and complaints of dysuria. Which lab test(s) will likely be ordered for this client?
3. The LPN is working in a community clinic for patients with diabetes. Marlon is a new client who has been experiencing symptoms of hypoglycemia for some months now. The doctor has decided to send Marlon to the clinic for a full assessment of his blood sugar levels and diabetic status. What lab tests can the LPN expect to be ordered for Marlon, and what are the normal values for these tests?

Answers

1. *Query food poisoning, gastroenteritis: perform serum electrolytes (serum potassium), urea, and creatinine, CBC count, stool studies for occult blood, stool for C-difficile.*
2. *CBC count, blood urea creatinine (BUN), urinalysis, urine culture and sensitivity, urine calcium.*
3. *FBS (4.0–7.0 mmol/L), RBS (< 7.0 mmol/L), HbA1C (<6.5%), urinalysis (0–0.8 mmol/L).*

Case Study

A seven-year-old boy was brought to his pediatrician because he had developed hematuria, which required hospitalization. About six weeks before his admission, he had a severe sore throat but received no treatment for it. Subsequently, he did well except for complaints of mild lethargy and decrease in appetite. For the ten days before admission, he had an elevated temperature. He complained of minimal bilateral back pain. Physical examination revealed a well-developed young boy with moderate bilateral tenderness.

Question 1: List all the laboratory testing involved with this child's disease process. Consider rationale for each.

Answer:

- *Urinalysis (odour, glucose, blood, protein, RBCs, colour, specific gravity), BUN, and creatinine test (test kidney function).*

Question 2: What client teaching and nursing implications are involved with the above-mentioned tests?

Answer:

- *Explain purpose and specific method of urine collection, determine if client can obtain urine sample independently. If specimen cannot be tested immediately, cover and refrigerate it.*

Self-Assessment

Now that you have reviewed all the information on common laboratory tests and test values and completed the case studies, you are ready to engage in self-assessment by completing the online test provided for this course. The resources identified in this module provide comprehensive information on all the diagnostic and laboratory tests mentioned in this module and in the on-line test. Upon successful completion of the final test (minimum 75% pass mark) a Certificate of Completion will be uploaded into your ANBLPN account.

Summary

This module has provided the learner with an opportunity to evaluate their knowledge concerning lab values. There are a multitude of laboratory tests that the LPN can learn about and work within their practice. Interpretation of laboratory values is an important skill and can be developed through continued practice and study. Since this is a critical component of the client assessment, LPNs will continue to need this data to understand the care and treatment of the clients they work with.

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