

# RNnetwork Study Guide





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# Objectives

# OBJECTIVES

## General Objective

The objective of this study guide is to provide the RNnetwork Nurse with:

1. An overview of common disease processes with associated medications and treatments seen in the current patient population.
2. A review of the physiological evolution of common disease processes and classes of drugs or procedures used in their treatment.
3. A review of critical clinical issues requiring immediate intervention.

## Specific Objectives

These are the objectives that the RNnetwork Nurse would like to achieve.

- **Neurological:** Headaches (Migraines), Parkinson's Disease, Alzheimer's Disease, Stroke (CVA - Cerebral Vascular Accident), Muscular Dystrophy, Multiple Sclerosis, Epilepsy/Seizure Disorder, Increased Intracranial Pressure, and Subdural Hematoma.
- **Respiratory:** Asthma, COPD (Chronic Obstructive Pulmonary Disease), and Pneumonia.
- **Cardiac:** ACS (Acute Coronary Syndrome), Hypertension, Medical Devices, Mitral Valve Disease, and Peripheral Artery Disease.
- **Gastrointestinal:** Hemorrhoids, Constipation, GERD (Gastro-Esophageal Reflux Disease), IBS (Irritable Bowel Syndrome), Gastro-Intestinal Bleed, and Colon Cancer.
- **Genitourinary:** Cystitis, Enlarged Prostate, and Renal Calculi (Kidney Stones).
- **Wounds:** Phases of Wound Healing, Staging Pressure Ulcers, Ulcer Care, Wound Cleansing, and Dressings.
- **Diabetes Mellitus:** Type I & II DM.
- **Burns:** First, Second, and Third Degree Burns.
- **Labor and Delivery:** 3 Stages of Labor, Pain management, and complications
- **Obstetrics**
- **Pediatrics:** Growth and development, Common Childhood Illnesses
- **Orthopedics:** Fractures, Osteoarthritis, and Devices
- **Drug Calculations:** Systems of Measurement, Common Conversions, Methods of Calculations, and Practice Problems.

# I. Neurology

## I. NEUROLOGY

**A. Headaches (Migraine):** These are often caused by stress, allergies, or environmental factors. Sufferers can have auras (a warning sign that a migraine is imminent). Symptoms can include light sensitivity, nausea, vomiting, and severe throbbing pain.

- **Medications and Treatments:** The two main categories of drugs used to treat migraine headaches are for pain-relief and prevention. Medication management of migraine headaches requires factoring the frequency, severity, and degree of disability caused.
- **Pain relieving drugs:** NSAIDs (Advil, Motrin, and Aleve) are commonly used for pain relief as well as tryptophans (Imitrex and Axert) which also help with nausea and light sensitivity. Ergots (Migergot and Cafergot) are not as effective as the NSAIDs and tryptophans; however they are most effective in treating pain lasting longer than 48 hours. Anti-nausea medications (Phenergan or Compazine) are commonly used in conjunction with the pain relieving medications as part of the treatment regimen. Opiates are used to manage pain and can be habit-forming, placing a patient at risk of addiction. Current studies show that opiates often cause rebound headaches, despite their use for pain control and therefore is often used as a last resort.
- **Preventative Medications:** Cardiovascular drugs have been found to be effective for decreasing frequency and intensity of migraine headaches taken on a daily/ long term basis. First line treatments with cardiovascular drugs are beta blockers. These drugs have been found to be extremely effective in reducing the severity and frequency of headaches. Calcium

channel blockers and anti-hypertensive medications are also very effective in decreasing the frequency, intensity and duration of the headache. Anti-depressants such as tricyclic anti-depressants (Pamelor) and SSRI's (Effexor) are another treatment choice for migraine headaches. Research has shown that these medications are effective due to affecting the levels of serotonin and other neurotransmitters. Medication management is guided by the effectiveness of the treatment. The goal is to reduce the frequency, intensity and duration of the headache. The physician will often combine the different medications, in order to eradicate or greatly minimize the signs and symptoms of migraine headaches.

**B. Parkinson's Disease:** Parkinson's disease is a deterioration of the central nervous system and loss of dopamine production in the brain. Early signs include shaking, tremors, and difficulty walking. As the disease progresses, it begins to affect behavior and cognitive function. Dementia occurs late in the disease. Severe muscle spasms can cause difficulty sitting, standing, and severely impact the ability to walk.

- **Medications and treatments:** There is no known cure for Parkinson's disease. The current approach for this disease is directed at treating the symptoms that are most bothersome. Dopaminergic drugs are used to help replenish dopamine levels in the brain or mimic the effects of dopamine to reduce muscle rigidity, improve speed, and coordination, while decreasing tremors. Carbidopa/Levodopa (Sinemet) is the primary medication used for treating Parkinson's disease. The brain converts levodopa into dopamine, thereby increasing the dopamine levels in the brain. Due to increased levels of dopamine, the patient



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experiences a decrease in tremors, muscle rigidity and improved ability to walk. When starting this medication, it is important for the pharmacy to check for drug interactions or incompatibilities with the medications the patient is currently taking. Medications are one part of the treatment plan for patients with Parkinson's disease. Surgical procedures are available, but are reserved for patients who, after exhausting all medication treatment regimes, still have symptoms that are not well controlled with medication. The goal of surgery is to decrease the most debilitating symptoms of Parkinson's disease such as tremors, rigidity, slowed movements and walking problems. The most common surgery performed, if needed, is Deep Brain Stimulation. A neurostimulator device is implanted in the brain which sends electrical stimulation to targeted areas that control movement thereby blocking abnormal electrical signals that cause tremor and other Parkinson's symptoms. Patients may still need to take some medications, but the side effects (dyskinesia) from the medications are dramatically reduced because the patient needs less medication.

[http://www.medicinenet.com/parkinsons\\_disease/article.htm](http://www.medicinenet.com/parkinsons_disease/article.htm)

- C. Alzheimer's Disease:** This is the most common form of dementia in older Americans. Onset is usually after 65 years of age, but early onset of the disease occurs in some individuals. The first symptoms are often mistaken for usual signs of aging. The individual begins to have difficulty recalling recent events. There is an inability to acquire new memories. As the disease progresses, changes occur in mood and behavior; with an increase in aggression, confusion, irritability. The start of long term

memory loss occurs and the patient can no longer recall important events such as anniversaries, birthdates of children, graduation from high school, etc. Eventually the patient no longer has the ability to recall events that occurred only minutes ago. Once the diagnosis is confirmed, the life expectancy is approximately 7 years.

- **Medications and treatments:** In the early stages of Alzheimer's disease, cholinesterase inhibitors are prescribed. These drugs, Razadyne (galantamine), Exelon (rivastigmine) and Aricept (donepezil), are used in hope of preventing or delaying the worsening of symptoms as well as help control behavioral symptoms. These drugs work by either blocking the toxic effects of neurotransmitter build-up (glutamate) or prevents the breakdown of acetylcholine in the brain. These medications lessen symptoms such as memory loss and confusion for a limited period of time. Namenda (memantine) is a medication used to treat moderate to severe Alzheimer's disease helping to delay the progression of symptoms, thereby allowing the patient to maintain certain daily functions for a period of time (6 to 8 months). The disease continues to destroy brain synapses, leading to complete dependence on others with no ability or comprehension for self-care. Patients lose their ability to recall events and eventually do not recognize family members and friends they have known their entire lives.

<http://www.mayoclinic.com/health/alzheimers-disease/DS00161>

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001767/>

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### D. Stroke (CVA - Cerebral Vascular Accident):

A stroke is caused by the interruption of blood supply to an area of the brain and can be embolic (blood clot) or hemorrhagic. This causes oxygen depletion to the area of the brain with a possibility of irreversible damage to the area. If symptoms are brought to the attention of medical personnel within a 4 hour window, the possibility of reversing the symptoms is greatly increased. The four hour window is necessary for the use of clot busting drugs (TPA) which greatly increase the chances for recovery and no residual effects. TPA is the front line drug for embolic strokes. Some hospitals have Brain Attack teams that are activated when a patient presents in the emergency room within the appropriate time frame. The team will assume responsibility for the patient and begin protocol care.

- **Medications and Treatment:** If a patient presents to the emergency room within a 4 hour time period, from onset of symptoms, then clot busting drugs such as TPA (altase) can be used. The sooner the drug can be given increases the chances of reversal of symptoms and decrease the risk of bleeding into the brain. Blood Thinners are also medications used to treat stroke patients. The medications are used in hopes of improving the patient's recovery from a stroke and hopefully prevent future ones.

There are two classes of drugs commonly used in the treatment and prevention of a stroke, antiplatelet medications and anticoagulants. **Antiplatelet drugs** work by decreasing platelet aggregation and inhibiting thrombus formation. Antiplatelet drugs are the only drugs that work in the arterial system. The anticoagulant drugs work in the venous system. The medications are used in hospitals for

prevention of blood clots. Patients who have had surgery, and/ or restricted to bed rest for extended periods of time, are given these medications. The most common antiplatelet drugs used are Plavix (Clopidogrel), Lovenox (Enoxaparin), ASA, and Persantine (Dipyridamole). These drugs are taken once daily as prescribed by a physician.

**Anticoagulant Drugs** are designed to prevent clot formation or to prevent an already present clot from getting larger. These drugs are given to patients who have had a stroke or a myocardial infarction. These patients will be on an anticoagulant medication long term, thereby decreasing the chance of having another stroke or heart attack due to a blood clot. Anticoagulant drugs work by either inhibiting clotting factors or blocking the activity of thrombin. Coumadin (Warfarin) is a drug that works by inhibiting clotting factors. Heparin is a drug that works by inhibiting the activity of thrombin. When a patient is admitted due to a stroke or heart attack, thought to be caused by a blood clot, initial treatment is with heparin. The patient is often given a bolus dose and then started on a heparin drip. Serial blood work (PT, PTT and INR) are checked at frequent intervals until the PT, PTT and INR are 1 ½ time greater than the normal range. Once the patient's lab values have increased 1 ½ times, the patient will be started on Coumadin and taken off the heparin drip. The patient will have a.m. labs checking the PT, PTT and INR levels to be sure that the new values remain elevated. The physician will determine the daily dose of Coumadin after receiving the results of the a.m. labs. Normal range for a PT test is 10-12 seconds. Normal PTT values are

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30-45 seconds. Normal INR values are 1-2. These patients will be followed by their primary care physician on a periodic basis to be sure that the medication remains in therapeutic range.

**Warning:** Patients taking anticoagulant and antiplatelet drugs need education regarding side effects. Patients should be taught about increased bruising, epistaxis (nose bleeds), and hematuria (blood in urine). If the patient sustains a cut or a puncture wound, pressure needs to be applied longer due to increased bleeding times. If a patient has a nosebleed (epistaxis) or blood in the urine (hematuria), the patient should report this to their physician. If unable to stop a nose bleed, the patient should go to the nearest emergency room.

Patients who have gastrointestinal ulcers may not be able to take these medications or will need to be monitored very closely for any signs of bleeding. NSAIDS should not be used when taking these medications due to the increased risk of gastrointestinal bleeding.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001740/>

<http://www.mayoclinic.com/health/stroke/DS00150>

**E. Muscular Dystrophy:** This disease is inherited and diverse. The basic issue is with muscle weakness and muscle loss. There are many types of muscular dystrophy, each having their own unique symptoms. When a physician completes a thorough physical and runs various tests, they will be able to identify the type of dystrophy present. There are no known cures at this time. The key is to remain active as long as possible in as much as inactivity causes the disease to progress faster.

- **Medications and treatments:** There is no current medication used to treat this illness. Physical and occupational therapy are used to help the patient maintain strength and coordination as well as learning modifications for activities of daily living. Modifications for bathing, grooming, and other activities allow the person to remain independent.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002172/>

**F. Multiple Sclerosis:** This is an autoimmune response of the body causing problems in the brain and spinal cord. The myelin sheath covers nerves and helps to conduct electrical signals to the brain and spinal cord. MS causes deterioration of this sheath by inflammation, thereby affecting nerve conduction. Researchers are not clear as to what causes this disease. Current theories are viral or a genetic defect. The illness has episodes of activity and then, the person may go into remission. There is no way to predict the length of time the person will be sick vs. the amount of time the remission may last. Some of the more common symptoms include loss of balance, difficulty with speech, problems with co-ordination and muscle weakness.

- **Medications and treatments:** There is no known cure for multiple sclerosis. Treatment is aimed at getting the patient to return to functional activity after an attack. The goal is to prevent new attacks and prevent disability.

<http://www.mayoclinic.com/health/multiple-sclerosis/DS00188>

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**G. Epilepsy/Seizure Disorder:** Episodic abnormal electrical activity in the brain. Epilepsy is more likely to occur in children and adults over 65.

- Seizure activity is categorized into two basic categories: Generalized and partial. Generalized seizures are caused by abnormal electrical activity throughout the brain. Partial seizures are localized in a particular area of the brain. The most common seizures are:
- Grand Mal/Generalized Tonic-Clonic: Unconsciousness, convulsions and muscle rigidity. **Do Not Place** anything in the mouth when this person is seizing. The most important thing is to keep them from hitting any objects that could cause additional injury. Patients have a "postictal state where they have stopped seizing but remain semi-conscious. They may foam at the mouth due to inability to swallow saliva during the seizure.
- Absence: Brief loss of consciousness.
- Myoclonic: Sporadic (isolated) jerking movements often isolated to a limb.
- Clonic: Repetitive jerking movements.
- Tonic: Muscle stiffness, rigidity seen in all muscular areas.
- Atonic: Loss of muscle tone. Often results in the person falling.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001714/>

<http://www.webmd.com/epilepsy/guide/understanding-seizures-and-epilepsy>

**H. Increased Intracranial Pressure:** This is caused by a rise in the pressure inside the skull, often the result of an injury to the brain. Increased pressure can also be caused by an increase in cerebrospinal fluid, a mass in the brain, or just the swelling of the brain itself. Prolonged increase in the intracranial pressure crushes the brain tissue (brain herniation) and often is fatal if not treated aggressively. The most common causes of increased intracranial pressure are:

- Aneurysm
- Encephalitis
- Hydrocephalus
- Meningitis
- Severe head injury due to some type of trauma
- Subdural Hematoma
- Status Epilepticus
- Stroke

## I. NEUROLOGY

- **Medications and treatments:** The most important issues are oxygenation and decreasing the pressure in the brain. Hyperventilation using a ventilator or bag valve mask can help decrease ICP by decreasing CO<sub>2</sub> levels. Increased CO<sub>2</sub> levels causes increases in ICP. This solution is immediate but temporary. Keeping the mean arterial pressure low can also help decrease intracranial pressure. Physicians may use common antihypertensive medications such as beta blockers to keep the mean arterial pressure below 60. Analgesia and sedation are used to keep restlessness and struggling to a minimum, thereby keeping the ICP lowered. If sedation does not keep the patient quiet enough, then the use of paralytics may be used.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001797/>

- I. **Subdural Hematoma:** Caused by a tearing of the venous blood vessels causing hematoma to form between the Dura mater and the arachnoid mater. This is often caused by a traumatic brain injury to an individual or seen in the elderly due to a fall. There are two types of subdural hematomas-acute and chronic. An acute subdural hematoma is often fatal if not treated emergently. Blood rapidly accumulates in the dural space causing an increase in intracranial pressure and the risk of brain herniation due to the rapid accumulation in a fixed space.

<http://www.bettermedicine.com/article/subdural-hematoma>

<http://www.mayoclinic.com/health/intracranial-hematoma/DS00330/DSECTION=causes>

## I. NEUROLOGY

## **II. Respiratory**

## II. RESPIRATORY

**A. Asthma:** Airways narrow, swell, produce extra mucus, making breathing difficult. The most common asthma signs and symptoms are coughing, wheezing and shortness of breath. For some people asthma symptoms are a minor nuisance. For others, they are a major problem that interferes with daily activities. Severe asthmatics can be at risk for a life-threatening asthma attack. Asthma cannot be cured, but symptoms can be controlled.

- **Medications and treatments:** The right medication depends on a number of things including age, symptoms, and triggers. Preventive, long-term control medications reduce airway inflammation leading to symptoms. Quick-relief inhalers (bronchodilators) quickly open swollen airways that are limiting breathing. In some cases, medications to treat specific allergies are needed.

– Long Term Control Medications:

- **Inhaled Corticosteroids:** These medications include fluticasone (Flovent Diskus, Flovent HFA), budesonide (Pulmicort Flexhaler), mometasone (Asmanex), flunisolide (Aerobid), beclomethasone (Qvar) and others. They are the most commonly prescribed type of long-term asthma medication. You may need to use these medications for several days to weeks before they reach their maximum benefit. Unlike oral corticosteroids, these corticosteroid medications have a relatively low risk of side effects and are generally safe for long-term use.
- **Leukotriene Modifiers:** These oral medications include montelukast (Singular), zafirlukast (Accolate) and zileuton (Zyflo, Zyflo CR). They

help prevent asthma symptoms for up to 24 hours. In rare cases, these medications have been linked to psychological reactions such as agitation, aggression, hallucinations, depression, and suicidal thinking.

- **Long-Acting Beta Agonists (LABAs):** These inhaled medications include salmeterol (Serevent Diskus) and formoterol (Foradil Aerolizer). LABAs open the airways and reduce inflammation. However, they have been linked to severe asthma attacks. LABAs should be taken only in combination with an inhaled corticosteroid.
- **Combination Inhalers:** These include fluticasone and salmeterol (Advair Diskus) and budesonide and formoterol (Symbicort). These medications contain a LABA along with a corticosteroid. Like other LABA medications, these medications may increase your risk of having a severe asthma attack.
- **Quick Relief Medications:** Quick-relief (rescue) medications are used as needed for rapid, short-term symptom relief during an asthma attack.
  - **Short-Acting Beta Agonists:** Inhaled, quick-relief bronchodilators rapidly ease symptoms of an asthma attack. They include albuterol (ProAir HFA, Ventolin HFA, others), levalbuterol (Xopenex HFA) and pirbuterol (Maxair Autohaler). These medications act within minutes and effects last several hours.



## II. RESPIRATORY

- Ipratropium (Atrovent): Like other bronchodilators, ipratropium relaxes the airways, making it easier to breathe and is mostly used for emphysema and chronic bronchitis, but sometimes used to treat asthma attacks.
- Oral and Intravenous Corticosteroids: Used for relief of airway inflammation caused by severe asthma. Oral medications such as prednisone and intravenous medications such as methylprednisolone are the front line drugs used to treat the acute phase of an asthmatic attack. Long term usage may cause serious side effects, so they are used only on short-term basis for severe asthma symptoms.

<http://www.mayoclinic.com/health/asthma/DS00021>

- B. COPD (Chronic Obstructive Pulmonary Disease):** This is a group of lung diseases that block airflow as you exhale and make it increasingly difficult for you to breathe. Emphysema and chronic asthmatic bronchitis are the two main conditions that make up COPD. Many people have both. In all cases, damage to your airways eventually interferes with the exchange of oxygen and carbon dioxide in your lungs. COPD is a leading cause of death and illness worldwide. Most COPD is caused by long-term smoking and can be prevented by not smoking or quitting soon after you start. This damage to your lungs cannot be reversed, so treatment focuses on controlling symptoms and minimizing further damage.

- **Medications and treatments:** Control of symptoms, reduce risk of complications, and exacerbations.
  - Stop Smoking: This is the most essential step in any treatment plan for smokers with COPD.
  - Bronchodilators: These medications, which usually come in an inhaler, relax the muscles around airways. This can help relieve coughing, shortness of breath, and make breathing easier. (Mayo Foundation for Medical Education and Research, 2011)
  - Inhaled Steroids: Inhaled corticosteroid medications can reduce airway inflammation and make breathing easier. Prolonged use of these medications can weaken bones and increase the risk of high blood pressure, cataracts and diabetes. They are usually reserved for people with moderate or severe COPD.
  - Oxygen Therapy: The goal is to keep the patient's pulse oximetry greater than 90%. In order to maintain this, supplemental oxygen will be required. Devices to deliver oxygen – Nasal Cannula (up to 6 l/min) or a Non-Rebreather Mask (up to 15 l/min) are choices available to deliver oxygen to a patient. Additional oxygen should help reduce work of breathing.

<http://www.mayoclinic.com/health/copd/DS00916>

## II. RESPIRATORY

**C. Pneumonia:** This is an inflammation of lungs, usually caused by infection. Bacteria, viruses, fungi or parasites can cause pneumonia. It is a particular concern to those older than 65 or have a chronic illness or impaired immune system. It is the number three cause of death in those who are 65 or older. It can also occur in young, healthy people. Pneumonia can range in seriousness from mild to life-threatening and often is a complication of another condition. Symptoms can vary greatly, depending on any underlying conditions and type of organism causing the infection. Pneumonia often mimics the flu, beginning with a cough and a fever. Common signs and symptoms may include: fever, cough, shortness of breath, sweating, shaking chills, headache, muscle pain, fatigue, and chest pain that fluctuates with breathing (pleurisy).

- **Medications and treatments:** Treatments vary depending on the severity of symptoms and type of pneumonia.
  - Bacterial – Treated with antibiotics, which have been determined by blood cultures, or sputum cultures, to be the most effective against the type of bacteria identified.

- Viral - Antibiotics are not effective against most viral forms of pneumonia. A few viral pneumonias may be treated with antiviral medications; however the recommended treatment generally is rest and plenty of fluids.
- Mycoplasma – This is treated with antibiotics. In some cases fatigue may continue long after the infection itself has cleared. Many cases go undiagnosed and untreated. Signs and symptoms mimic a bad chest cold, so some people never seek medical attention. The symptoms generally resolve spontaneously.
- Fungal – This is treated with antifungal medication.

<http://www.mayoclinic.com/health/pneumonia/DS00135>

## **III. Cardiac**

### III. CARDIAC

**Acute Coronary Syndrome:** This is any condition brought on by sudden, reduced blood flow to the coronary arteries. A description of chest pain felt during a heart attack, chest pain felt at rest or light physical activity is referred to as unstable angina. Patients should immediately call 911 if these symptoms are felt. Acute coronary syndrome is treatable if diagnosed quickly. Acute coronary syndrome treatments vary depending on signs, symptoms and overall health condition. Symptoms may include: chest pain that feels like burning, pressure, or tightness lasting several minutes or longer. Left arm pain or jaw pain, nausea, vomiting, shortness of breath, or sudden heavy sweating.

<http://www.mayoclinic.com/health/acute-coronary-syndrome/DS01061>

- **Medications and treatments:** Treatments vary depending on symptoms and degree to which arteries are blocked. Medications are given to relieve chest pain and improve blood flow through the coronary arteries.
  - Aspirin (ASA): Decreases blood clotting, helping to keep blood flowing through narrowed coronary arteries. This drug is one of the first things given in the emergency room for suspected acute coronary syndrome. If a patient is experiencing chest pain at home, give 325 mg of ASA and chew it, then call 911.
  - Thrombolytics: Also called “clot busters”, help prevent a blood clot that is blocking blood flow to the heart from enlarging. The earlier thrombolytic drugs are given during a heart attack lessens the damage to the heart. “TIME IS MUSCLE.”
  - Nitroglycerin: This vasodilator will help improve blood flow to the coronary blood vessels thereby alleviating chest pain. Side effects include: headache and hypotension.
  - Beta Blockers: Help relax the heart muscle, slow heart rate and decrease blood pressure, thereby decreasing the oxygen demand of the heart. These medications can increase blood flow to the coronary arteries, thereby decreasing chest pain and the potential for myocardial damage.
  - Angiotensin-Converting Enzyme (ACE) inhibitors and Angiotensin Receptor Blockers (ARBs): These medications allow blood to flow from the heart more easily. The physician may prescribe ACE inhibitors or ARBs on discharge, after having an episode of acute coronary syndrome or myocardial infarction if the heart’s pumping capacity is diminished. These drugs also lower blood pressure and may prevent subsequent ACS or MI.
  - Calcium Channel Blockers: These medications relax the heart, allowing increased blood flow to and from the heart. Generally given if symptoms persist after nitroglycerin and beta blockers are given.
- **Procedures**
  - **Angioplasty and Stenting:** A physician inserts a catheter via the femoral vein under fluoroscopy into the blocked or narrowed part of the coronary artery. A wire with a deflated balloon is passed to the narrowed area. The balloon is inflated compressing the deposits against the artery walls. A mesh tube (stent) is usually left in the artery to help keep the artery open. Angioplasty may also be done with laser technology.

### III. CARDIAC

**Hypertension:** High blood pressure (hypertension) quietly damages the body for years before symptoms develop. Left uncontrolled it can cause disability, end-stage renal disease, destruction of cardiac function, which results in poor quality of life, or a fatal heart attack. With treatment and lifestyle changes, hypertension can be controlled to reduce risk of life-threatening complications.

- **Complications**

- Arterial Damage: Healthy arteries are flexible, strong and elastic. Their inner lining is smooth allowing blood to flow freely, supplying vital organs and tissues with adequate nutrients and oxygen. With hypertension, the increased pressure of blood flow through arteries gradually causes a variety of problems:
  - Narrowing: Hypertension damages the cells of the arterial inner lining, launching a cascade of events making artery walls thick and stiff (arteriosclerosis) or hardening of the arteries. Dietary fats enter the bloodstream, passing through the damaged cells and start the disease of atherosclerosis. These changes affect arteries throughout the body, restricting blood flow to the heart, kidneys, brain, arms and legs. The damage can cause many problems, including chest pain (angina), heart attack, heart failure, kidney failure, stroke, blocked arteries in legs or arms (peripheral arterial disease), eye damage, and aneurysms.
  - Aneurysm: Constant pressure, over time, of blood moving through a weakened artery can cause a section of its wall to enlarge and form a bulge (aneurysm). An aneurysm can potentially rupture, causing life-threatening internal bleeding. Aneurysms can form in any artery in the body, most dangerous one is found in the aorta, the body's largest artery.

- Cerebral Damage:

- Transient Ischemic Attack (TIA): This is a brief, temporary disruption of blood to the brain; often caused by atherosclerosis or a blood clot — both of which can be attributed to high blood pressure. A transient ischemic attack is often a warning sign of increased risk of a full-blown stroke. Patient may experience temporary numbness, facial droop or confusion. Patients are often not aware that they are at high risk of having a stroke.
- Cerebral Vascular Accident (CVA, Stroke): This occurs when part of the brain is deprived of oxygen and nutrients, causing brain cells to die. Uncontrolled hypertension can lead to stroke by damaging and weakening the brain's blood vessels, causing them to narrow, rupture or leak. Atherosclerotic disease causes blood clots to form in the arteries leading to the brain, blocking blood flow and potentially causing a stroke.
- Dementia: Brain disease resulting in problems with thinking, speaking, reasoning, memory, vision and movement. There are a number of causes of dementia. One cause, vascular dementia, can result from narrowing and blockage of the arteries that supply blood to the area of the brain that controls memory, cognition and emotions. It can also result from strokes caused by an interruption of blood flow to the brain. In either case, high blood pressure may be the culprit. High blood pressure that occurs even as early as middle age can increase the risk of dementia in later years.

### III. CARDIAC

- Renal (Kidney) Damage: Kidneys are responsible for balancing the body's fluid status, electrolyte balance and removal of waste. A process that depends on healthy blood vessels in the kidneys. High blood pressure can injure both the blood vessels in and leading to your kidneys, causing several types of kidney disease called nephropathies. Having diabetes in addition to high blood pressure can worsen the damage, often resulting in end-stage renal disease which requires either transplantation or chronic dialysis.
  - Renal Failure: Hypertension is one of the most common causes of kidney failure. It can damage both the large arteries leading to the kidneys and the tiny blood vessels (glomeruli) within the kidneys. Damage to either causes ineffective renal filtration of fluids, electrolytes and toxins from the blood. As a result, dangerous levels of fluid, electrolytes and toxins can accumulate, ultimately requiring dialysis or kidney transplantation.
- Ocular (Eye) Damage: These tiny, delicate blood vessels supplying blood to the eyes can be damaged by hypertension.
  - Retinopathy: Damage of the vessels supplying blood to the retina. This condition can lead to bleeding in the eye, blurred vision and complete loss of vision.
  - Optic Neuropathy: Blocked blood flow damages the optic nerve. It can kill nerve cells in the eyes, which may cause bleeding within the eye or vision loss.

<http://www.mayoclinic.com/health/high-blood-pressure/DS00100>

- Cardiomyopathy: A disease that weakens and enlarges the heart muscle. There are three main types of cardiomyopathy — dilated, hypertrophic and restrictive — all of which affect heart muscle. Cardiomyopathy makes it harder for the heart to pump blood and deliver it to the body. The ventricles have become weak and boggy. There are many causes of cardiomyopathy, including coronary artery disease and valvular heart disease. Cardiomyopathy can lead to heart failure resulting in death.

Cardiomyopathies can be treated. The type of treatment depends on the type of cardiomyopathy and how serious it is. Treatment may include medications, surgically implanted devices or, in severe cases, a heart transplant.

<http://www.mayoclinic.com/health/cardiomyopathy/DS00519>

- Dilated Cardiomyopathy: The most common type of cardiomyopathy. In this disorder, your heart's main pumping chamber — the left ventricle — becomes enlarged (dilated), its pumping ability becomes less forceful, and blood does not flow as easily through the heart. This causes blood to back up into the lungs as well as in the periphery. Although this type can affect people of all ages, it occurs most often in middle-aged people and is more likely to affect men. Some people with dilated cardiomyopathy have a family history of the condition.

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- Hypertrophic Cardiomyopathy: This type involves abnormal growth or thickening of the heart muscle, particularly affecting the left ventricle. As thickening occurs, the heart tends to stiffen and the size of the left ventricle may shrink, reducing cardiac output and thus interfering with the heart's ability to deliver blood to the body. Hypertrophic cardiomyopathy can develop at any age, but the condition tends to be more severe if it becomes apparent during childhood. Most affected people have a family history of the disease, and some genetic mutations have been linked to hypertrophic cardiomyopathy.

Symptoms: Some people who develop cardiomyopathy have no signs and symptoms during the early stages of the disease. As the condition advances, signs and symptoms usually appear. B type Natriuretic Peptide (BNP) is a blood test that can identify cardiomyopathy. Cardiomyopathy symptoms may include:

- Breathlessness with exertion or even at rest
- Swelling of the legs, ankles and feet
- Bloating of the abdomen due to fluid buildup
- Fatigue
- Irregular heartbeats that feel rapid, pounding or fluttering
- Dizziness, lightheadedness and fainting

Regardless the type of cardiomyopathy, signs and symptoms tend to get worse unless treated. In certain people, this worsening happens quickly, while in others, cardiomyopathy may become worse slowly through time.

Causes: Most of the time, the cause of the cardiomyopathy is unknown. Possible causes of cardiomyopathy include:

- Long-term high blood pressure
- Heart valve problems
- Heart tissue damage from a previous heart attack
- Chronic rapid heart rate
- Metabolic disorders, such as thyroid disease or diabetes
- Nutritional deficiencies of essential vitamins or minerals, such as thiamin (vitamin B-1), selenium, calcium and magnesium
- Pregnancy
- Excessive use of alcohol over many years
- Abuse of cocaine or antidepressant medications, such as tricyclic antidepressants
- Use of some chemotherapy drugs to treat cancer
- Certain viral infections, which may injure the heart and trigger cardiomyopathies. (Rheumatic fever in childhood)
- Iron buildup in heart muscle (hemochromatosis)

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- Restrictive Cardiomyopathy: The heart muscle in people with restrictive cardiomyopathy becomes rigid and less elastic, meaning the heart cannot properly expand and fill with blood between heartbeats. While restrictive cardiomyopathy can occur at any age, it most often tends to affect older people. It is the least common type of cardiomyopathy and can occur for no known reason (idiopathic). The condition may also be caused by diseases elsewhere in the body that affect the heart.

Treatment: Depending on type and severity of heart failure a number of options are available.

#### **Surgery:**

Heart valve repair or replacement: Cardiologists may recommend heart valve repair or heart valve replacement surgery to treat a weakened heart valve by reconstruction or implants (mechanical or pig valve). Ineffective valves in the heart will lead to congestive heart failure. Heart valve surgery may relieve your symptoms and improve quality of life.

Heart transplant: Those with severe congestive heart failure may need a heart transplant. Severe left ventricular failure is the reason for a transplant. Left ventricular devices are used in order to buy time until a heart is found.

Myectomy: The surgeon removes part of the overgrown septal muscle in the heart to increase cardiac output. Cardiac output is severely reduced if a patient has hypertrophic cardiomyopathy. Surgeons may perform myectomy when medication no longer relieves symptoms.

### ECG Interpretation

#### **Cardiac Anatomy**

The coronary arteries descend from the ascending aorta. The coronary arteries bring fresh oxygenated blood to all areas of the heart. Myocardial oxygen demand is high for the heart. The heart contains 3 valves: The tricuspid valve which separates the right atrium from the right ventricle; the mitral valve, which separates the left atrium from the left ventricle; and the aortic valve which is located in the ascending aorta.

Coronary Artery Disease (CAD) occurs when blockage begins to build in the main coronary arteries. When the blockage becomes severe enough, the person will usually experience chest pain, arm pain, and complain of severe pressure in the sternal area. Treatment for this depends on how many blockages are present. If the blockage is 50% or lower, determined in the cath lab, then stents are placed. If the patient has severe blockage in several of the main coronary arteries, the person will be taken to surgery for a Coronary Artery Bypass Graft (CABG).

Valvular problems result in mechanical issues for the heart. Tricuspid or mitral regurgitation are the names of these problems the valves can have. If the valves are incompetent (inability to allow complete atrial filling), then this person will also require heart surgery. All three valves can be repaired or replaced. It is important that the mitral and tricuspid valves are competent so the atrium has time to fill before blood enters the ventricles.



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#### Electrical Physiology

Understanding the electrical physiology of the heart is essential for understanding and learning ECG interpretation. The electrical conduction system of the heart includes the sinoatrial node (SA node), the atrioventricular node (AV node), the Bundle of His which then divides into the left and right bundles branches. The Purkinje fibers are located at the base of the heart. (Reference to diagram C). The electrical system is responsible for the relaxation and pumping of the heart, which then sends blood to all parts of the body. An impulse is generated from the SA node which then travels to the AV node. The impulse hesitates allowing the atrium to completely empty into the ventricles. The impulse then continues down the Bundle of His and Purkinje fibers which cause the ventricles to contract. Understanding the electrical and physiological functioning of the heart allows a nurse to read a strip and determine what issues the heart may be having.

#### Coronary Blood Supply

The coronary arteries are critical to normal heart function as well. If circulation to any area of the heart is obstructed and blood flow is not re-established, then the patient will suffer a myocardial infarction. Let's discuss coronary arteries and their locations. The main vessels run down the front of the heart. The major vessels include the left anterior descending, circumflex, and right coronary artery. (See diagram A ). These vessels supply the majority of the cardiac muscle with blood supply. The vessels also have branches that supply the posterior and inferior blood areas of the heart. The anatomic regions of the heart are supplied as follows:

Area	Artery
Inferior	Right Coronary Artery
Anteroseptal	Left Anterior Descending
Anteroapical	Left Anterior Descending (distal branch)
Anterolateral	Circumflex
Posterior	Right Coronary Artery

#### Waves and Intervals

The electrical tracing of the heart consists of the P wave, QRS complex, and a T wave. The baseline for the tracing is called the isoelectric line. Three intervals are also reviewed when interpreting a strip: the PR interval, QRS complex, and the QT interval. The ST segment will often be the first area of change if a person is having an MI.

**The P wave represents the impulse across the atria to the AV node. The P wave reflects depolarization of the atria.**

**The PR interval is measured from the beginning of the P wave to the beginning of the QRS.**

**The QRS complex reflects the rapid depolarization of the right and left ventricles.**

**The ST segment connects the QRS complex and the T wave. This segment is the period of time represented when the ventricles are depolarized. It is isoelectric.**

**Ventricular recovery or repolarization is the T wave. The interval from the beginning of the QRS complex to the apex of the T wave is called the absolute refractory period.**

**The QT interval (measured from the beginning of the QRS complex to the end of the T wave) varies with heart rate. A prolonged QT interval is a risk factor for ventricular tachyarrhythmias and sudden death.**

### III. CARDIAC

#### Six Critical Questions

Developing habits/techniques when analyzing ECG strips will allow you review all important issues with ECG strips and allow you to come up with an interpretation, without much trouble. Some rhythms will need you to remember the rules/issues that identify them. You will need to memorize the characteristic of 1st degree block, 2nd degree block- Mobitz type I and 2nd degree block- Mobitz type II. Each of these rhythms has unique identifiers that will help you distinguish one from the other; Junctional rhythms are another arrhythmia that often is missed. Memorizing a few rules in regards to the above rhythms and always answering the 6 critical questions will bring you to the correct interpretation each and every time.

1. Regularity: Is the rhythm regular or is it not? Measure from R-R interval and measure P-P interval.

2. Rate: Most strips are 6 second strips so you multiply the number of QRS complexes by 10.
3. P Waves: Is there a P wave for every QRS complex? Are they upright or are they inverted?
4. PR Interval: should be .20 or less. If the distance is greater than .20, begin to think of some type of block.
5. QRS wave: The distance should be .12 or less.
6. Interpretation: After you have answered each of these questions, you should have enough information for you to be able to determine what the rhythm is.

The next section of this study guide is designed to help answer these six critical questions.

<http://library.med.utah.edu/kw/ecg/index.html>

<http://www.12leadecg.com/arrhythmias/>

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#### Basic Rules for ECG Interpretation

Rhythm	Regularity	Rate	P Wave	PRI	QRS
Normal Sinus	Regular; constant R-R	AVV rate = between 60-100	Ps uniform. One P for every QRS	Between .12-.20 & constant	QRS < or = .12
Sinus Bradycardia	Regular	AVV rate = < 60 bpm	Ps uniform. One P for every QRS	Between .12-.20 & constant	QRS < or = .12
Sinus Tachycardia	Regular	AVV rate = > 100 bpm, usually between 100-160 bpm	Ps uniform. One P for every QRS	Between .12-.20 & constant	QRS < or = .12
Sinus Arrhythmia	Irregular; R-R interval varies with respiration	AVV rate = usually between 60-100 bpm but can be slower	Ps uniform. One P for every QRS	Between .12-.20 & constant	QRS < or = .12
Atrial Flutter	Usually Regular; Ventricular rate will be regular if AV node conducts in consistent pattern	Atrial 250-350 bpm. Ventricular will vary based on impulses conducted	Seen as "Flutter" waves, have sawtooth appearance	Cannot be measured	QRS < .12
Atrial Fibrillation	Grossly Irregular	If ventricular rate < 100 bpm rhythm said to be "controlled"; if > 100 bpm considered rapid ventricular response	No discernable P waves, fibrillatory waves or grossly chaotic undulations of baseline	Cannot be measured	QRS < .12
Premature Atrial Contraction	Usually regular except ectopic beat	Depends on underlying rhythm	P wave of premature beat will have different morphology of others. Usually notched or flat. May be lost within T wave of preceding complex	Between .12-.20 but can be prolonged; PRI of ectopic will be different from PRI of other complexes	QRS < .12
Premature Junctional Contraction	Ectopic interrupts the underlying rhythm's regularity, R-R will be irregular	Depends on underlying rhythm	P waves may be before, after or hidden by QRS complex, if visible will be inverted	If precedes QRS then < .12. If behind or during QRS no PRI measurement can be given.	QRS < .12
Junctional Escape Rhythm	Regular; R-R constant.	AVV rates = Rate =inherent junction rate 40- 60 bpm	P waves may be before, after or lost in QRS complex, if visible will be inverted	If precedes QRS then < .12. If behind or during QRS no PRI measurement can be given.	QRS < .12
Accelerated Junctional Rhythm	Regular; R-R constant.	AVV rates = Usually between 60-100. Not a true tachycardia because not > 100 bpm	P waves may be before, after or lost in QRS complex, if visible will be inverted	If precedes QRS then < .12. If behind or during QRS no PRI measurement can be given.	QRS < .12
Junctional Tachycardia	Regular; R-R constant.	AVV rates = Usually between 100-180 bpm.	P waves may be before, after or hidden by QRS complex, if visible may be inverted	If precedes QRS then < .12. If falls behind or during QRS no PRI measurement can be given.	QRS < .12
Premature Ventricular Contraction	Ectopic beat interrupts the regularity of underlying rhythm	Depends on rate of underlying rhythm	Ectopic not preceded by P wave. May see coincidental P near PVC but is dissociated	No PRI	At least .12. configuration different from underlying QRS complexes. T wave frequently opposite direction from QRS complex

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Rhythm	Regularity	Rate	P Wave	PRI	QRS
<b>1st degree block</b> Not a true block because each impulse conducted through vent.	Based on underlying rhythm	Depends on rate of underlying rhythm	P waves upright & Uniform with every P wave followed by QRS complex	PRI will always be constant across strip & > .20	QRS < .12
<b>2nd degree block Type I, Mobitz I or Wenckebach</b>	R-R irregular Cyclic pattern of grouped beats	Atrial rate usually normal. Ventricular rate may be bradycardia range.	P waves upright & uniform and always more P waves than QRS complexes.	PRI gets progressively longer; until one P wave not followed by QRS. After blocked beat cycle repeats.	QRS < .12
<b>2nd degree block Type II, Mobitz II</b>	If conduction consistent, R-R will be regular. If conduction varies, R-R will be irregular	Atrial rate usually normal. Ventricular rate may be bradycardia range.	P waves upright & uniform and always more P waves than QRS complexes.	PRI on conducted beats constant & may be longer than .20	QRS < .12
<b>3rd degree or CHB</b>	P-P regular & R- R regular but not related	Atrial usually normal range. Ventricular will be slower	P waves upright & uniform and always more P waves than QRS complexes	Totally inconsistent. No relationship between P waves & QRS	QRS < .12 if focus junctional, QRS .12 or > if focus ventricular
<b>Atrial Tachycardia</b>	Regular; R-R constant	Usually 150-250 bpm	P wave in front of every QRS, the configuration may be flattened or notched. P waves can be lost in the T waves	Between .12-.20 & constant. Difficult to measure if P obscured by T wave	QRS < .12
<b>Ventricular Tachycardia</b>	Usually Regular; but may be slightly irregular	Atrial cannot be determined, Ventricular range 150-250 bpm considered slow VT. > 250 bpm called Ventricular flutter	None seen	No PRI	Often difficult to differentiate the QRS from the T wave. Measures @ least .12 or >
<b>Ventricular Fibrillation</b>	Cannot determine regularity. Baseline chaotic	Cannot be determined with no discernible complexes to measure	No discernible P waves	No PRI	No discernible QRS complex
<b>Idioventricular</b>	Usually regular; slows as heart dies	Ventricular rate usually 20-40 but may drop below 20 bpm	No P waves	No PRI	QRS is wide measuring @ least .12 or >
<b>Asystole</b>	Cannot determine	No rate	No P waves	No PRI	Straight line no QRS complexes

### III. CARDIAC

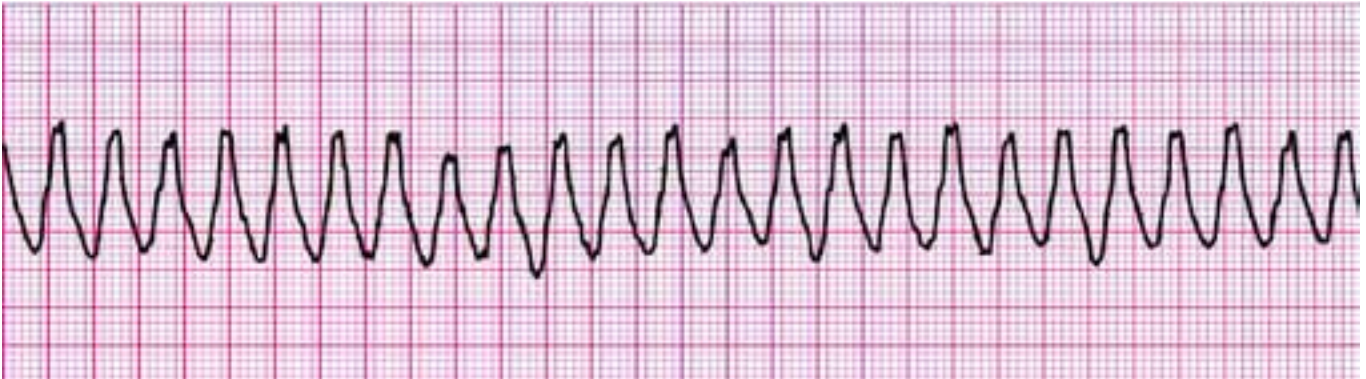
#### Practice Strips

I.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

2.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_



### III. CARDIAC

3.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

4.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

### III. CARDIAC

5.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

6.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_



### III. CARDIAC

7.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

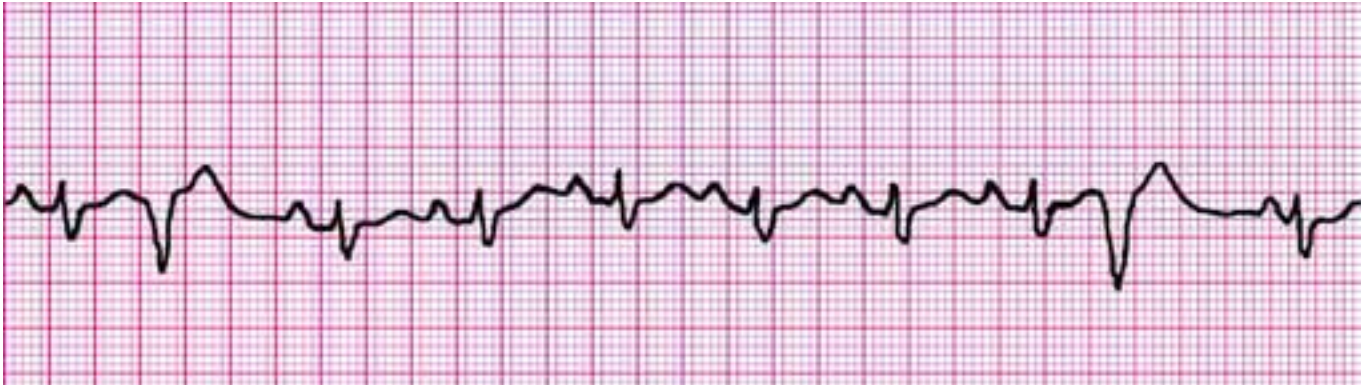
8.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

### III. CARDIAC

9.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

10.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_



### III. CARDIAC

11.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

12.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

### III. CARDIAC

13.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

14.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. P Waves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_



### III. CARDIAC

15.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

16.



1. Regularity \_\_\_\_\_
2. Rate \_\_\_\_\_
3. PWaves \_\_\_\_\_
4. PRI \_\_\_\_\_
5. QRS \_\_\_\_\_
6. Interpretation \_\_\_\_\_

### III. CARDIAC

#### Answer Key

##### 1. Regular

40  
Inverted before the QRS  
.12  
.08  
Sinus bradycardia

##### 2. Regular

250  
None  
None  
.24  
Ventricular Tachycardia

##### 3. Regular

120  
Upright, before every QRS  
.16  
.08  
Sinus Tachycardia

##### 4. Regular except for ectopic beats

100  
Upright, one for each QRS  
.20  
.12  
Bigeminy (NSR with PVCs)

##### 5. Regular

80  
Sawtooth atrial rate 320, ventricular rate 80  
None  
.10  
Atrial Flutter, 4:1 conduction

##### 6. Regular

5.  
Upright, one for every QRS  
.16  
.10  
Sinus Bradycardia

##### 7. Irregular

60  
Fibrillatory  
Non  
.08  
Atrial Fibrillation, controlled

##### 8. Regular

100  
Upright, 1 for every QRS  
.28  
.08  
Sinus Rhythm with 1st degree block

##### 9. Regular except ectopic beats

100  
Upright, 1 for each QRS complex  
.20  
.12  
NSR with 2 PVCs

##### 10. Irregular

70  
Upright, 1 for every QRS  
.16  
.06  
Sinus Arrhythmia

### III. CARDIAC

#### I1.None

None  
None  
None  
None  
Ventricular Fibrillation

#### I5.Regular

30  
None  
None  
14-.16  
Idioventricular

#### I2.Regular

190  
None  
None  
Supraventricular Tachycardia

#### I6.Regular

90  
Upright, more than 1 p wave for every QRS  
Varies  
.08  
Second Degree Heart Block type II

#### I3.Regular

30  
More than 1 P for each QRS  
No consistent PRI  
Complete Heart Block (3rd degree)

#### I4.Regular

40  
Two P waves for each QRS  
.28 and constant  
12  
Second Degree Heart Block Type II

### III. CARDIAC



## **IV. Gastrointestinal**

## IV. GASTROINTESTINAL

This body system and its different illnesses comprise over 50% of hospital admissions. A variety of factors can cause issues with the liver, pancreas, GI tract as well as bleeding. The following are the most commonly seen issues in the ER as well as admitted patients in the hospital.

- **Hemorrhoids:** Are painful swollen veins in the lower part of the rectum or anus. Hemorrhoids may be internal or external. A patient could have both types. The cause of hemorrhoids is often due to too much pressure on the veins in the pelvic and rectal area. If you strain to have a bowel movement, it increases the pressure and causes the veins in the tissues to swell. Pregnancy may bring about hemorrhoids as well. The most common symptoms are bleeding during bowel movements, itching or rectal pain. With internal hemorrhoids you may see streak of bright red blood on the toilet paper. You may see bright red blood in the toilet after you have a normal bowel movement. External hemorrhoids may bleed but usually blood is not visually seen. The bleed forms a painful harden lump.
- **Medications and treatments:** Stool softeners such as Phillips stool softener, Dulcolax, Colace. Patients are counseled to increase the fiber in their diet. If issues with itching, there are over the counter medications such as Lanacaine which provides temporary anesthesia and relieves itching. Corticosteroids may be used to help with inflammation and itching, however, they can only be used for short periods of time. Chronic use may cause skin damage. If problems persist, then non-surgical and surgical intervention options are presented.

<http://www.webmd.com/a-to-z-guides/hemorrhoids-topic-overview>

<http://www.medicinenet.com/hemorrhoids/article.htm>

- **Constipation:** Medically defined as fewer than 3 bowel movements per week. Constipation means different things to different people. For some it may mean infrequently stools. Many people, especially older Americans are under the impression that if you do not have a bowel movement every day, it necessitates using a laxative. Less than 50% of people have bowel movements every day. For some people, constipation means hard stools, difficulty passing stools, or the feeling of incomplete emptying after a bowel movement. Treating this problem should be tailored to the patient's specific complaint. Causes of constipation can be related to inadequate water intake, inadequate fiber in the diet, traveling, inactivity, stress, or resisting a bowel movement due to pain (hemorrhoids).
- **Medications and treatments:** Eat a well-balanced meal. Drink plenty of water. Avoid caffeinated fluids as they have a tendency to dehydrate. Exercise regularly. If needed, a mild stool softener or laxative such as Colace or Milk of Magnesia will help with constipation.
  - Milk of Magnesia: This medication contains magnesium hydroxide. This medication has a chalky taste which for some people makes the medication undesirable. Mixing the medication with some type of flavored drink (Gatorade) will greatly improve the taste.
  - Docusate: Brand name Colace or Surfak. This is a lubricating laxative. It may also be combined with a stimulant (combination) medication called Peri Colace in order to help the stool pass easier and provide additional peristalsis.
  - Senekot: This is a stimulant laxative. This medication increases peristalsis

## IV. GASTROINTESTINAL

- Bisacodyl: This is a stimulant laxative manufactured under the names of Correctol and Dulcolax.
- Miralax: An osmotic laxative that contains polyethylene glycol and is usually used for two weeks or less at a time. This medication is also used in large doses as the prep for a colonoscopy.

Overuse of laxatives which can cause the bowel muscles to weaken.

**Warning:** If a person has blood in the stool, losing weight even though you are not dieting, severe pain with bowel movements, or the constipation has lasted longer than two weeks, the patient should seek medical attention by calling their physician.

<http://www.medicinenet.com/constipation/article.htm>

<http://www.webmd.com/digestive-disorders/digestive-diseases-constipation>

- **GERD** (Gastro Esophageal Reflux Disease): Food is passed from the mouth through the esophagus to the stomach. The stomach has a sphincter that closes to prevent food, liquids, etc, from re-entering the esophagus. If this sphincter is incompetent, food or liquids may reflux back into the esophagus causing a burning feeling in the stomach or esophagus called “heartburn”. A hiatal hernia can also cause symptoms of GERD. This is a condition where a part of the stomach moves above the diaphragm. Pregnancy will often aggravate this condition as well as some drugs, cigarettes, alcohol and obesity. If you suspect a medication is causing this, let your physician know. The most common symptoms patients complain of are:
  - Burning pain in the chest (under the breastbone)
  - More likely to be worse at night.

- Increased by bending, stooping, lying down or eating.
- Nausea after eating

[http://www.medicinenet.com/gastroesophageal\\_reflux\\_disease\\_gerd/article.htm](http://www.medicinenet.com/gastroesophageal_reflux_disease_gerd/article.htm)

- **Medications and treatments:** Do not lie down with a full stomach. Avoid eating 2-3 hours before bedtime. Do not smoke. Eat smaller meals. Lose weight. Sleep with your head raised about 6 inches. Medications include proton pump inhibitors, H<sub>2</sub> antagonists, antacids, and promotility agents. The only surgical procedure is called a Nissen Fundoplication. Surgery is used only after all other non-surgical methods have been exhausted. Life styles changes and medications often provide the patient with adequate relief.
- **Class: Proton Pump Inhibitors:** These medications are designed to reduce acid production. By reducing the acid production, the esophagus and other tissue will have the chance to heal if any damage has occurred. These medications are prescribed for people who suffer from heartburn, ulcers of the stomach or intestine, or excess stomach acid. The following is a list of proton pump inhibitors that are commonly prescribed.
  - Aciphex: Decreases the amount of acid production in the stomach. Used to treat GERD and other excessive acid producing problems.
  - Nexium: Decreases the amount of acid production in the stomach. It is also used to treat GERD, erosive esophagitis, and other excessive acid producing problems.
  - Prevacid: Decreases the amount of acid production in the stomach. Used to treat and prevent stomach and intestinal ulcers, erosive esophagitis and other conditions involving excess stomach acid.

## IV. GASTROINTESTINAL

- Prilosec: Decreases the amount of acid production in the stomach. Used for GERD and other conditions involving excess stomach acid production.
- Protonix: Decreases the amount of acid production in the stomach. Used to treat damage to the esophagus due to acid reflux.
- Over the Counter: Prevacid, Prilosec, Zantac, and Tagamet.

The testing used to determine whether a patient has the problem includes: an EGD, barium swallow, and continuous esophageal Ph monitoring. Certain foods can aggravate the symptoms. Some of these include: alcohol, caffeine, carbonated beverages, fruits, fruit juices, and tomato sauces. Patients should try to identify these foods. Keeping a food diary may reveal the offending foods.

**Warning:** If the patient experiences bleeding, choking, shortness of breath, vomiting, or trouble swallowing, this patient should be seen by a physician as soon as possible. If the patient is at home, they should be taken to an emergency room.

- **Irritable Bowel Syndrome:** This syndrome is characterized by cramping, abdominal pain, bloating constipation, and diarrhea. Despite the very uncomfortable and often distressing symptoms, the intestines are not permanently harmed, and do not lead to other serious diseases as cancer. Symptoms can be controlled with diet, stress management, and medications. For some people, however, this disease can be disabling. They are unable to work, attend social events or even travel short distances. Symptoms can vary from person to person.

<http://www.webmd.com/ibs/guide/irritable-bowel-syndrome-ibs-topic-overview>

[http://www.medicinenet.com/irritable\\_bowel\\_syndrome/article.htm](http://www.medicinenet.com/irritable_bowel_syndrome/article.htm)

<http://www.umm.edu/ency/article/000249.htm>

<http://www.nlm.nih.gov/medlineplus/irritablebowelsyndrome.html>

How is IBS diagnosed? Your physician will take a complete medical history including the patient providing a careful description of symptoms and a physical exam. There is no specific test for IBS, although diagnostic tests may be performed to rule out other disease process.

- **Medications and treatments:** The most common treatment is increasing fiber in the diet, which reduces the chance of spasm. Fiber also promotes regular bowel movements, helping to reduce bloating. Increasing exercise and quitting smoking will reduce the “flares”. Identifying food intolerances will also help decrease symptoms associated with irritable bowel syndrome. Medications used to treat IBS such as antispasmodics slow the action of the digestive tract and reduce the chance of spasm. Examples of antispasmodics are Bentyl, Levsin, and Levbid are used in the treatment of IBS.
- Antidiarrheal medication such as Imodium may be used as well. Antidepressants may be prescribed in small doses which have been found to help alleviate bowel symptoms. If these treatments are not effective and do not provide consistent relief for the patient, the physician may prescribe Zelnorm or Lotronex. These medications are used for women and are approved for short term use only. This medication is taken twice daily, 30 minutes before morning and evening meals. The length of treatment is 4-6 weeks. If the patient does respond to this therapy an additional 4-6 weeks may be prescribed. This medication has not been sufficiently studied in men; therefore the FDA has not approved it for IBS in men.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001292/>

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- **GI Bleed:** Blood loss in the gastrointestinal tract, from the pharynx to the rectum. Its causes are diverse. A medical history and physician exam, generally distinguishes between the main forms. The degree of bleeding can range from nearly undetectable to acute, massive, and life-threatening. Management of this problem is also determined by whether it is an upper GI bleed or lower GI bleed.
  - Initial treatment is focused on resuscitation of blood volume with intravenous fluids and blood transfusion. Medications used to treat are proton pump inhibitors and occasionally with vasopressin. Vasopressin causes constriction of the arteries, thereby reducing blood loss. Upper endoscopy and colonoscopy are generally considered appropriate to identify the source of bleeding and determine the therapeutic interventions. Gastrointestinal bleeding can range from microscopic bleeding, where the amount of blood is so small that it can only be detected by laboratory testing, to massive bleeding where frank blood is passed and hypovolemic shock may develop.

<http://digestive.niddk.nih.gov/ddiseases/pubs/bleeding/>

- **Colon Cancer:** Colon or colorectal cancer is found in the large intestine or the rectum. The term colon cancer refers to colon carcinoma only. Colon cancer is one of the leading causes of cancer-related deaths in the United States. Early diagnosis often leads to complete cure. Colon cancer is, in many cases, a treatable disease. How well you do depends on many things, including the stage of the cancer. When treated in the early stages, patients often survive about 5 years after the diagnosis. If it does not return in 5 years, the patient is considered cured.

There is no single cause of colon cancer. Nearly all colon cancers begin as non-cancerous (benign) polyps which slowly develop into cancer.

### Risk factors:

- Older than 60
- African American or Eastern European descent
- Diet high in red meats
- Cancer somewhere else in the body
- Colorectal polyps
- IBS
- Family history
- History of breast cancer
- Genetics
- Tests to screen for colorectal cancer: Colonoscopy, Sigmoidoscopy, Complete Blood Count, and Liver Function Tests. There are 4 stages of cancer. As the stage number increases, the severity of the cancer is increased.
- Treatment: Surgery, Chemotherapy, or Radiation therapy.

## **IV. GASTROINTESTINAL**

## **V. Genitourinary**

## V. GENITOURINARY

The genitourinary system consists of the kidneys, ureters, bladder and urethra. The kidneys are located in the back below the ribs. The kidneys are responsible for water and electrolyte balance, and removing wastes. The kidneys also produce a hormone called erythropoietin which stimulates the bone marrow to produce red blood cells. The ureters are narrow long cylindrical tubes which are responsible for the flow of urine from the kidney to the bladder. The bladder stores the urine and when a certain level/pressure is met, the patient feels the need to urinate. When urination occurs the bladder empties through the urethra. The bladder contracts and flattens. The amount of urine produced and voided by a patient depends on the amount of fluid intake, and intake of high water content foods. The amount of urine produced in an adult is 1.5 quarts of urine each day.

- **Cystitis:** Signs and symptoms of cystitis include feelings of urgency, burning, voiding small amounts of urine, hematuria and pressure in the lower abdomen. Sometimes the patient will also have a fever. These symptoms are caused due to a bacterial infection. Cystitis is more common in women than in men. Women have a much shorter urethra thus it is easier for bacteria to enter the bladder. Urinalysis and urine cultures are used to determine if a patient has cystitis. There is a variety of antibiotics that can be used to treat cystitis. The patient usually takes a course of antibiotics for one week. If the infection has advanced to the kidneys, the treatment takes longer. If a patient continues to have frequent chronic infections, a cystoscopy (a scope procedure that allows the physician to look inside the bladder) is done. Often times the urethra needs dilation due to the chronic inflammation associated with frequent urinary tract infections. During the cystoscopy, the physician can look for bladder stones, causes of blood in the urine, enlarged prostate, kidney stones or tumors. Ureteral

stents can also be placed with this procedure to help increase the flow of urine from the kidneys to the bladder.

- **Enlarged Prostate:** The first signs and symptoms are frequent trips to the bathroom at night to void. Difficulty starting urination and leaking are other initial symptoms. The prostate enlarges over time as a man gets older. By the age of 60, over 50% of men have BPH (Benign Prostate Hypertrophy). The enlarging prostate begins to put pressure on the urethra. This causes narrowing of the urethra. This blockage does not allow the bladder to empty completely. Other symptoms include straining to urinate, continued dribbling of urine, and a feeling of incomplete bladder emptying. Due to the bladder not completely emptying, men are more susceptible to bladder infections. BPH Impact Index is a monitoring scale which allows doctors to determine when a patient needs treatment. A score of less than 8, is considered mild BPH and the physician will monitor this patient periodically to see if the score is elevating. When the patient symptoms start affecting quality of life the physician may start medications, or use a minimally invasive procedure that can be done in the office. If these treatments fail to provide relief, surgery is the solution. There are several medications that can be taken to help relieve symptoms.

<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001419/>

<http://kidney.niddk.nih.gov/kudiseases/pubs/prostateenlargement/>

- **Medications and treatments:** Alpha Blockers: These drugs work by relaxing the muscles around the prostate and bladder neck, however they do not reduce the size of the prostate. Relaxation of the muscles around the prostate and bladder neck allow urine to flow more easily. The names of some of these drugs are Flomax, Uroxatral, Hytrin and Cardura.



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- **Alpha Reductase Inhibitors:** These drugs work by reducing the levels of a male hormone (dihydrotestosterone) DHT which can partially shrink the prostate. These drugs may take up to three months to work, but urine flow is improved. These drugs can also reduce the need for surgery. Names of these drugs are Proscar and Avodart.
- **Invasive treatments:** These treatments are aimed at removing tissue pressing on the urethra, destruction of select tissue, or placement of a urethral stent. These procedures can be done in the office.
- **Surgery:** Transurethral resection of the prostate (TURP) is the most common surgical procedure for BPH. This procedure cuts tissue and seals blood vessels. One side effect of this surgery is retrograde ejaculation. A man will ejaculate backwards into the bladder. This is not painful and should not be issue unless fertility is a concern. Erection problems occur in 5-35% of men. This is often temporary and normal functioning returns after several months. Transurethral incision of the prostate (TUIP) is a surgical procedure that places cuts in the prostate, but does not remove prostate tissue. The cuts reduce the pressure on the urethra, thus making it easier to urinate. Open Prostate Surgery requires the surgeon to make an incision in the abdomen. This surgery is done when the prostate severely enlarged. Surgery may be required if there is bladder damage, bladder stones or the urethra is narrowed. Recovery takes several weeks to months. Patients go home with a Foley catheter and is removed when the surgeon feels that the patient is able to urinate on their own.
- **Renal Calculi (Kidney Stones):** The stones are made up of tiny crystals that create a solid mass and can be found in the kidney or in the bladder. Kidney stones will block the flow of urine out of the kidneys causing the kidneys to swell. The pain associated with this problem is severe. These patients present in the emergency room doubled over with pain and often are nauseated. A person who gets kidney stones will often get them again in the future. There are different types of kidney stones, which can be made of different types of substances depending on the cause. Stones made of calcium are the most common. Calcium often binds with other substances such as oxalate. Cystine stones are formed in patients who have cystinuria, which is caused by too much amino acid production by the body. It is a genetic defect known as an autosomal recessive disorder. You must inherit the gene from both parents in order to have symptoms. Symptoms of kidney stones also includes: abnormal urine color; blood in the urine, fever; nausea, and vomiting. There are several tests that can be done to determine if a patient has kidney stones: An abdominal CT/MRI, intravenous pyleogram (IVP) and ultrasound.  
<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001493/>
- **Medications and treatments:** Treatment will vary depending on the type of stone and the severity of symptoms. If symptoms are severe, the patient may be hospitalized. If the physician feels that the stone will pass, the patient will often be given intravenous fluids and need to increase the amount of oral fluid intake and strain the urine each time he/she urinates in order to collect any kidney stones that pass in order for them to be analyzed by the lab. Pain relievers are prescribed if pain is severe. For less severe symptoms NSAIDs are often recommended. Medications can also be

## V. GENITOURINARY

prescribed depending on the type of stone. Medications used are Allopurinol (for uric acid stones), Antibiotics (for struvite stones), or diuretics. Surgical intervention is done if the stone is too large to pass, is increasing in size or is blocking the flow of urine from the kidneys to the bladder. The most common, non-invasive procedure, is Lithotripsy. Lithotripsy uses ultrasonic waves to break the kidney stones into smaller pieces. Reducing the size of the stones by this method often will allow the stones to pass. Ureteroscopy may be used for stones located in the lower urinary tract. Nephrolithotomy is the standard open surgical procedure that may be needed if other methods fail or for some reason are not possible.

<http://www.mayoclinic.com/health/urinary-tract-infection/DS00286>

<http://kidney.niddk.nih.gov/kudiseases/pubs/stonesadults/>

[http://www.medicinenet.com/interstitial\\_cystitis/article.htm](http://www.medicinenet.com/interstitial_cystitis/article.htm)

**Warning:** If the patient has a sudden and complete inability to urinate, this is a medical emergency. Patients should see their doctor right away or go to the emergency room. A Foley catheter will be placed temporarily to allow the bladder to empty.

## **VI. Wounds**

## VI. WOUNDS

**Phases of Wound Healing** - The entire wound healing process is a complex series of events beginning the moment of injury and can continue for months to years. The following overview is designed to help identify the stages of wound healing.

- **Inflammatory Phase**
  - **Immediate** - to 2-5 days
  - **Hemostasis** – Vasoconstriction, platelet aggregation, thromboplastin forms a clot
  - **Inflammation** – Vasodilation, phagocytosis
- **Proliferative Phase**
  - 2 days to 3 weeks
  - **Granulation** – Fibroblasts lay a bed of collagen, fills the defect and produces new capillaries needed to begin wound healing.
  - **Contraction** – Wound edges pull together to reduce the defect. Often seen as the formation of a scab.
  - **Epithelialization** – Crosses moist surface and cells travel about 3 cm from point of origin in all directions
- **Remodeling Phase**
  - 3 weeks to 2 years
  - New collagen forms which increases tensile strength to wounds
  - Scar tissue is only 80 percent as strong as original tissue

### Staging Pressure Ulcers

The following information was copied verbatim from the AHCPR Guidelines, which is consistent with the recommendations of the National Pressure Ulcer Advisory Panel (NPUAP) Consensus Development Conference:

- **Stage 1**

Nonblanchable erythema (redness) of intact skin, the heralding lesion of skin ulceration. In individuals with darker skin, discoloration of the skin, warmth, edema, induration, or hardness may also be indicators. This pressure ulcer is an observable ulcer related to alteration of intact skin whose indicators, as compared to the adjacent or opposite area on the body, may include changes in one or more of the following: Skin temperature (warmth or coolness) tissue consistency (firm or boggy feel) and/or sensation (pain, itching). The ulcer appears as a defined area of persistent redness or lightened pigmented skin. Whereas in darker skin tones, the ulcer may appear with persistent red, blue, or purple hues.
- **Stage 2**

Partial thickness skin loss involving epidermis, dermis, or both. The ulcer is superficial and presents clinically as an abrasion, blister, or shallow crater.
- **Stage 3**

Full thickness skin loss involving damage to or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia (muscle). The ulcer presents clinically as a deep crater with or without undermining of adjacent tissue.
- **Stage 4**

Full thickness skin loss with extensive destruction, tissue necrosis, or damage to muscle, bone, or supporting structures (e.g., tendon, joint capsule). Undermining and sinus tracts also may be associated with Stage 4 pressure ulcers.

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### Ulcer Care

Initial care of the pressure ulcer involves debridement, wound cleansing, the application of dressings, and possibly adjunctive therapy. In some cases, operative repair will be required. In all cases, specific wound care strategies should be consistent with overall patient goals.

- **Debridement:**
  - Moist, devitalized tissue supports the growth of pathological organisms. Therefore, the removal of such tissue favorably alters the healing environment of a wound. Although debridement is a time-honored modality for treating pressure ulcers, it has not been studied in a randomized trial.
- **Removal of devitalized tissue:** Remove devitalized tissue in pressure ulcers when appropriate for the patient's condition. This reduces chances of infection and allows growth of healthy tissue to take place.
- **Selection of a method:** Select the method of debridement most appropriate to the patient's condition and goals.
  - Sharp, mechanical, enzymatic, and/or autolytic debridement techniques may be used when there is no urgent clinical need for drainage or removal of devitalized tissue.
  - Sharp debridement involves the use of a scalpel, scissor, or other sharp instrument to remove devitalized tissue. This method is the most rapid form of debridement and may be the most appropriate technique for removing areas of thick, adherent eschar (usually caused from a burn) and devitalized tissue in extensive ulcers.
- If there is an urgent need for debridement, as with advancing cellulitis or sepsis, sharp debridement should be used. Surgical debridement is often the choice for this urgent issue.
- Those performing sharp debridement should have demonstrated the necessary clinical skills and meet licensing requirements.
- Although small wounds can be debrided at the bedside, extensive wounds are usually debrided in the operating room or in a special procedures room. When debriding extensive Stage IV ulcers in the operating room, the surgeon should consider a bone biopsy to detect osteomyelitis.
- Mechanical debridement techniques include wet-to-dry dressings, hydrotherapy, wound irrigation, and dextranomers.
- Enzymatic debridement is accomplished by applying topical debridement agents (creams, enzyme ointments) to devitalized tissue on the wound surface.
- Autolytic debridement involves the use of synthetic dressings to cover a wound and allow devitalized tissue to self-digest from enzymes normally present in wound fluids. This technique should not be used if the wound is infected.
- **Dressings during and after debridement:** Use clean, dry dressings for 8 to 24 hours after sharp debridement associated with bleeding; then reinstitute moist dressings. Clean dressings may also be used in conjunction with mechanical or enzymatic debridement techniques.

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- **Stable heel ulcers, an exception:** Healing ulcers with dry eschar need not be debrided if they do not have edema, erythema, fluctuance, or drainage. Assess these wounds daily to monitor for pressure ulcer complications that would require debridement (e.g., edema, erythema, fluctuance, drainage).
- **Pain:** Prevent or manage pain associated with debridement as needed.
- **Appropriate irrigation pressures:** Use enough irrigation pressure to enhance wound cleansing without causing trauma to the wound bed. Safe and effective ulcer irrigation pressures range from 4 to 15 pounds per square inch (psi). Irrigation pressures below 4 psi may not cleanse the wound adequately, and pressures greater than 15 psi may cause trauma and drive bacteria into the wound tissue. Irrigation devices that deliver 8 psi of pressure are significantly more effective in removing bacteria and preventing infection than is a bulb syringe.
- **Whirlpool:** Consider whirlpool treatment for cleansing pressure ulcers that contain thick exudate, slough, or necrotic tissue. Note that trauma can result if the wound is positioned too close to the high-pressure water jets. Discontinue whirlpool when the ulcer is clean.

**Wound Cleansing** - Wound healing is optimized and the potential for infection is decreased when all necrotic tissue, exudate, and metabolic wastes are removed from the wound. The process of cleansing a wound involves selecting both a wound-cleansing solution and a mechanical means of delivering that solution to the wound. The benefits of obtaining a clean wound must be weighed against the potential trauma to the wound bed as a result of such cleansing. Routine wound cleansing should be accomplished with a minimum of chemical and mechanical trauma.

- **Cleanse wounds initially and at each dressing change**
  - **Nontraumatic technique:** Use minimal mechanical force and less coarse materials when cleansing the ulcer with gauze, cloth, or sponges.
  - **Avoidance of antiseptics:** Do not clean ulcer wounds with skin cleansers or antiseptic agents (e.g., povidone, iodine, iodophor, sodium hypochlorite solution [Dakin's solution], hydrogen peroxide or acetic acid), because they are cytotoxic. Table 2 delineates a toxicity index by listing the dilutions required for various skin and wound cleansers to maintain the viability and phagocytic function of white blood cells exposed to these agents.
  - **Normal saline:** Use normal saline for cleansing most pressure ulcers.

**Dressings** - Pressure ulcers require dressings to maintain their physiologic integrity. An ideal dressing should protect the wound, be biocompatible, and provide ideal hydration. The condition of the ulcer bed and the desired dressing function determine the type of dressing needed. The cardinal rule is to keep the ulcer tissue moist and the surrounding intact skin dry.

- **Selection of a dressing:** Use a dressing that will keep the ulcer bed continuously moist. (Wet-to-dry dressings should be used only for debridement and are not the same as continuously moist saline dressings, which keep the ulcer bed moist.) The following criteria should be considered when selecting a dressing:
  - **Moist ulcer bed:** Use clinical judgment to select a type of moist wound dressing suitable for the ulcer. Studies of different types of moist wound dressings showed no differences in pressure ulcer healing outcomes.

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- **Dry surrounding skin:** Choose a dressing that keeps the surrounding skin intact (periulcer) dry while keeping the ulcer bed moist.
- **Exudate control:** Choose a dressing that controls exudate but does not desiccate the ulcer bed. Excessive exudate may delay wound healing and macerate surrounding tissue.
- **Caregiver time:** Consider caregiver time when selecting a dressing. Film and hydrocolloid dressings require less caregiver time than do continuously moist saline gauze dressings.
- **Clinicians should also consider the following:**
  - **Prevent abscess formation:** Eliminate wound dead space by loosely filling all cavities with dressing material. Avoid over packing the wound. Over packing may increase pressure and cause additional tissue damage.
  - **Keep dressings intact:** Monitor dressings applied near the anus, because they are difficult to keep intact. Taping the edges of dressings (“picture-framing”) may reduce this problem.

<http://www.medicaledu.com/default.htm>

## VI. WOUNDS



## **VII. Diabetes mellitus (DM)**

## VII. DIABETES MELLITUS (DM)

Diabetes Mellitus is a multisystem disease with both biochemical and anatomical/structural consequences. It is a chronic disease of carbohydrate, fat, and protein metabolism caused by the lack of insulin, which results from the marked and progressive inability of the pancreas to secrete insulin because of autoimmune destruction of the beta cells.

### Type I DM

#### Causes

The exact cause of type I diabetes is unknown. We do know that in most people with type I diabetes, their body's own immune system — which normally fights harmful bacteria and viruses — mistakenly destroys the insulin-producing (islet) cells in the pancreas. Genetics may play a role in this process, and exposure to certain viruses may trigger the disease.

Whatever the cause, once the islet cells are destroyed, we produce little or no insulin. Normally, the hormone insulin helps glucose enter our cells providing energy to our muscles and tissues. Insulin comes from the pancreas, a gland located just behind the stomach. When everything is working properly, after eating, the pancreas secretes insulin into the bloodstream. As insulin circulates, it acts like a key unlocking microscopic doors allowing sugar to enter the body's cells. Insulin lowers the amount of sugar in the bloodstream, and as the blood sugar level drops, so does the secretion of insulin from the pancreas.

The liver stores and manufactures glucose. When insulin levels are low — not having eaten in a while, for example — the liver converts stored glycogen back to glucose to keep our blood glucose level within a normal range.

In type I diabetes, none of this occurs because there is no insulin to let glucose into the cells. So instead of being transported into our cells, sugar builds up in our bloodstream, where it can cause life-threatening complications.

The cause of type I diabetes is different from the cause of the more familiar type 2 diabetes. In type 2 diabetes, the islet cells are still functioning, but the body becomes resistant to insulin or the pancreas does not produce enough insulin or both.

#### Symptoms

Signs and symptoms can come on quickly and may include:

- **Increased thirst and frequent urination.** As excess sugar builds up in your bloodstream, fluid is pulled from the tissues causing thirst. As a result, you may drink — and urinate — more than usual.
- **Extreme hunger.** Without enough insulin to move sugar into cells, muscles and organs are depleted of energy, triggering intense hunger that may persist even after eating. Without insulin, the sugar in food never reaches energy-starved tissues.
- **Weight loss.** Despite eating more than usual to relieve hunger, weight loss may occur — sometimes rapidly. Without the energy sugar supplies, muscle tissue and fat stores may simply shrink.
- **Fatigue.** If cells are deprived of sugar, you may become tired and irritable.
- **Blurred vision.** If blood sugar level is too high, fluid may be pulled from tissues — including the lenses of the eyes, affecting the ability to focus clearly.

## VII. DIABETES MELLITUS (DM)

### Complications:

Type 1 diabetes affects many of the major organs, including the heart, blood vessels, nerves, eyes and kidneys. Keeping our blood sugar level close to normal most of the time can dramatically reduce the risk of many complications.

Long-term complications of type 1 diabetes develop gradually, over years. The earlier diabetes is developed combined with poor control of blood sugar — the higher the risk of complications. Eventually, diabetes complications may be disabling or even life-threatening.

- **Heart and blood vessel disease.** Diabetes dramatically increases the risk of various cardiovascular problems, including coronary artery disease with chest pain (angina), heart attack, stroke, narrowing of the arteries (atherosclerosis) and high blood pressure. In fact, about 65 percent of people who have type 1 or type 2 diabetes die of some type of heart or blood vessel disease, according to the American Heart Association.
- **Nerve damage (neuropathy).** Excess sugar can injure the walls of the tiny blood vessels (capillaries) that nourish nerves, especially in the legs. This can cause tingling, numbness, burning or pain typically beginning at the tips of the toes or fingers gradually spreading upward. Poorly controlled blood sugar could lead to the loss of all sense of feeling in the affected limbs. Nerve damage that affects the gastrointestinal tract can lead to problems with nausea, vomiting, diarrhea or constipation. For men, erectile dysfunction may be an issue.
- **Kidney damage (nephropathy).** The kidneys contain millions of tiny blood vessel clusters that filter waste from our blood. Diabetes can damage this delicate filtering system. Severe damage can lead to kidney failure or irreversible end-stage kidney disease, requiring dialysis or a kidney transplant.
- **Eye damage.** Diabetes can damage the blood vessels of the retina (diabetic retinopathy), potentially leading to blindness. Diabetes also increases the risk of other serious vision conditions, such as cataracts and glaucoma.
- **Foot damage.** Nerve damage in the feet or poor blood flow to the feet increases the risk of various foot complications. Left untreated, cuts and blisters can become serious infections. Severe damage might require toe, foot or even leg amputation.
- **Skin and mouth conditions.** Diabetes increases our susceptibility to skin problems, including bacterial and fungal infections. Gum infections also may be a concern, especially with a history of poor dental hygiene.
- **Osteoporosis.** Diabetes may lead to lower than normal bone mineral density, increasing the risk of osteoporosis.
- **Pregnancy complications.** High blood sugar levels can be dangerous for both the mother and the baby. The risk of miscarriage, stillbirth and birth defects are increased when diabetes is not well controlled. For the mother, diabetes increases the risk of diabetic ketoacidosis, diabetic eye problems (retinopathy), pregnancy-induced high blood pressure and preeclampsia.
- **Hearing problems.** Hearing impairments occur more often in people with diabetes.

## VII. DIABETES MELLITUS (DM)

### Tests and Diagnosis:

In June 2009, an international committee of experts from the American Diabetes Association, the European Association for the Study of Diabetes and the International Diabetes Federation recommended that type 1 diabetes testing include the following:

- **Glycated hemoglobin (A1C) test.** This blood test indicates the average blood sugar level for the past two to three months. It measures the percentage of blood sugar attached to hemoglobin, the oxygen-carrying protein in red blood cells. The higher the blood sugar levels, the more hemoglobin there is with sugar attached. An A1C level of 6.5 percent or higher on two separate tests indicates diabetes. A result between 5.7 and 6.4 percent is considered prediabetes, which indicates a high risk of developing diabetes.

If the A1C test is not available, or certain conditions making the A1C test inaccurate — such as pregnancy or an uncommon form of hemoglobin (known as a hemoglobin variant) — the following tests to diagnose diabetes may be used:

- **Random blood sugar test.** A blood sample is taken at a random time. Blood sugar values are expressed in milligrams per deciliter (mg/dL) or millimoles per liter (mmol/L). Regardless of when the last meal was, a random blood sugar level of 200 mg/dL (11.1 mmol/L) or

higher suggests diabetes, especially when coupled with any of the signs and symptoms of diabetes, such as frequent urination and extreme thirst. A level between 140 mg/dL (7.8 mmol/L) and 199 mg/dL (11.0 mmol/L) is considered prediabetes, which is a greater risk of developing diabetes.

- **Fasting blood sugar test.** A blood sample is taken after an overnight fast. A fasting blood sugar level less than 100 mg/dL (5.6 mmol/L) is normal. A fasting blood sugar level from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered prediabetes. Diabetes is diagnosed if it is 126 mg/dL (7 mmol/L) or higher on two separate tests. A level from 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L) is considered prediabetes.

### Treatment

Type 1 diabetes mellitus (DM) requires a multidisciplinary approach by the physician, nurse, and dietitian. In patients with new-onset type 1 diabetes, lifelong insulin therapy must be started. Many patients present with diabetic ketoacidosis (DKA). On occasion, the patient with new-onset type 1 diabetes who presents with mild manifestations and who is judged to be compliant can begin insulin therapy as an outpatient. However, this approach requires close follow-up and the ability to provide immediate and thorough education about the use of insulin; the signs, symptoms, and treatment of hypoglycemia; and the need to self-monitor blood glucose levels.

### Types of Insulin

Type	Onset (hr)	Peak (hr)	Duration (hr)
Aspart™ (Novolog®), Glulisine™ (Apidra®), Lispro™ (Humalog®)	0.2-0.5	0.5-2	3-4
Regular (Humulin® R, Novolin®, Novolin® R)	0.5-1	2-3	6-8
NPH™ (Humulin N®, Novolin N®, Novolin NPH®)	1.5	4-10	16-24
Lente™	1.5-3	7-15	16-24
Ultralente™ (Humulin U®)	3-4	9-15	22-28
Glargine™ (Lantus®)	?	No peak	24-36

## VII. DIABETES MELLITUS (DM)

### Type II DM

Type II DM is characterized by the combination of peripheral insulin resistance and inadequate insulin secretion by pancreatic beta cells. Insulin resistance, which has been attributed to elevated levels of free fatty acids in plasma, leads to decreased glucose transport into muscle cells, elevated hepatic glucose production, and increased breakdown of fat.

For type 2 diabetes mellitus to occur, both defects must exist. For example, all overweight individuals have insulin resistance, but diabetes develops only in those who cannot increase insulin secretion sufficiently to compensate for their insulin resistance. Their insulin concentrations may be high, yet inappropriately low for the level of glycemia.

In the progression from normal glucose tolerance to abnormal glucose tolerance, postprandial blood glucose levels increase first; eventually, fasting hyperglycemia develops as suppression of hepatic gluconeogenesis fails.

### Type 2 diabetes major risk factors

Researchers do not fully understand why some people develop type 2 diabetes and others do not. It is clear that certain factors increase the risk, however, including:

- **Weight**
  - Being overweight is a primary risk factor for type 2 diabetes. The more fatty tissue you have, the more resistant cells become to insulin.
- **Fat distribution**
  - If your body stores fat primarily in your abdomen, your risk of type 2 diabetes is greater than if your body stores fat elsewhere, such as your hips and thighs.
- **Inactivity**
  - The less active you are, the greater your risk of type 2 diabetes. Physical activity helps you control your weight, uses up glucose as energy and makes your cells more sensitive to insulin.

- **Family history**
  - The risk of type 2 diabetes increases if your parent or sibling has type 2 diabetes.
- **Race**
  - Although it is unclear why, people of certain races — including blacks, Hispanics, American Indians and Asian-Americans — are more likely to develop type 2 diabetes than whites are.
- **Age**
  - The risk of type 2 diabetes increases as you get older, especially after age 45. That is probably because people tend to exercise less, lose muscle mass and gain weight as they age. But type 2 diabetes is also increasing dramatically among children, adolescents and younger adults.
- **Prediabetes**
  - Prediabetes is a condition in which your blood sugar level is higher than normal, but not high enough to be classified as type 2 diabetes. Left untreated, prediabetes often progresses to type 2 diabetes.
- **Gestational diabetes**
  - If you developed gestational diabetes when you were pregnant, your risk of developing type 2 diabetes later increases. If you give birth to a baby weighing more than 9 pounds (4.1 kilograms), you are also at risk of type 2 diabetes.

## VII. DIABETES MELLITUS (DM)

### Symptoms

Type 2 diabetes symptoms may develop very slowly. In fact, you can have type 2 diabetes for years and not even know it. Look for:

- **Increased thirst and frequent urination**
  - As excess sugar builds up in your bloodstream, fluid is pulled from the tissues. This may leave you thirsty. As a result, you may drink — and urinate — more than usual.
- **Increased hunger**
  - Without enough insulin to move sugar into your cells, your muscles and organs become depleted of energy. This triggers intense hunger.
- **Weight loss**
  - Despite eating more than usual to relieve hunger, you may lose weight. Without the ability to metabolize glucose, the body uses alternative fuels stored in muscle and fat. Calories are lost as excess glucose is released in the urine.
- **Fatigue**
  - If your cells are deprived of sugar, you may become tired and irritable.
- **Blurred vision**
  - If your blood sugar is too high, fluid may be pulled from the lenses of your eyes. This may affect your ability to focus clearly.
- **Slow-healing sores or frequent infections**
  - Type 2 diabetes affects your ability to heal and resist infections.
- **Areas of darkened skin**
  - Some people with type 2 diabetes have patches of dark, velvety skin in the folds and creases of their bodies — usually in the armpits. This condition, called acanthosis nigricans, may be a sign of insulin resistance.

### Tests and diagnosis

In June 2009, an international committee composed of experts from the American Diabetes Association, the European Association for the Study of Diabetes and the International Diabetes Federation recommended that type 2 diabetes testing include the:

- **Glycated hemoglobin (A1C) test.** This blood test indicates average blood sugar level for the past two to three months. It measures the percentage of blood sugar attached to hemoglobin, the oxygen-carrying protein in red blood cells. The higher the blood sugar levels, the more hemoglobin will have sugar attached. An A1C level of 6.5 percent or higher on two separate tests indicates diabetes. A result between 5.7 and 6.4 percent is considered prediabetes, which indicates a high risk of developing diabetes. Normal levels are below 5.7 percent.

If the A1C test is not available, or if there are certain conditions that can make the A1C test inaccurate — such as pregnancy or an uncommon form of hemoglobin (known as a hemoglobin variant) — the following tests to diagnose diabetes may be used:

- **Random blood sugar test.** A blood sample will be taken at a random time. Blood sugar values are expressed in milligrams per deciliter (mg/dL) or millimoles per liter (mmol/L). Regardless of when you last ate, a random blood sugar level of 200 mg/dL (11.1 mmol/L) or higher suggests diabetes, especially when coupled with any of the signs and symptoms of diabetes, such as frequent urination and extreme thirst. A level between 140 mg/dL (7.8 mmol/L) and 199 mg/dL (11.0 mmol/L) is considered prediabetes, which puts you at greater risk of developing diabetes. A blood sugar level less than 140 mg/dL (7.8 mmol/L) is normal.

## VII. DIABETES MELLITUS (DM)

- **Fasting blood sugar test.** A blood sample will be taken after an overnight fast. A fasting blood sugar level less than 100 mg/dL (5.6 mmol/L) is normal. A fasting blood sugar level from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered prediabetes. If it is 126 mg/dL (7 mmol/L) or higher on two separate tests, you have diabetes mellitus. From 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L) is considered prediabetes, which puts you at greater risk of developing diabetes.
- **Oral glucose tolerance test.** For this test, you fast overnight, and the fasting blood sugar level is measured. Then you drink a sugary liquid, and blood sugar levels are tested periodically for the next several hours. A blood sugar level less than 140 mg/dL (7.8 mmol/L) is normal. A reading of more than 200 mg/dL (11.1 mmol/L) after two hours indicates diabetes. A reading between 140 and 199 mg/dL (7.8 mmol/L and 11.0 mmol/L) indicates prediabetes.

The American Diabetes Association recommends routine screening for type 2 diabetes beginning at age 45, especially if you are overweight. If the results are normal, repeat the test every three years. Screening is also recommended for people who are under 45 and overweight if there are other heart disease or diabetes risk factors present, such as a sedentary lifestyle, a family history of type 2 diabetes, a personal history of gestational diabetes or blood pressure above 135/80 millimeters of mercury (mm Hg).

If you are diagnosed with diabetes, the doctor may do other tests to distinguish between type 1 and type 2 diabetes — which often require different treatment strategies because in type 1 diabetes, the pancreas no longer makes insulin.

### After the diagnosis

A1C levels need to be checked between two and four times a year. The target A1C goal may vary depending on age and various other factors. However, for most people, the American Diabetes Association recommends an A1C level below 7 percent.

\* The American Diabetes Association has a formula that translates the A1C into what is known as an estimated average glucose (eAG). The eAG more closely correlates with daily blood sugar readings. An A1C of 7 percent translates to an eAG of 154 mg/dL (8.5 mmol/L).

Compared with repeated daily blood sugar tests, A1C testing better indicates how well your diabetes treatment plan is working. An elevated A1C level may signal the need for a change in your medication or meal plan.

## VII. DIABETES MELLITUS (DM)

### Treatment

#### Medications for type 2 diabetes

Healthy lifestyle choices — including diet, exercise and weight control — are an important part of diabetes treatment. Sometimes medication to control blood sugar is needed, too. Sometimes a single medication is effective. In other cases, a combination of medications works better:

Medications for type 2 diabetes come in various classes — alpha-glucosidase inhibitors, amylin agonists, dipeptidyl-peptidase 4 (DPP-4) inhibitors, meglitinides, sulfonylureas and thiazolidinediones. Each class contains one or more specific drugs. Some of these drugs are taken orally, while others must be injected.

Various diabetes drugs work in different ways to lower blood sugar. A drug may work by:

- Stimulating the pancreas to produce and release more insulin
- Inhibiting the production and release of glucose from the liver, which means you need less insulin to transport sugar into your cells
- Blocking the action of stomach enzymes that break down carbohydrates or make tissues more sensitive to insulin.

#### Medication that increase insulin production

Medications (examples)	Route	Advantages	Disadvantages
<b>Dipeptidyl-peptidase 4 (DPP-4) inhibitors</b> <ul style="list-style-type: none"> <li>• Saxagliptin (Onglyza)</li> <li>• Sitagliptin (Januvia)</li> </ul>	By mouth	Do not cause weight gain	May cause upper respiratory tract infection, sore throat and headache; Sitagliptin has been associated with severe inflammation of the pancreas
<b>Glucagon-like peptide 1 (GLP-1) agonists</b> <ul style="list-style-type: none"> <li>• Exenatide (Byetta)</li> </ul>	By injection	May promote weight loss	May cause nausea, headache and dizziness; rarely, may cause kidney problems including kidney failure; taken twice a day
<b>Meglitinides</b> <ul style="list-style-type: none"> <li>• Repaglinide (Prandin)</li> <li>• Nateglinide (Starlix)</li> </ul>	By mouth	Work quickly	May cause low blood sugar and weight gain; taken three times a day
<b>Sulfonylureas</b> <ul style="list-style-type: none"> <li>• Glipizide (Glucotrol)</li> <li>• Glimepiride (Amaryl)</li> <li>• Glyburide (DiaBeta, Glynase)</li> </ul>	By mouth	Can be used alone or with other diabetes medications; work quickly	May cause low blood sugar, nausea and weight gain



## VII. DIABETES MELLITUS (DM)

### Medications that improve the effectiveness of insulin

Medications (examples)	Route	Advantages	Disadvantages
<b>Metformin</b> (Fortamet, Glucophage, others)	By mouth	Do not cause weight gain; may decrease LDL ("bad") cholesterol and triglycerides	May cause nausea and diarrhea; rarely, may cause a harmful buildup of lactic acid (lactic acidosis)
<b>Thiazolidinediones</b> <ul style="list-style-type: none"> <li>Rosiglitazone (Avandia)</li> <li>Pioglitazone (Actos)</li> </ul>	By mouth	May slightly increase HDL ("good") cholesterol	May cause swelling and weight gain that leads to or worsens heart failure; may increase LDL ("bad") cholesterol; may increase risk of heart attack, although this may not apply to Actos; rarely, may cause liver problems

### Medications that affect food absorption

Medications (examples)	Route	Advantages	Disadvantages
<b>Alpha-glucosidase inhibitors</b> <ul style="list-style-type: none"> <li>Acarbose (Precose)</li> <li>Miglitol (Glyset)</li> </ul>	By mouth	Do not cause weight gain	May cause nausea and diarrhea; taken three times a day

<http://www.mayoclinic.com/health/diabetes/DS01121>

<http://www.mayoclinic.com/health/diabetes-treatment/DA00089>

<http://www.mayoclinic.com/health/type-1-diabetes/DS00329>

<http://emedicine.medscape.com/article/117853-overview>

## VII. DIABETES MELLITUS (DM)

## **VIII. Burns**

## VIII. BURNS

### Definition

Burns are injuries to tissue that can be caused by fire, the sun, chemicals, heated objects or fluids, electricity, or other means. Burns can be minor medical problems or life-threatening emergencies.

Burn treatment depends on the severity and size of the burn. You can treat most minor burns at home using first-aid measures, such as cooling the skin and applying an anesthetic cream or aloe gel to the burn. Deep or widespread burns need immediate medical attention.

### Symptoms

Signs and symptoms of burns include:

- Red, swollen skin
- Pain, which may be severe
- Wet or moist-looking skin
- Blisters
- Waxy white, leathery or tan skin
- Blackened or charred skin, in severe cases

Burns do not affect the skin uniformly, so a single injury can reach varying depths. Distinguishing a minor burn from a more serious burn involves determining the degree of damage to the tissues of the body. The following are four classifications of burns:

- **First-degree burn.** This minor burn affects only the outer layer of the skin (epidermis). It causes redness and pain and usually resolves with first-aid measures within several days to a week.
- **Second-degree burn.** These burns affect both the epidermis and the second layer of skin (dermis), causing redness, pain and swelling. A second-degree burn often looks wet or moist. Blisters may develop and pain can be severe. Deep second-degree burns can cause scarring.

- **Third-degree burn.** Burns that involve the epidermis and the dermis and reach the tissue underneath them (subcutaneous tissue) are called third-degree burns. The skin may appear stiff, waxy white, leathery or tan. Third-degree burns can destroy nerves, causing numbness.

### Complications

Deep or widespread burns can lead to many complications, including:

- **Local infection.** Burns can leave skin vulnerable to bacterial infection, particularly staphylococcus infection, and increase risk of sepsis.
- **Widespread infection (sepsis).** Sepsis occurs when bacteria from an infection enter the bloodstream and spread throughout the body. Sepsis is a rapidly progressing, life-threatening condition that can cause shock and organ failure.
- **Low blood volume (hypovolemia).** Burns can damage blood vessels causing fluid loss, resulting in hypovolemia. Severe blood and fluid loss prevents the heart from pumping enough blood to the body.
- **Dangerously low body temperature (hypothermia).** The skin helps control the body's temperature, so when a large portion of the skin is injured, body heat is lost. This increases the risk of hypothermia — the body loses heat faster than it can produce it.
- **Respiratory problems.** Breathing hot air or smoke can burn airways causing respiratory distress. Smoke inhalation damages the lungs and can lead to respiratory failure.
- **Scarring.** Burns can cause scars and keloids (ridged areas caused by an overgrowth of scar tissue).

## VIII. BURNS

- **Bone and joint problems.** Deep burns can limit skeletal range of motion. Scar tissue can form causing contractures - when skin, muscles or tendons shorten and tighten, permanently pulling joints out of position.
- **Malnutrition/Starvation.** Hypermetabolism or metabolic stress is the direct response to a severe burn injury. The amount of stress increases proportionally to the extent of the injury and strongly influences a patient's nutritional requirements. This response can magnify the normal metabolic rate by 200%. Malnutrition, starvation, and delayed wound healing will result if calories are not provided consistently to meet nutritional requirements.

### Diagnosis

#### Rule of nines

The rule of nines is one way to calculate the percentage of body surface involved in a burn. Specific areas are assigned percentage values as follows: head and neck, 9 percent; front part of the torso, 18 percent; back part of the torso, 18 percent; arms, 9 percent each; legs, 18 percent each; and pubic area, 1 percent.

The rule of nines is usually modified for children because they have relatively smaller limbs and larger head sizes.

#### Pulmonary Evaluation

Depending on the type of burn injury, a thorough pulmonary exam may be done to evaluate if hot air or gases have caused an inhalation injury. These tests might include:

- Chest X-ray
- Endoscopy — a procedure using a tiny camera on the end of a long flexible tube to view the trachea and upper airway.

### Treatment

- **Assessment of the burn and any related conditions,** such as inhalation injuries. If not already done, clothing and jewelry are removed from the burned area.
- **Intravenous (IV) fluids** to prevent dehydration.
- **Medications.** Oral or IV pain medications and antibiotics are given to reduce pain and to prevent infection. Topical medications may also be applied to the burned area to reduce pain and speed healing.
- **Wound care.** The burn is cleaned and embedded pieces of clothing or other debris are removed.
- **Protective dressings.** Depending on the size and location of the burn, the area may be wrapped with dressings or bandages to protect the skin, reduce pain, and prevent the loss of heat and moisture through the wound.
- **Skin grafting.** For burns that cover a large area of skin, skin grafting may be required to help skin tissue regenerate, prevent scarring and aid the healing process.
- **Surgery.** In severe cases, surgery may be necessary to close the wound, remove the dead tissue or treat related complications.

## VIII. BURNS

# **IX. Labor and Delivery**



## IX. LABOR AND DELIVERY

As a woman progresses to the 38th week of pregnancy, she will begin to experience a variety of symptoms that let her know that the baby will soon be delivered. Braxton Hicks contractions are sporadic and can be felt starting in the 3rd trimester. They are irregular and are essentially painless. Towards the end of the pregnancy (last few weeks) the child's head becomes engaged and the woman's pregnancy appears to have moved lower down. When this occurs, the mother is able to breathe easier. However, she also has to urinate more frequently due to the baby and uterus pressing on the bladder.

Labor is divided into three stages: 1st Stage – Early Labor, 2nd Stage – Active labor, and 3rd Stage – Transition.

**A. 1st Stage – Early Labor:** The first stage of labor is often the longest phase of labor. The contractions are not very intense yet. Early labor contractions may be anywhere from 5 to 20 minutes apart lasting from 30 – 45 seconds. When the contractions become closer together (5 minutes apart for one hour) and stronger, the mother should get in contact with her care provider. Most often, her physician will direct her to go to the hospital. She may experience some vaginal discharge. This discharge is often the mucus plug from the cervix, which protected the baby from infection during the pregnancy. Usually the patient's water breaks during this stage of labor. When the water has broken, the contractions become even stronger. After the patient's water has broken, the fetus needs to be delivered within 24 hours, which reduces the chance of infection. If the patient has labored more than 18 hours and the water had already broken, she will be given antibiotics. When she is admitted to the L&D unit, the patient will have a vaginal exam checking for dilation and effacement. The patient should be 3 % dilated

and 100% effaced. Most physicians will place a fetal monitor on the patient, which monitors the fetus's heart rate as well as the mother's contractions. As labor progresses, the pain and intensity of the contractions are very powerful. The contractions are very close together and there is little time for relaxation. The end of stage one is when the cervix is fully dilated (10 centimeters).

**B. 2nd Stage – Active Labor:** The second stage of labor is when the delivery of the baby occurs. The cervical opening is 10 centimeters and the cervix is 100% effaced. The patient can choose whatever delivery position that may provide her comfort and allows the delivery to progress. Squatting can provide some benefits. This position seems to shorten this stage of labor and lowers the risk of a vaginal tear. Crowning occurs when the baby's head fully appears. Your doctor will ask you to push in order to deliver the rest of the baby. When the infant is delivered, the umbilical cord is cut. The baby's nose and throat are suctioned out and the infant is wrapped in warm blankets and placed under a warmer.

**C. 3rd Stage – Transition:** The third stage of labor is the delivery of the placenta. After the placenta has been delivered, the patient will be taken back to her room, the nurse will continue to monitor the amount of bleeding and massage the uterus to help with uterine contraction and bleeding. Nursing the infant will also cause the uterus to contract.

<http://www.webmd.com/baby/guide/normal-labor-and-delivery-process>

## IX. LABOR AND DELIVERY

### Pain Management During Labor and Delivery

During the course of the patient's pre-natal visits and birthing classes, the mother should have a good understanding of the options for pain management. Today, women have multiple options. Regional anesthesia and opioids are some of the options used in labor and delivery. The various regional anesthetic blocks are the most common method of pain control chosen by patients.

**An Epidural Block** is by far the most common choice of pain control. The medication stays in the epidural space, providing the mother relief and no medication is circulated to the baby. The patient sits up at the side of the bed. The anesthesiologist will ask her to lean over as far as she can (towards her feet). This allows the epidural space to stretch helping the anesthesiologist with placement of the needle. The skin is numbed and then the epidural needle is placed in the epidural space. Local anesthetic is injected into the epidural space numbing the nerves and thus providing pain relief for the mother. A catheter is placed over the needle and threaded into the epidural space so that the patient may be re-dosed with anesthetics and/or narcotics. An epidural will not slow labor and according to dose, may allow the mother to walk.

**Spinal block** is a stronger dose of local anesthesia and is placed in the subarachnoid space. This type of block is often used in patients who need a C-section. The patient will not be able to move their legs until the anesthetic has worn off. It will provide complete pain relief, up to two hours, in the lower body. This anesthetic will not affect the baby as well.

**Opioid (narcotics)** may be used to relieve labor pain. They may be given IM or IV. The issue with narcotics is they might cause sleepiness and nausea as well as depressing breathing for the mother and baby.

**Pundental blocks** are anesthetic blocks used to numb the perineal area. This block is given 10-15 minutes before delivery. It also provides numbness if the physician needs to do an episiotomy.

### Complications during labor and delivery

If the mother has been receiving pre-natal care throughout her pregnancy, the risk of complications are rare. The following are the most common complications that can be seen during labor and delivery. Complications during labor can be very minor or life threatening for the mother and baby.

<http://www.webmd.com/baby/understanding-labor-delivery-complications-basics>

**Preterm Labor:** Labor that is considered pre-term is labor that starts before the 37th week. Some women start going into labor much earlier. The earlier the labor starts, the greater risk for the infant. Even if your baby is born a few weeks early, risk to the baby is still present. Options in treating pre-term labor depends on how early in the pregnancy this is occurring and what is happening with the mother. The following are options/treatments used to manage pre-term labor:

- Hydration (oral or IV)
- Bed rest (Home or hospital)
- Medications to stop labor (magnesium, terbutaline and brethine).
- Medication to prevent infections (membrane rupture or belief that an infection is causing the labor)
- Evaluation of your baby (non-stress, stress test, amniotic fluid evaluation and an ultrasound).
- Medications to help the lung development more quickly.

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**Placental Issues:** If there are issues with the placement of the placenta, it is often known before birth via ultrasound.

**Placenta previa** is where the placenta is covering the cervical os thus blocking the birth canal.

<http://pregnancy.about.com/od/laborcomplications/p/problemlabor.htm>

**Placental abruption:** The placenta tears away from the uterine wall. This is an emergency for mother and baby both. The blood loss due to the abruption requires an emergency C-Section.

### Bleeding Issues

Vaginal bleeding is normal after delivery and decreases as the uterus contracts. If the bleeding is excessive, as is often seen in C-sections, your doctor has some options to help stop or greatly decrease the bleeding. Uterine massage is often done by nurses on the L&D floor as ordered by the doctor. Medications such as Pitocin can help with uterine clotting at the placental attachment point during the post-partum period. Excessive bleeding can be caused by failure of the placenta to deliver. In these cases, surgical removal of the placenta may be required. If bleeding continues the uterus will need to be removed.

### Fetal Distress

When a patient is admitted, external fetal monitors are attached to the mother in order to monitor the fetus and monitor for signs and symptoms of distress. A fetoscope can be used by the health professional to listen for the baby's heartbeat. A Doppler can be used as well to search for the baby's heartbeat. External electronic fetal monitoring is the most common device used to monitor mother and baby's well-being. The external monitor consists of two belts. One uses ultrasound to measure the baby's heart rate, and the other belt measures the mother's contractions. If the pregnancy is high risk, the healthcare professional may choose to use an Internal Fetal Monitor. Internal fetal monitoring consists of placing a scalp electrode by screwing a tiny wire into the top layers of the baby's scalp. An intrauterine pressure catheter is placed between the uterine wall and the baby. This type of monitoring measures force of contraction much more accurately than the external device. If the fetal monitor shows the fetus is having difficulty maintaining a healthy heart rate during contracts, the baby's heart rate is low, or there is concern that the baby is not getting sufficient oxygen, the healthcare provider will take the mother and perform a C-section immediately. Possible causes of fetal distress leading to emergent C-sections can include the umbilical cord around the neck of the fetus or the cord is compressed during contractions. If the meconium is present before delivery, meconium aspiration is a danger for the infant. This risk greatly increases if the mother has gone past her due date. Meconium is the baby's first bowel movement, which normally occurs after birth. Vaginal deliveries can have the infant born with the cord around the neck. The obstetrician can remove this due to the cord being able to stretch thus allowing the physician to remove it.

## IX. LABOR AND DELIVERY

### Abnormal presentation

Most infants deliver in the head down position. The baby faces the mother's back and the baby's chin is tucked in towards the chest. This position allows the baby to deliver without much difficulty. Different issues can cause an abnormal presentation. Failure of the infant to engage into the birth canal is due to the fact that the fetus is able to move much easier due to the fetus being small. Excess amniotic fluid (polyhydramios) or multiple fetuses can also cause abnormal presentations. Placenta previa blocks the cervical opening and often requires a C-section. Other types of abnormal presentations are breech, occipitoposterior, frank breech and footling breech. A Breech presentation means that the baby's buttocks is presenting instead of the head. Many times though the baby will turn by the 36 weeks. Occipitoposterior presentation means the baby is born face up instead of face down. If the abnormal position is a frank breech, then the legs are extended with the feet close to the baby's face. The baby's buttock is presenting to the cervical opening. A footling breech is the presentation of one or both feet in the birth canal. One of the more rare presentations is a face presentation meaning the face is positioned over the cervix. Abnormal presentations are often discovered during the antenatal visits by ultrasounds.

<http://www.laboranddelivery.com/>

## **IX. LABOR AND DELIVERY**

# **X. Obstetrics**

## X. OBSTETRICS

Obstetrics is the care of a woman during her pregnancy as well as delivering the fetus. Please review the section on labor and delivery for information regarding this phase of care for the pregnant woman. This section will focus on prenatal care, medical problems that may arise during pregnancy and high risk pregnancy.

When a couple decides to become pregnant or have recently found out they are pregnant, there are a number of issues that your obstetrician/nurse midwife should discuss with you. Calculation of delivery date is done by counting 38 weeks from the start of the last menstrual period. If the healthcare provider feels that your pregnancy is high risk, you will be referred to an obstetrician who specializes in high risk pregnancy. If you or your partner has a significant genetic disorder in your family history, the physician may order genetic testing. If you have any of the following issues you fall under the high risk category:

- Chronic condition such as diabetes or heart problems
- Increased risk of pre-term labor (occurred in previous pregnancies)
- Older than 35
- Pregnant with more than one fetus

Your physician will discuss any medications you are on. If a medication you are taking poses a risk to the fetus (especially during the first trimester), the physician may have you stop taking the medication depending on your condition. Smoking and drinking can pose a risk to your baby as well. Prenatal vitamins will be prescribed that contain folic acid which is important for proper neural tube development and occurs in the first 28 days. The mother should maintain a healthy diet and continue to participate in healthy activities. Mothers who are used to working out or running can continue to do these activities until the last few weeks of pregnancy or the activity starts to become uncomfortable. If your physician feels that physical activity poses a risk to your pregnancy, they will make you aware of this.

<http://nursingcrib.com/nursing-notes-reviewer/maternal-child-health/the-apgar-scoring-system/>

[http://kidshealth.org/parent/pregnancy\\_newborn/medical\\_care/medical\\_care\\_pregnancy.html](http://kidshealth.org/parent/pregnancy_newborn/medical_care/medical_care_pregnancy.html)

<http://womenshealth.gov/pregnancy/childbirth-beyond/labor-birth.cfm>



# **XI. Pediatric Nursing**

## XI. PEDIATRIC NURSING

Pediatric nursing is a branch of medicine, whose focus is to provide medical care to infants, children and adolescents. Physicians who specialize in this area of medicine are called Pediatricians. Treatment of children became a specialty around the late 1800's to early 1900's. Children's hospitals were being built in large cities in Europe during this time.

Pediatric nursing encompasses caring for children when they are ill as well as making sure they are developmentally on course. Nurses also monitor vaccination time tables. Teaching the parents about the vaccinations will hopefully relieve any anxiety about vaccinating their child. There has been a lot of media attention throughout the years that vaccinations may cause autism. Vast clinical trials have been conducted through the years and there is no connection between vaccination and autism.

The lifelong process of growing up encompasses physical, behavioral, cognitive and emotional growth and change. Growth and development stages identified are babyhood to childhood, childhood to adolescence, and adolescence to adulthood. As a person goes through these phases; attitudes, relationships and understanding of the world around us make us who we are. Each stage of development has specific markers. Reaching these markers is important for becoming an emotional, physical and healthy sexual adult.

Four factors are assessed as we grow and develop - physical, cognitive, sexual and emotional development. The following are the goals of each age group. These lists are not comprehensive but do represent the most important goals of each area assessed.

### Growth and Development

#### Infant to Toddler (age zero to 3 y.o.)

##### Physical:

- Double their height by the age of 3
- Birth weight will have tripled by age of 3
- Development of teeth and able to eat solid foods
- Learn to crawl and walk
- Begin toilet training

##### Cognitive:

- Advances from using single words to complete sentences
- Imagination develops. May have imaginary friends.
- Concrete thinking occurs. Child is able to use the 5 senses to process information.
- Understands the difference between male and female.

##### Emotional:

- Development of trust with those who fulfill their emotional and physical needs.
- Testing of independence and exploring of limits.
- Able to demonstrate feelings in a physical manner: Kissing, hugging to show love. Hitting to show anger.
- "Terrible twos" child is expressing their individuality by saying "NO"

##### Sexual:

- Curious about their own bodies and others.
- Touching of genitals
- Talk openly about their bodies.
- When taught, able to name and understand body parts(head, nose, penis, etc.)

## XI. PEDIATRIC NURSING

### Preschoolers ( ages 4-5)

#### Physical:

- Growth rate slower than during infancy. Internal organs grow faster than body giving the appearance of a rounded tummy.
- Reach 50% of adult height and 20% of adult weight by age 5.
- Better coordination. Able to run, skip climb up and down stairs with no problems.
- 90% of brain development completed by age 5.
- Lose their “baby look”

#### Cognitive:

- Separation from family not as traumatic due to increased independence.
- Understands about being healthy “ need for brushing teeth, washing hands”
- Understands what “privacy” means.
- Understands concepts of good and bad.

#### Emotional:

- Not as emotionally dependent on caregivers. Child does not need or want as much physical contact.
- Begins to develop friendships with peers. Realize that some people they do like and some they don't.

#### Sexual:

- Curious about where babies come from.
- Curious about bodies. May play games like doctor
- Sure of their own gender and can identify female vs male.
- Recognizes gender roles and able to distinguish role as either male or female.

### Grade-schoolers (6-8 yrs. Old):

#### Physical:

- Increase in height slows to about 2 ½ inches per year and 8 pounds per year.
- Develop more muscle.
- Increase in strength.
- Start losing baby teeth and adult teeth are erupting.
- Able to use large and small motor skills in sports and other physical activities.

#### Cognitive:

- Able to understand more complex and abstract ideas.
- Begin elementary school
- Start spending greater amount of time with peers. Will turn to peers for information.
- Understands past, present and future.
- Conforming to “proper behavior”. Learned from adults about what proper behavior is.
- Improved self-control.
- Understands concept of abnormal vs. normal. Concerned about being perceived as normal. Curious about what the difference is between the two concepts.
- Have opinions and think for themselves. Information comes through reading and media.

#### Emotional:

- Concerned about modesty and wants privacy
- Expression of love is through talking and sharing. May now be embarrassed by physical affection.
- Understanding more complex emotions such as confusion and excitement.
- Desires more freedom and space from parents.
- Have friends and peer groups they interact with.

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### Sexual:

- Socialize with their own gender. Separation between males and females is fairly rigid. Teased by others if they don't act according to the predefined roles of female or male. Group understanding and association with this philosophy is what keeps the child in the peer group.
- Understand social stigmas and taboos around sexuality. Understand that intercourse is not just for making a baby.
- Rely on peers, media and other sources of information about sex.
- Stronger self confidence in gender and body image.

### Preteens (9-12 yrs old):

#### Physical:

- Growth spurt occurs with increase in weight gain, muscle growth and enter puberty.
- May begin to have pimples. Skin becomes more oily
- Hair growth under arms and pubis. Boys may begin to grow facial hair and hair on chest.
- Joint pain due to rapid growth.
- Males experience growth of genitals, darkening of scrotum, voice deepens and sperm production starts.
- Females experience maturing of genitals, breast development, ovulation and start of menstrual cycle.

#### Cognitive:

- Continue to move towards more independence.
- As they become more independent, their skill in making decisions continues to improve.
- Start to think about the future. Going to college and picking an occupation.
- Understands complex social issues such as poverty and war.

- Focus at school is centered on academics instead of play centered activities.

#### Emotional:

- Don't want to stand out. Want to blend in with their peers.
- Increasing focused on outward appearance. Want to look like everyone else.
- Increase in self-consciousness and self-centeredness.
- Relationships with peers are more important than family. Concerns are about dating, relationships and crushes.
- Development of sexual feelings for others. A new dimension to relationships with others.
- Understands the concept of a loving caring relationship.
- Mood swings, especially with family relationships.

#### Sexual:

- Awareness of their sexuality and how they choose to express it.
- Continues to be concern about whether they are normal. Especially in regards to sexual feelings, masturbation, and wet dreams.
- Anxious about when puberty will occur. When will it happen? How to be prepared for it?
- Privacy extremely important.

### Teens (13-17):

#### Physical:

- Puberty is complete and looks are those of an adult for the most part. Rate of transition can vary. Some children develop faster than others.
- For females, they have reached their adult height. Males often continue to grow into their twenties.

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### Cognitive:

- Cognitive maturity has occurred. Knowledge of options and consequences, they have the ability to make mature decisions.
- Peer influence is still important but not as strongly as when they were in the pre-teen phase.
- Now are old enough to drive. This increases their independence.
- Continue to build skills in order to be self-sufficient.
- Relationships with peers and family are more mature.

### Emotional:

- Teens have the ability/capacity to develop long lasting, mutual and healthy relationships. The foundation has to be in place for this. The foundation was created through relationships with family, peers, teachers, and authority figures. The ability to trust, along with past positive experiences, allows them to have a healthy understanding of love.
- The personality of a person is now more important than the looks.

### Sexual:

- See themselves as sexual beings and understand the options and consequences of sexual behavior.
- Expression of sexuality may or may not include sexual intercourse.
- Educated and have a solid understanding of pregnancy, HIV/AIDS and other sexually transmitted diseases. Able to make decisions about sex based on knowledge.
- Understand what their sexual orientation is.
- Ability to recognize healthy and unhealthy relationships.

<http://www.advocatesforyouth.org/parents/152?task=view>

### Common childhood illnesses

As we grow and mature, so does our immune system. At times it seems your child is always sick. Children are more susceptible to bacterial and viral illnesses due to the immaturity of the immune system. However, with each exposure, the body creates antibodies against bacterial/viral illnesses. Teething also occurs around six months of age. Runny noses, sore gums and fever are common symptoms associated with teething. The following is an introduction to some of the most common childhood illnesses. We will discuss the symptoms, treatment, incubation period, and the infectious period. Many common childhood illnesses now have vaccinations. Measles were a common childhood illness 30 yrs ago. In the late 80s, college campuses were having outbreaks of measles in their student population. A vaccination was developed and now, in order to get into college, you need proof of vaccination against this disease or have already had the disease as child, which makes you immune to another episode. The vaccinations cover measles, mumps and rubella and multiple other childhood illnesses as well. It is important to vaccinate people against these illnesses to prevent outbreaks. Infectious processes such as these can be potentially fatal in more vulnerable populations (elderly, immuno compromised, under 6 months)

**Chicken pox:** The symptoms of chickenpox are red, itchy spots or blisters spread over the entire body. The child has a moderate fever as well. Treatment for chickenpox is to control the symptoms. Since it is a virus, antibiotics will not work as a treatment. Calamine lotion is a liquid medication that is used for the treatment of itching and soothing skin irritation. You can buy this at any drug store. Using a cotton ball, dab the cream onto the affected areas. The medication should be allowed to dry for several minutes in order for the application to last. The incubation period is between 10-20 days from being exposed and then showing symptoms of

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chickenpox. A child remains contagious until 6 days after the first spots appear. Chickenpox will resolve on its own. The most important issue is controlling the symptom of itching and treating the fever.

**Whooping cough:** Also called Pertussis is a bacterial infection of the upper respiratory system. Symptoms include severe coughing spells with a “whooping” sound when the person breathes in. At first the symptoms are similar to those of the common cold, runny nose, sneezing, mild cough and low grade fever. However symptoms continue to persist and after several weeks, the coughing spells become severe and can last up to more than a minute. The child may turn red or purple. Breathing is wheezy. Sometimes the child will vomit during a severe coughing spell. The symptoms are usually worse at night. Treatment again is focused on relief of symptoms. Humidification of the air, plenty of fluids, and sedatives may be given. These are prescribed in order to help the child rest. OTC cough mixtures are ineffective and are NOT recommended. If the child’s skin has a bluish tint (lack of oxygen), periods of stopped breathing (apnea), seizures or convulsions and high fever; they should be taken to the emergency room right away. At this point, the child is not able to oxygenate well enough on their own and need medical treatment. The incubation period begins 7 days after exposure to the virus. This childhood illness has a vaccination as well. DTaP is the name of the vaccination given to prevent pertussis. A series of 5 vaccinations is recommended beginning at 2 months, 4 months, 6 months, 15-18 months and at 4-6 yrs old. It is recommended that adults be vaccinated as well. The adult form of the vaccination can be given up to 65 years old.

[http://kidshealth.org/parent/infections/lung/whooping\\_cough.html](http://kidshealth.org/parent/infections/lung/whooping_cough.html)

**Fifth’s Disease:** Early symptoms are similar to those of the flu. This is a viral illness and therefore will not respond to antibiotics. Early symptoms include a low grade fever, headache, and a stuffy or runny nose.

The child appears to be getting well and then a rash appears several days later. A bright red rash appears on the face with red blotches spreading to the trunk, arms, and legs. The rash does not appear on the palms of the hand or soles of the feet. When the rash is clearing, the center of the blotches becomes clear. This often leaves the appearance of a lacy net-like appearance. Children under the age of 10 are most likely to catch Fifth’s disease. The incubation period is two weeks between the exposure and the appearance of symptoms. Once the rash appears, the child is no longer infectious.

<http://kidshealth.org/parent/infections/skin/fifth.html>

**Hand, Foot and Mouth Disease:** The symptoms manifest as a large number of small spots and blisters. They occur particularly in the mouth feet and hands. The child may have a low grade fever for several days as well. Treatment is mainly focused on keeping the temperature down. OTC fever reducers for children are very effective in controlling this symptom. The mouth is often very sore due to the ulcerations. The child should be fed things that don’t require a lot of chewing. The incubation period for hand, foot and mouth disease is 2-3 days between exposure and the appearance of rash/ulcerations and fever. The child is contagious as long as the spots/blisters are still present.

**Scarlet Fever:** This illness is caused by the group A strep bacteria. Symptoms include low grade fever, sore throat and a rash which is located in the armpits and groin. The skin starts peeling and the tongue surface becomes coarse and pink. This condition is known as strawberry tongue. The treatment for scarlet fever is antibiotics and fever/pain control (OTC acetaminophen or ibuprofen). Dosing is according to age and weight. The incubation period is 3-8 days from exposure to the infection and showing symptoms. It is imperative that the child completes the course of antibiotics. The rash may persist for several weeks.

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**Mumps:** Mumps is a viral infection that is spread by sneezing, coughing and sharing food or drink. Symptoms of the mumps are swelling between the ear and the jaw at the salivary glands, facial pain, headache, and sore throat. The incubation period is between 12-24 days after exposure. Treatment is focused at keeping fever reduced, provide cool drinks to help increase fluid intake and reduce pain. The MMR (measles, mumps, reubella) vaccination is given between the age of 12-15 months old or at the age of 4-6 and age 11-12 if the vaccination has done been given.

### Ear Infections

Ear infections are the most common reason for a trip to the pediatrician. Almost half of all antibiotic prescriptions written for children are for otitis media. Upon physical exam the physician looks at the ear drum using an otoscope. A red, bulging ear drum is the classic presentation of otitis media. Common upper respiratory infections such as a cold or the flu, most often will cause a middle ear infection as well. These problems cause the Eustachian to become so swollen that air can no longer flow in the middle year and therefore fluid cannot drain out causing the bulging ear drum.

**Acute Otitis Media:** There are three different types of ear infections - Acute Otitis Media, Otitis Media with effusion and Otitis Externa. Acute otitis media is the most painful of the three Colds, allergies or upper respiratory infections with the accumulation of pus and mucous blocking the Eustachian tube, often results in an earache and swelling. The swollen eardrum is painful and often times the child will pull on the affected ear. The infection often starts as viral but bacteria quickly find their way into the warm moist environment of the middle ear. Treat with antibiotics and OTC pain relievers for children. The healing process takes from 2-6 weeks.

[http://en.wikipedia.org/wiki/Otitis\\_media](http://en.wikipedia.org/wiki/Otitis_media)

**Otitis Media with Effusion:** This is an issue where there is buildup of fluid in the middle ear, without acute signs or symptoms of infection. The OME may

have started out as an AOM. The bacterial infection has been treated but there still is fluid in the ear. The Eustachian tube is the part of the ear that becomes blocked with fluid. The Eustachian tube drains into the back of the throat. There is minimal pain with this type of Otitis and almost always goes away on its own. Fluid may remain in the middle ear and take month or longer for it to resolve on its own.

**Otitis Externa (Swimmer's Ear):** This type of infection usually is microbial and occurs suddenly, rapidly worsens and then becomes very painful. The difference between Otitis Externa and other ear infections is that touching or pulling gently on the ear brings on acute pain. The patient may have ear discharge and itchiness. If the swelling and buildup of fluid become great enough, the patient may suffer temporary conductive hearing losses. An increase in pain due to touching or moving the outer ear is the classic sign of Otitis Externa. The lack of cerumen is also a sign of Otitis Externa as well. Antibacterial or antifungal solutions are used to acidify the ear environment, hopefully to prevent bacterial growth. Prescription drops containing anti-inflammatory steroids help reduce swelling and itching. After several days of treatment with solutions and anti-inflammatory medications, the otitis resolves. Complete return to hearing with normal cerumen production may take some additional time. When the ear is completely healed, the ear canal is self-cleaning. External otitis is usually either bacterial or fungal so only one type of medication is needed.

<http://www.cdc.gov/getsmart/antibiotic-use/URI/ear-infection.html>

<http://www.netdoctor.co.uk/diseases/facts/childrensdiseases.htm>

[http://en.wikipedia.org/wiki/Otitis\\_externa](http://en.wikipedia.org/wiki/Otitis_externa)

<http://en.wikipedia.org/wiki/Pediatrics>



## **XI. PEDIATRIC NURSING**

# **XI. Orthopedics**

## XI. ORTHOPEDICS

Most people will experience some type of orthopedic problem in their life time. Fractures, dislocations, shoulder injuries, low back pain and knee/hip issues are some of the top injuries that are seen in the ER and Orthopedists. Injuries are usually sustained from trauma, falls, sports and aging.

Fractures are identified by their severity and the impact on surrounding tissues.

If the fracture ruptures through the skin then the fracture is designated as open or compound. If there is no piercing of the skin, the fracture is designated as simple. There are also other classifications of fractures defined by the type fracture sustained.

### Types of Fractures

- Transverse fracture: a fracture at right angles to the long axis of the bone
- Greenstick Fracture: A fracture on one side of the bone, which causes the other side to bend. Seen most often in children.
- Comminuted Fracture: A fracture that results in 3 or more bone fragments.
- Intra-articular: A fracture that involves the joint.

The most common orthopedic sports injuries include ankle sprains, Achilles Tendinitis, groin strain, shin splints, lower back pain, tennis or golf elbow, shoulder injury, and runner's knee. Ankle sprains could be caused by inversion of the foot, strain or tears of the weaker lateral ligament of the ankle. The RICE protocol is the method of treatment. RICE stands for resting the affected ankle or other injury, ice, compression and elevation. NSAIDs are used for pain control. If the injury is severe, narcotics may be prescribed as well.

The knee is a vulnerable joint that is often injured by playing sports or the patient has chronic degenerative osteoarthritis causing the loss of cartilage in the knee.

Sports injuries to the knee include ACL injury (anterior cruciate ligament), MCL (middle cruciate ligament), PCL (posterior cruciate ligament) and torn cartilage. If you start to have the following symptoms, you should seek medical advice.

- Hearing a popping noise or the knee gives out at the time of injury
- Severe pain
- Cannot move the knee
- Begin limping
- Have swelling at the injury site.

<http://www.foxnews.com/story/0,2933,527700,00.html>

<http://forums.studentdoctor.net/showthread.php?t=718902>

<http://wrightstatephysicians.org/ortho/injuries.html>

### Osteoarthritis

Osteoarthritis is a condition where the cartilage breaks down and wears away. The knee starts swell and is painful and stiff. The ligaments around the joint become weaker and stiffer. Osteoarthritis occurs in men and women equally until the age of 55. After 55, women seem to have this problem more than men.

Causes of this disease are heredity (runs in families) and being overweight. Fractures that occurred earlier in life make an individual more susceptible to OA. Jobs that involve repetitive kneeling, squatting, lifting, climbing stairs, or walking leave these workers very susceptible to sustaining osteoarthritis. High impact activities such as basketball, football, soccer, or baseball increase the chances of arthritis.

Medications used in treating this problem include:

- Corticosteroids injected into the knee. Steroids reduce inflammation and decrease pain, however this treatment does not work for everyone.
- OTC medications such as glucosamine and chondroitin sulfate can provide pain relief over time.

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- Skin Cream (Capsaicin) can help to relieve pain.
- Artificial joint fluid such as Synvisc and Hyalgan injected into the knee can relieve joint pain up to 3-6 months.

Physical therapy is an alternate solution to improve muscle strength and motion of stiff joints and balance. If these non-invasive treatments do not help, your orthopedist may talk to you about surgical options. Many procedures are now done arthroscopically. Treatment of torn and damaged cartilage can be done arthroscopically. Surgical fusion of the bones, usually in the spine area of the lower back can provide relief from back pain. Joint replacement (total or partial) is usually done when the person can no longer tolerate the pain in the affected joint.

### Hip pain and fractures

Hip pain is also a common problem. Hip pain can have many causes. Seeing an Orthopedist is important to find out what the underlying cause is and to also rule out fractures. Hip fractures are most common in the older population. Osteoporosis is often the cause. Osteoporosis is the thinning of bone tissue and loss of bone density over time. In the early stages there are no signs or symptoms; however as the disease progresses, pain and tenderness in the affected hip will occur. Some of the causes of osteoporosis are being bedridden, chronic rheumatoid arthritis, taking long term steroids, hyperparathyroidism and Vitamin D deficiency.

Various medications and treatments are available to help strengthen the bones and stop bone loss. Bone density tests are used to test for osteoporosis. Treatment is geared towards control of pain, slow/stop bone loss, prevention of fractures with medications, and minimize risk of falls. Medications are used to strengthen bones. Bisphosphonates (Fosamax, Boniva, and Actonel), Calcitonin, and hormone replacement therapy are the most

common medications used to treat this problem. Exercise and diet can also improve bone density. Osteoporosis can be prevented by making sure you have enough calcium and Vitamin D in your diet.

### Orthopedic Nursing

Orthopedic Nursing is often centered on the care of a patient who has had some type of joint replacement, spine or neck surgery, and arthroscopies. The following is a list and description of the most common orthopedic surgeries done.

**Total Knee Replacement:** A surgical procedure to replace a diseased knee joint with artificial material. The end of the femur bone is removed and replaced with a metal shell. The tibia is also removed and replaced with a channeled plastic piece with a metal stem. If the kneecap is diseased as well then a plastic button may also be added under the knee cap surface. The artificial joint is anchored in place with bone cement or a material which allows the bone tissue to grow into it. Total knee replacement surgery is considered for patients whose knee joints have been progressively damaged by arthritis, trauma or other destructive diseases of the joint. Pain, stiffness and decreasing daily function lead most patients to consider having knee replacement surgery.

<http://orthoinfo.aaos.org/topic.cfm?topic=a00325#Knee>

**Total Hip Replacement:** This is a surgical procedure whereby the diseased cartilage and bone of the hip joint is surgically replaced. Replacement involves removal of the diseased ball and socket and replacing them with a metal ball and stem inserted into the femur bone and an artificial plastic cup socket. The metallic artificial ball and stem are called the "prosthesis". Conditions that lead to total hip replacement include bony fractures of the hip joint, rheumatoid arthritis and death (aseptic necrosis) of the hip bone. Replacement is usually done when chronic pain and impaired daily functioning occur.

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**Total shoulder replacement:** These patients suffer from joint dysfunction. Causes are osteoarthritis or rheumatoid arthritis. Patients who have suffered a shoulder fracture from severe trauma are candidates for this surgery as well.

In a total shoulder replacement, a metal ball is used to replace the humeral head while a polyethylene cup becomes the replacement of the glenoid socket.

**Rotator cuff repair:** A tear in the cuff will often limit the range of motion. The rotator cuff helps anchor the shoulder joint and helps it move as well. If pain does not improve with non-invasive treatments such as physical therapy or medication, surgery may be recommended.

**Arthroscopic surgery:** this procedure allows the surgeon to view and repair a joint by using an arthroscope. An arthroscope consists of a tube, lens and a light source to visualize the surgical area. Orthopedic surgeons can use an arthroscope for knees, shoulders and other repairs.

<http://www.harrisonmedical.org/home/common-orthopaedic-procedures>

### Devices

Orthopedic nursing provides most of the care for patients with various devices. Some more complicated than others. The following is a brief overview of some of the most common devices used in orthopedics.

**External Fixation Device:** The purpose of this device is to set bone fractures which cannot be casted. A cast would not allow proper alignment of the fractured bone. External fixation is used for fractures but also is used to correct deformities. This device is worn outside the body. This device is called a fixator.

A fixator is connected to the bone using bone screws or more commonly called pins. The pins will go through skin and muscle in order to connect the external part of the fixator to the bone. This device will allow for proper healing and alignment of the

fracture. This device can be used for wrist, foot/ ankle, and knee fractures. The key to proper healing is to prevent infection. Pin site care is imperative and most often is a nursing function. The pin site care supplies that are used:

- Cleansing solution and Sterile Water
- Disposable Cups to hold the sterile water
- Sterile gauze 2" x 2" and 4" x 4"
- Sterile cotton swabs
- Bag for waste disposal

[http://en.wikipedia.org/wiki/External\\_fixation](http://en.wikipedia.org/wiki/External_fixation)

Be sure to wash hands before giving pin site care and then wear a pair of gloves. First, massage the skin around the pin site. This will bring any drainage to the surface. Next saturate a sterile cotton swab with the cleansing solutions which are ordered by the physician. Apply the solution directly to pin site. Using the cotton swab, swab in a circular motion, always moving away from the pin. If any crust has formed be sure to remove it. After the drainage and any crusting have been removed, dry the pin site with a new cotton swab. Use a new sterile cotton swab for each pin site. Wrap sterile gauze around the pin site. Gently press down on the skin around the pin site. After several days, the gauze will not be used. Pin sites will be left uncovered and exposed to air. The external fixator device also needs to be kept clean. Clean the entire device with 4" x 4" gauze and cotton swabs. Be sure that before the patient goes home they have a good understanding of pin care. After 10 days, the patient will be allowed to shower. Teach the patient about signs and symptoms of infection: Redness or swelling at pin site; thick or colored discharge from the pin site; loosening or movement of the pins; pain and/ or soreness at the pin sites. If the patient suspects infection, they should see their doctor as soon as possible. Pin site care should be done twice a day.

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### Halo Cervical Traction System

**Halo crown application and vest:** Halo traction is used to stabilize cervical fractures. The halo acts as a cast would for an arm. The brace consists of 3 main parts. The vest, which is on your chest, and the halo encircles your head, and the rods which extend from the ring to the vest. This device must be worn at all times. The vest is usually worn next to the skin. The lining of the vest may be wool or some acrylic matter. To increase comfort, wearing a tee shirt under the vest can help. The shirt should be a few sizes larger. Pants, shorts, or skirts should be no problem. It is best to wear low-heeled shoes or runner shoes. This allows for better traction and decrease the risk of falling or slipping. The skin under the vest should be checked daily. A flashlight can help with visualization. Be sure to check the bony prominences carefully. Look for excess perspiration or pressure sores. These patients are not permitted to shower due to the fact that the vest liner may remain wet. Use towels or plastic to help keep the vest dry and keep it from getting wet. If the patient has been lying down and wants to get up, there is a great need for caution. Bending at the waist puts a lot of stress and strain on the head pins. The best way to get out of the bed is to roll to one side, drop your legs over the side of the bed and use your arms to get in an upright position.

Pin care is essentially the same as care of an external device. Use a clean Q-tip for each pin site. Do not use ointments or antiseptics unless your physician has prescribed this. A metal wrench should be at the bedside at all times. The wrench should be used by medical personnel only.

### CPM machine

CPM stands for Continuous Passive Motion. This machine helps blood flow through the knee and exercises the knee. Patients who have had major surgery on the knee joint (total knee replacement, ACL repair, Arthroplasty or microfracture) are just a few of the surgical patients that will be placed in this device after surgery. The machine allows for gentle flexion and extension of the joint. The goal is to reduce the amount of scar tissue development and so that stiffness of the knee will be minimal. The device is easy to apply. The affected joint is placed in the CPM machine. Velcro strips help keep the leg in place. The device can be set to various degrees of flexion. Through time, the patient should increase the degree of flexion in order to get full ROM back.

<http://orthopedics.about.com/cs/kneereplacement/i/cpm.htm>

## **XI. ORTHOPEDICS**



## **XII. Drug Calculations**

## XII. DRUG CALCULATIONS

### Systems of Measurement

Three systems of measurement are used in medication administration:

- Metric
- Apothecary
- Household

**Metric System** is based on the decimal system and uses the gram as the basic unit of weight. The liter is the basic unit of volume, and the meter is the basic unit of length. For correct metric notation, when an amount is less than one, a zero should be placed in front of the decimal point. For example: 0.5mg.

Accepted abbreviations for metric system measures frequently used in dosage calculations are as follows:

Metric Abbreviations for Weight	Metric Equivalencies for Weight
Kilogram (kg)	1 kilogram = 1000 g
Gram (g)	1 gram = 1000 mg
Milligram (mg)	1 milligram = 1000 mcg
Microgram (mcg)	

When converting within the metric system, simply move the decimal point three places to the left or right, depending whether you are changing to a larger or smaller unit of measure.

A useful method to consider is the -

### LMNOPQRS

The letter **L** represents larger unit, the letter **S** represent smaller unit. To convert from large to small, the decimal moves three places in the direction you move from **L** to **S**, or to the right.

Example 1 illustrates that move. To convert from a smaller unit to a larger one, the decimal moves three places in the direction you move from **S** to **L**, or to the left.

Example 2 illustrates that move.

Example 1:	Example 2:
Convert: 300mg to mcg	Convert: 300 mg to g
300 mg = 300,000mcg	300 mg = 0.3 g

Metric Abbreviations for Volume	Metric Equivalencies for Volume
Liter (L)	1000 ml = 1L
Milliliter (ml)	1 cc = 1ml
Cubic Centimeter (cc)	(cc's and ml's are used interchangeably)

**The Apothecary System** uses grains, drams and ounces as units of weight. Lowercase Roman numerals are used when amounts are greater than one; fractions are used when amounts are less than one. The abbreviation precedes the amount, for example, grains x or grains 1/150.

One-half can be expressed as ss, therefore: iiss = 3 1/2.

### Apothecary Abbreviations

- Grain (gr)
- Dram (dr)
- Ounce (oz)

Equivalencies when converting from apothecary to metric are:

### Apothecary & Metric Equivalencies

- 1 ounce (30 cc = 30 mL)
- 1 dram (4 mL)
- 1 grain (60 mg)

## XII. DRUG CALCULATIONS

**Household** measures are commonly used to measure medications at home. Abbreviations and equivalencies follow.

Equivalencies			
Household measure	Abbreviation	Metric measure	Apothecary measure
1 cup	C	1 C = 240 cc	8 oz
1 tablespoon	T (tbs)	1 T = 15 cc or 15 mL	
1 teaspoon	t (tsp)	1 t = 5 cc	
drop	gtt	depends on size of drop	
pound	lb	2.2 lb = 1 kg	1 lb. = 16 oz

## XII. DRUG CALCULATIONS

### Quiz - Systems of Measurement

#### Problems

1. 0.4 mg = \_\_\_\_\_ mcg

2. 600 mg = \_\_\_\_\_ g

3. 20 mg = \_\_\_\_\_ g

4. 6.6 g = \_\_\_\_\_ mg

5. 0.06 g = \_\_\_\_\_ mg

6. 0.7 L = \_\_\_\_\_ cc

7. 650 mL = \_\_\_\_\_ L

8. Gr. v = \_\_\_\_\_ mg

9. Gr. 3 = \_\_\_\_\_ mg

10. 90 mg = \_\_\_\_\_ mcg

11. 1/2 tsp = \_\_\_\_\_ mL

12. Gr. 1/100 = \_\_\_\_\_ mg

13. 15 oz = \_\_\_\_\_ cc

14. 4 oz = \_\_\_\_\_ cc

15. 150 cc = \_\_\_\_\_ ounce (s)

16. 2 T = \_\_\_\_\_ mL

17. 400 mcg = \_\_\_\_\_ mg

18. 0.25 mg = \_\_\_\_\_ mcg

19. Gr. ss = \_\_\_\_\_ mg

20. Gr. X = \_\_\_\_\_ mg

21. drams 3 = \_\_\_\_\_ mL

22. 20 mL = \_\_\_\_\_ T.

23. 45 mL = \_\_\_\_\_ ounce (s)

24. 12 mL = \_\_\_\_\_ drams

25. 90 mL = \_\_\_\_\_ ounce (s)

## XII. DRUG CALCULATIONS

### Problem # Key

1. 400 mcg
2. 0.6 g
3. 0.02 g
4. 6600 mg
5. 60 mg
6. 700 cc
7. 0.65 L
8. 300 mg
9. 180 mg
10. 90,000 mcg
11. 2.5 mL
12. 0.6 mg
13. 450 cc
14. 120 cc
15. 5 oz
16. 30 mL
17. 0.4 mg
18. 250 mcg
19. 30 mg
20. 600 mg
21. 12 mL
22. 1.3 T
23. 1.5 oz
24. 3 drams
25. 36 oz

### Drug Calculations

#### Common Conversions:

- 1 Liter = 1000 Milliliters
- 1 Gram = 1000 Milligrams
- 1 Milligram = 1000 Micrograms
- 1 Kilogram = 2.2 pounds

#### Methods of Calculation

Any of the following three methods can be used to perform drug calculations. Select the one that works for you. It is important to practice the method that you prefer to become proficient in calculating drug dosages.

Remember: Before doing the calculation, convert units of measurement to one system.

#### I. Basic Formula: Frequently used to calculate drug dosages.

D (Desired dose)

H (Dose on hand)

V (Vehicle-tablet or liquid)

$$D/H \times V = \text{Amount to Give}$$

D = dose ordered or desired dose

H = dose on container label or dose on hand

V = form and amount in which drug comes (tablet, capsule, liquid)

Example:

Order- XYZdrol 50 mg p.o.TID

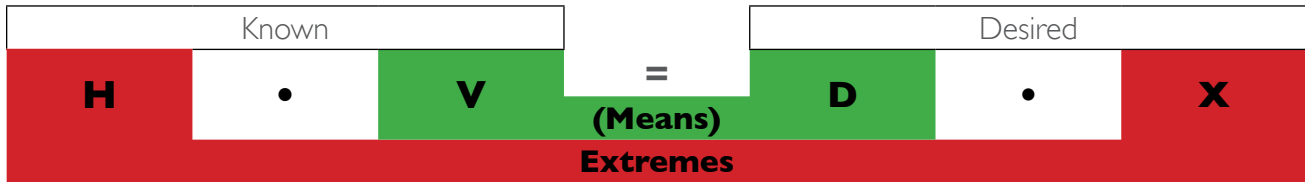
Drug available- XYZdrol 125 mg/5ml

D=50 mg    H=125 mg    V=5 ml

$$50/125 \times 5 = 250/125 = 2 \text{ ml}$$

## XII. DRUG CALCULATIONS

### II. Ratio & Proportion:



(Left side is known quantities)

(Right side is desired dose & amount to give)

Multiply the **means** and the **extremes**

$$HX = DV$$

$$X = DV/H$$

Example:

Order- XYZdrol 1 gm p.o. BID

Drug available- XYZdrol 250 mg per capsule

D=1 gm (note: need to convert to milligrams) 1 gm = 1000 mg

H=250 mg

V=1 capsule

$$250 \cdot 1 = 1000 \cdot X$$

$$250X = 1000$$

$$X = 1000$$

$$250$$

$$X = 4 \text{ capsules}$$

## XII. DRUG CALCULATIONS

### III. Fractional Equation

$$H/V = D/X$$

Cross multiply and solve for X.

$$H/V = D/X$$

$$HX = DV$$

$$X = DV/H$$

Example:

Order - ABColol 0.25 mg p.o. QD

Drug Available – ABColol 0.125 mg per tablet

$$D=0.25 \text{ mg} \quad H=0.125 \text{ mg} \quad V=1 \text{ tablet}$$

$$0.125/1 = 0.25/X$$

$$0.125X = 0.25$$

$$X = 0.25/0.125$$

$$X = 2 \text{ tablets}$$

### IV. Intravenous Flow Rate Calculation (two methods)

#### Two Step Method

**Step 1** - Amount of fluid divided by hours to administer ml/hr

**Step 2** -

$$\frac{\text{ml/hr} \times \text{gtts/ml (IV set)}}{60 \text{ min}} = \text{gtts/min}$$

Example

$$\text{Step 1} - 1000/4 = 250$$

$$\text{Step 2} - 250 \times 15/60 = 62.5 \text{ (62 gtts/min)}$$

#### One Step Method

$$\frac{\text{amount of fluid} \times \text{drops/milliliter (IV set)}}{\text{hours to administer} \times \text{minutes/hour (60)}}$$

Example:

1000 ml over 4 hrs

IV set = 15 gtts/ml

$$1000 \times 15/4 \text{ hrs} \times 60 = 15,000/240 = 62.5 \text{ (62 gtts/min)}$$

## XII. DRUG CALCULATIONS

### V. How to Calculate Continuous Infusions

#### A. mg/min (For example - Lidocaine, Pronestyl)

$$\frac{\text{Solution cc} \times 60 \text{ min/hr} \times \text{mg/min}}{\text{Drug mg}} = \text{cc/hr}$$

$$\frac{\text{Drug mg} \times \text{cc/hr}}{\text{Solution cc} \times 60 \text{ min/hr}} = \text{mg/hr}$$

Lidocaine & Pronestyl Rule of Thumb

2 gms/250 cc D5W

1 mg = 7 cc/hr  
2 mg = 15 cc/hr  
3 mg = 22 cc/hr  
4 mg = 30 cc/hr

#### B. mcg/min (For example - Nitroglycerin)

$$\frac{\text{Solution cc} \times 60 \text{ min/hr} \times \text{mcg/min}}{\text{Drug mg}} = \text{cc/hr}$$

$$\frac{\text{Drug mcg} \times \text{cc/hr}}{\text{Solution cc} \times 60 \text{ min/hr}} = \text{mg/hr}$$

Nitroglycerin Rule of Thumb

NTG 100 mg/250 cc  
1 cc/hr = 6.6 mcg/min

NTG 50 mg/250 cc  
1 cc/hr = 3.3 mcg/min



## XII. DRUG CALCULATIONS

C. mcg/kg/min (For example - Dopamine, Dobutamine, Nipride, etc.)

1. To calculate cc/hr (gtts/min)

$$\frac{\text{Solution cc}}{\text{Drug mg}} \times 60 \text{ min/hr} \times \text{kg} \times \text{mcg/kg/min} = \text{cc/hr}$$

**Example:**

Dopamine 400 mg/250 cc D5W to start at 5 mcg/kg/min.

\* Patient's weight is 290 lbs.

$$\frac{250 \text{ cc}}{400,000 \text{ mcg}} \times 60 \text{ min} \times 131.8 \times 5 \text{ mcg/kg/min} = 24.7 \text{ cc/hr}$$

2. To calculate mcg/kg/min

$$\frac{\text{Drug mcg} \times \text{cc/hr}}{\text{Solution cc} \times 60 \text{ min/hr} \times \text{kg}} = \text{mcg/kg/min}$$

**Example:** Nipride 100 mg/250 cc D5W was ordered to decrease your patient's blood pressure. The patient's weight is 221 lbs, and the IV pump is set at 30 cc/hr.

How many mcg/kg/min of Nipride is the patient receiving?

$$\frac{100,000 \text{ mcg} \times 30 \text{ cc/hr}}{250 \text{ cc} \times 60 \text{ min} \times 100.4 \text{ kg}} = \frac{3,000,000}{1,506,000} = 1.99 \text{ mcg/kg/min}$$

VI. How to calculate mcg/kg/min if you know the rate of the infusion

$$\frac{\text{Dosage (in mcg/cc/min)} \times \text{rate on pump}}{\text{Patient's weight in kg}} = \text{mcg/kg/min}$$

**Example:**

$$800 \text{ mg of Dopamine in } 250 \text{ cc D5W} = \frac{3200 \text{ mcg/cc}}{60 \text{ min/hr}} = 53.3 \text{ mcg/cc/min}$$

53.3 is the dosage concentration for Dopamine in mcg/cc/min based on having 800 mg in 250 cc of IV fluid. You need this to calculate this dosage concentration first for all drug calculations.

Consider a 100 kg patient

$$\frac{53.3 \text{ mcg/cc/min} \times 10 \text{ cc on pump}}{\text{Patient's weight in kg (100 kg)}} = 5.33 \text{ mcg/kg/min}$$

## XII. DRUG CALCULATIONS

VII. How to calculate drips in cc per hour when you know the mcg/kg/min that is ordered or desired

$$\frac{\text{mcg/kg/min} \times \text{patient's weight in kg}}{\text{dosage concentration in mcg/cc/min}} = \text{rate on pump}$$

**Example: 800 mg Dopamine in 250 cc D5W = 53.3 mcg/cc/min**

$$\frac{3.5 \text{ mcg/kg/min} \times 100 \text{ kg}}{53.3 \text{ mcg/cc/min}} = 6.6 \text{ cc}$$

**ALWAYS WORK THE EQUATION BACKWARDS AGAIN TO DOUBLE CHECK YOUR MATH!**

**Example: 6.6 cc x 53.3 mcg/cc/min**

$$\frac{100 \text{ Kg} = 3.5 \text{ mcg/kg/min}}{100 \text{ Kg}} = 3.5 \text{ mcg/kg/min}$$

$$\frac{\text{Dosage (in mcg/cc/min)} \times \text{rate on pump}}{\text{Patient's weight in kg}} = \text{mcg/kg/min}$$

$$\frac{\text{Dosage (in mcg/cc/min)} \times \text{rate on pump}}{\text{Patient's weight in kg}}$$

## XII. DRUG CALCULATIONS

### Practice Exercises

- A. Conversion:
1. 3.25 liters to milliliters
  2. 2.75 grams to milligrams
  3. 0.15 milligrams to micrograms
  4. 7525 milligrams to grams
  5. 75 micrograms to milligrams
  6. 800 milliliters to liters
  7. 195 pounds to kilograms
  8. 85 kilograms to pounds
- B. How many milligrams will be given for each dose? (Use the method you have chosen to calculate the amount to give).
1. Order-Dexamethasone 2 mg  
Drug available-Dexamethasone 0.5 mg per tablet
  2. Order-Tagamet 0.9 gm  
Drug available-Tagamet 300 mg per tablet
  3. Order-Phenobarbital 75 mg  
Drug available-Phenobarbital 15 mg per tablet
  4. Order-Ampicillin 1.5 gm  
Drug available-Ampicillin 250 mg per 5 ml
  5. Order-Dicloxacillin 62.5 mg  
Drug Available-Dicloxacillin 62.5 mg per 5 ml
  6. Order-Medrol 100 mg IM  
Drug Available-Medrol 125 mg per 2 ml
  7. Order-Lidocaine 3 mg per kg  
Patient's weight is 152 pounds
  8. Order- 650 mg of a medication in a 24 hour period.The drug is ordered every 6 hours.

## XII. DRUG CALCULATIONS

C. Infusion Rate- Calculate gtts/min

1. Order – 1000ml over 8 hrs (IV set 15gtts/ml)
2. Order – 750ml over 6hrs (IV set 10 gtts/ml)
3. Order – 250ml over 30 min. (IV set 15gtts/ml)

D. Practice Problems:

1. Dopamine 400 mg in 250 cc D5W to infuse at 10 mcg/kg/min. The patient's weight is 175 pounds. How many cc/hour would this be on an infusion pump?
2. A Dopamine drip (400mg in 250 cc of IV fluid) is infusing on your 90 kg patient at 15 cc/hour. How many mcg/kg/min are infusing for this patient?
3. A Nitroglycerin drip is ordered for your patient to control his chest pain. The concentration is 100 mg in 250 cc D5W. The order is to begin the infusion at 15 mcg/min. What is the rate you would begin the infusion on the infusion pump?
4. A Nitroglycerin drip (50mg in 250 cc D5W) is infusing on your patient at 14 cc/hour on the infusion pump. How many mcg/min is your patient receiving?
5. A procainamide drip is ordered (2gms in 250 cc D5W) to infuse at 3 mg/min. The patient weighs 315 pounds. Calculate the drip rate in cc/hour for which the infusion pump will be set at.
6. A Lidocaine drip is infusion on your 67.5 kg patient at 15 cc/hour. The Lidocaine concentration is 2 grams in 250 cc of D5W. How many mg/min is your patient receiving?

## XII. DRUG CALCULATIONS

### Answers to Practice Problems

#### A. Practice Problems

1. 3250 mL
2. 2750 mg
3. 150 mcg
4. 7.525 gm
5. 0.075 mg
6. 0.8 L
7. 88.6 kg
8. 187 lbs

#### B. Practice Problems

1. 4 tablets
2. 3 tablets
3. 5 tablets
4. 30 mL
5. 5 mL
6. 1.6 mL
7. 69 kg = 207 mg
8. 162.5 mg for 4 doses

#### C. Practice Problems

1. 31.25 (31)
2. 20.8 (21)
3. 125

#### D. Practice Problems

1. 29 cc/hr
2. 4.5 mcg/kg/min
3. 2.3 cc/hr
4. 46.2 mcg/min
5. 22 cc/hr
6. 2 mg/min

## XII. DRUG CALCULATIONS

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