

Well Being of the EMT

Scene Safety

- Starts well in advance
- Tetanus – diphtheria booster
- Hepatitis B vaccine
- Influenza vaccine
- MMR (Measles, Mumps, Rubella)
- Tuberculin protein derivative (PPD) testing

Body Substance Isolation

- Wash your hands
- Use Gloves
- Eye Protection
- Uniforms
- Gowns
- Masks

Personal Protection – Hazardous Material

- **Identify Possible Hazards**
 - Placards
 - Emergency Response Guide
 - Binoculars
- **Protective Clothing**
 - Hazardous material suits
- **Approach to from up hill and up wind**
- All hazardous material scenes are controlled by specialized HAZ-MAT Teams.
- EMT provides emergency care only after the scene is safe and the patients are clean
- Identify and reduce potential life threats
 - Electricity
 - Fire
 - Explosion
 - Hazardous materials
- Notify the dispatcher and request specialty team when needed.

Violence

- The scene should always be controlled by law enforcement before the EMT provides patient care to:
 - Perpetrator of a crime
 - Any bystander

- Any family member
- Any patient

Stress

- Any response, physical, emotional or behavioral to things that happen in our lives
- This could be either on or off the job
- Different types of stress
 - Cumulative stress
 - Acute stress
 - Critical incident stress
 - Post traumatic stress disorder
- How we build up stress
 - Mass Casualty Incidents
 - Infant and child trauma
 - amputations
 - abuse/domestic violence calls
 - death or injury of an MOS
- How we and our families build up stress
 - Can't plan activities
 - On-call situations
 - Wanting to share your feeling but cannot
 - Fear of separation and of being ignored
 - Lack of understanding from your family and friends
- Warning Signs
 - Feelings of guilt, anxiety, or isolation
 - Indecisiveness
 - Change in appetite
 - Inability to concentrate
 - Loss of interest in work
 - Irritable towards friends, co-workers, family
 - Change in sleeping patterns
 - Nightmares
 - Loss of interest in sexual activities
- How can we manage stress
 - Change your lifestyle
 - Exercise regularly
 - Practice relaxation techniques
 - Balance your schedule
 - Change your work environment
 - Seek professional help
- How do we deal with critical incident stress?
 - Pre-incident stress education
 - On-scene peer support
 - Disaster support services
 - Diffusing
 - CISM Team
 - Follow-up services

- Spouse and family support
- Health and welfare programs
- Community outreach programs
- Critical Incident Stress Management Team
 - A team of peer counselors and mental health professionals who help EMTs deal with critical incident stress
 - Meeting is held usually within 24 – 72 hours
 - Personnel evaluate the information and offer suggestions on ways to overcome the stress
 - Designed to accelerate the normal recovery process of experiencing a critical incident.

Domestic Violence and Abuse

- Abuse of one individual by another in order to establish and maintain power and control over that person.
- A pattern of coercive behavior that can include:
 - Physical
 - Sexual
 - Economic
 - Emotional
 - Psychological
- Role on Scene
 - Assess and treat your patient
 - Observe your surroundings
 - Legal responsibilities
- Documentation
 - ACR/PCR
 - NY State Law – EMTS and AEMTs are mandated reporters.
- Subjective Assessment
 - The ambulance may provide a safe place for a domestic violence victim to admit that there is a problem and ask for help
 - All types of questions may not be appropriate to ask all our patients

Medical, Legal and Ethical Issues

Ethical Responsibilities

- Make physical and emotional needs of the patient a priority
- Maintain patient confidentiality
- Be honest

Scope of Practice

- Provide patient care
- Work with your scope of training
- Follow protocols and directives
- Follow medical control

Standard of Care

- Establishes the level of care
- Standards which must be met based on
 - State protocols
 - Regional protocols
 - Directives
 - Textbooks
 - Laws

Duty to Act

- Obligation to provide care

Acts of Omission

- **Nonfeasance**
 - EMT failed to perform his or her duty

Acts of Commission

- **Misfeasance**
 - The EMT performed an approved action improperly
- **Malfeasance**
 - The EMT performs an action above their level of training.

Negligence

- Deviating from the standard of care resulting in further injury to the patient
- Not performing as a reasonable person would act given the same circumstances
- Breach of duty or an act of omission or commission
- Damages (tort)
- Proximate cause

Gross Negligence

- Intentional harming of the patient
- An act of malice
- Unreasonable action
- The desire to see someone hurt or injured

Laws

- **Good Samaritan Law**
 - Protects anyone that has no medical training that provides care to sick or injured person.
- **NYS Public Health Law Article 30**
 - Provides protection to any person that is not being paid who renders care outside of a medical facility

Legal Terms

- **Assault** – unlawfully placing a person in fear of immediate bodily harm without the person's consent.

- **Battery** – unlawfully touching a person; this includes providing emergency care without consent
- **False Imprisonment** – Transporting a competent patient against their will.

Components of a Law Suit

- **Tort** – act that give rise to a civil suite
- In order prove **negligence**, all of the following must be proven:
 - There was a duty to act
 - There was a breach of duty
 - The patient’s condition worsened or was made worse
 - The Breach of Duty caused or helped to cause the change in the patient’s condition.

Abandonment

- Provider discontinues care before completing care before transferring care to someone with equal or greater level of training.

Consent

- To allow
- A formal written or oral order giving permission
- **Actual consent:** the EMT must
 - Identify who you are,
 - Make certain patient is:
 - Mentally competent
 - Of legal age
 - Able to understand
 - What you thing is wrong with them
 - What the treatment will be
 - Benefits of accepting treatment
 - The dangers of refusing treatment
 - Able to make a reasonable decision.
- **Implied Consent**
 - The patient is not capable of giving actual consent
 - Any unconscious patient
 - Patient is unable to make a rational decision
 - Any patient with an alerted mental state
 - Intoxicated
 - Drugs
 - Diabetic
 - Any mentally disabled patient that can’t make an informed decision.
 - Any minor patient needing medical care with no parent or legal guardian is present.
 - Minor – under the age of 18
 - Emancipated Minor
 - A minor that is treated as an adult in certain situations

Medical Control

- **Off-Line Medical Control**
- Treatment that the EMT-B are allowed to administer based on protocols
- Standing Orders
- **On-Line Medical Control**
- Treatments that the EMT-B are allowed to administer based on protocols after receiving permission from an approved physician.

Right of Refusal

- Any patient who is alert and can give informed consent has the right to refuse medical care:
 - The EMT must explain the possible consequences of refusal
 - Encourage the patient to reconsider
 - Use family members or friends to help change the patient's mind
 - In many cases, the EMT must call Medical Control
- All cases must be well documented and witnessed by a neutral party
- Documentation must include physical findings and any treatment rendered

Do not Resuscitate Orders

- DNR Orders may be printed on a NYS DOH approved form or bracelet
 - This is an example of an "advanced directive"
- DNR orders only apply to the patients medical condition
- DNR orders do not apply to traumatic cardiac arrest
- A patient with a valid DNR that goes into respiratory arrest will not be resuscitated
- Must be physically present
- When in doubt, start CPR

Health Care Proxy Law

- Legal form
 - This is an example of an "advanced directive"
- Patient designates a person to make medical decisions on his or her behalf
- If there are any special instructions by patient, it is spelled out on this form
- Form remains valid indefinitely
- A copy remains with Agent, and a patient's doctor
 - EMT must treat any patient with a Health Care Proxy
 - Take a copy of the form to the hospital, and allow the agent, if present, to accompany the patient
 - Remember: Do not withhold any pre-hospital treatment!

Living Will

- Patient's statement of desires or intentions regarding treatment or resuscitation
 - This is an example of an "advanced directive"
- Legal form, but can be written on any paper
- Do not withhold any pre-hospital treatment

- Take form or paper with the patient to hospital

PCRs/ACRs

- Must be completed whenever there is patient contact
- The patient is your responsibility until the patient is signed over to the receiving hospital.
- A completed PCR/ACR is a legal document
- Any care provided which is not documented is viewed by the court of law as not having been done

Patient Confidentiality

- A pre-hospital care provider is governed by the same rules as a doctor
- EMTs may not provide “specific” information to anyone other than medical personnel about the patient’s condition

Special Situations

- Donor/organ harvesting considerations
 - Donor information may be on the back of driver’s license or on a separate ID card
- Deaf patients
- Blind patients
- Language barriers
- Crowd control
- Traffic control
- Unruly patients and family members
- Suspected child abuse
- Suspected elder abuse

Abandoned Infant Protection Act

- **New York Social Service law** states that infants 5 days or younger may be abandoned by their parents or caretaker in a safe location
 - Hospital
 - Fire house
 - Police station
 - Ambulance
 - With an appropriate person
- Parents or caregivers may wish to remain anonymous
- Provides the parent or caregiver with an acceptable defense against prosecution for abandonment
- Does not relieve the EMT of the responsibility to report abandonment to the NYS Central Register

Crime Scenes

- Ensure
 - Your safety

- Patient care and patient safety
- Do not disturb the scene
- Avoid touching things at the scene
- Do not run anything off that was left on
- Use only one pathway to and from the patient
- Do not use the telephone at the scene
- Preservation of Evidence
 - Do not cut through gunshot or stab holes in clothing
 - Do not leave anything behind

DOAs

When Not to Start CPR

- Extreme dependent lividity
- Rigor mortis
- Tissue decomposition
- Obvious mortal injury
- A valid DNR is present

Diagnosis of Death

- A physician is the only individual that can legally pronounce a patient dead
- Nurses, EMTs and AEMTs make a presumptive diagnosis of death.

Stopping CPR

Once CPR has been started by anyone CPR may not be stopped unless On Line Medical Control is contacted and approves of your decision to stop.

General Pharmacology

Medication Names

- Generic
 - The general name for a given drug
 - Not associated with any specific manufacturer
 - Same as the official name
 - United States Pharmacopoeia
- Trade
 - The brand name a manufacturer uses in marketing the drug
 - Tylenol
 - Excedrin
 - Benadryl

Definitions

Actions - desired effects of a medication

Indications – the medical condition(s) in which a drug has proven to be of therapeutic value.

Contraindications – situations in which a drug should not be used because it may cause harm to the patient

Dose – how much of the medication should be given; how often the medication should be given.

Administration – route by which the medication is administered such as oral, bilingual, intravenous or intramuscular

Side Effects – any actions of a medication other than those desired.

▪ **Medication Forms**

- **Solution** – epinephrine/nitroglycerine paste
- **Suspension** – activated charcoal
- **Syrup**
- **Gel** – glucose
- **Tablet** – aspirin
- **Powder**
- **Gas - Oxygen**

Patient Assessment – Medical Patients

Scene Size Up

- Body substance isolation (BSI)
- Scene Safety
- Nature of Illness/Mechanism of Injury
- Number of Patients
- Need for additional resources

Initial Assessment

- General Impression
- Chief Complaint
 - What is the patient's most serious medical problem?
 - This is usually the reason the ambulance was called.
- Mental Status
 - Maintain c-spine immobilization
 - Determine the patient's level of responsiveness
 - Use the AVPU scale
 - **A = Alert**
 - The patient is alert and oriented X 3
 - Patient knows his/her name
 - Patient knows where he/she is
 - Patient knows some time frame
 - **V = Verbal**
 - The patient is responsive to verbal stimuli
 - The patient is conscious, but disoriented in some way
 - The patient is able to follow commands
 - The patient is semi-conscious, but moves or makes noise when spoken to
 - **P = Painful**
 - The patient is responsive to painful/physical stimuli
 - Patient moves or makes noise when touched
 - Patient has a gag reflex
 - **U = Unresponsive**
 - The patient does not respond to stimuli
- ABCs
 - **Airway**
 - Do you hear any audible noises
 - Is the patient's airway clear?
 - Suction
 - FBAO maneuvers
 - Will the patient's airway stay open? Maintainable?
 - Are airway adjuncts needed?
 - If the patient is talking to you, no need to pen the airway.
 - **Breathing**

- Are the rate and quality of breathing adequate to sustain life?
 - Ventilate with oxygen if breathing is not adequate
 - Auscultate in 2 places (mid-axillary line)
 - Does the patient need oxygen?
 - Any unconscious patient
 - Any patient with respiratory complaint
 - Any patient complaining of chest pain
 - Any patient with a respiratory rate <8
 - Any patient with a respiratory rate >24
 - Some patients do not need oxygen
 - **Circulation**
 - Radial/Carotid
 - Check skin color, temperature, and condition (CTC)
 - Treat for shock
 - Ask patient “are you bleeding anywhere?”
- Transport decision
 - Rapid transport
 - Actual or impending cardiorespiratory arrest
 - Respiratory distress/failure
 - Poor general impression
 - Obstetrical call with complications
 - AMS
 - Chest Pain
 - Shock
 - Severe pain
 - Delayed Transport
 - General medical illness
 - Uncomplicated child birth

Focused History & Physical Exam

- History of present illness questions
 - Specific for each nature of illness
 - If patient has non-specific nature of illness or any pain use:
 - **Onset** – What were you doing?
 - **Provocation** – anything make it better or worse?
 - **Quality** – describe it?
 - **Radiation** – does the pain go anywhere?
 - **Severity** – on a scale of 1 to ten?
 - **Time** – How long has it been going on?
 - **Interventions** – What did you do to help yourself?
- Sample History
 - Signs and Symptoms
 - Allergies
 - Medications
 - Pertinent past medical history
 - Last oral intake

- Events – What happened?
- Focused History and Physical Exam for Unconscious patients
 - Rapid physical assessment (onscene)
 - Baseline vital signs (enroute)
 - SAMPLE (enroute)
 - Detailed physical exam (enroute if time permits)
- Focused History and Physical Exam for Conscious patients
 - History of present illness
 - Baseline vital signs
 - SAMPLE
 - Detailed physical exam
- **On – Going Assessment**
 - Performed on stable patients every 15 minutes
 - Performed on C, U, or P patients at least every 5 minutes
 - Repeat initial assessment
 - Repeat vital signs
 - Repeat focused physical exam
 - Evaluate interventions

*** (SEE CLASS HANDOUT FOR APPROPRIATE TESTING ORDER)

Patient Assessment – Trauma Patients

Scene Size Up

- Body substance isolation (BSI)
- Scene Safety
- Mechanism of Injury
- Number of Patients
- Need for additional resources

Initial Assessment

- General Impression
- Chief Complaint/Life Threats
- Mental Status
 - Maintain c-spine immobilization
 - Determine the patient’s level of responsiveness using AVPU scale
- **ABCs**
 - **Airway**
 - Do you hear any abnormal noises
 - Is the patient’s airway clear?
 - Suction
 - FBAO maneuvers
 - Will the patient’s airway stay open? Maintainable?
 - Are airway adjuncts needed?
 - **Breathing**

- Are the rate and quality of breathing adequate to sustain life?
 - Ventilate with oxygen if breathing is not adequate
 - Inspect and palpate the chest wall
 - Seal holes
 - Stabilize flail/impaled objects
 - Auscultate in 2 places (mid-axillary line)
 - **Circulation**
 - Radial/Carotid
 - Check for severe bleeding
 - Check skin color, temperature, and condition (CTC)
 - Treat for shock
- **Transport decision**
 - Rapid transport
 - Actual or impending cardiorespiratory arrest
 - Respiratory distress/failure
 - Rising intracranial pressure
 - Shock
 - 2 or more long bone fractures
 - Trauma with burns
 - Poor general impression
 - AMS
 - Penetrating injury to head or torso
 - Uncontrolled external bleeding
 - Delayed Transport
 - Low potential for cardiorespiratory instability
 - MOI suggests hidden injury
 - Minor isolated injury
 - Uncomplicated extremity injury

Focused History & Physical Exam

- Significant MOI
 - Initial assessment
 - Rapid trauma assessment
 - SAMPLE (if possible)
 - Transport
 - Baseline vital signs
 - Detailed physical exam, if time permits
- Non-significant MOI
 - Initial assessment
 - Focused physical exam
 - Baseline vital signs
 - Sample history
 - Transport
- **On – Going Assessment**
 - Performed on stable patients every 15 minutes
 - Performed on C, U, or P patients at least every 5 minutes

- Repeat initial assessment
- Repeat vital signs
- Repeat focused physical exam
- Evaluate interventions

***** (SEE CLASS HANDOUT FOR APPROPRIATE TESTING ORDER)**

Respiratory Emergencies

The Need for Oxygen

- Humans are oxygen dependent
- Cells die when deprived of oxygen
 - Brain cells among the first to die
- Biological Death begin 4-6 minutes after onset of hypoxia
 - Hypoxia – deficiency of oxygen

Biological Death

- Causes of irreversible brain damage
- Hypoxia is the brain's worst enemy
 - Causes swelling
 - Decreased function
 - AMS
 - Multiple system changes

Components of Air

- Inhaled air
 - 21% of oxygen
 - 78% Nitrogen
 - 1% Carbon Dioxide & Moisture
- Exhaled air
 - 16% oxygen
 - 78% nitrogen
 - 6% Carbon Dioxide & Moisture

Heart-Lung-Brain Relationship

- Three systems work together to ensure adequate oxygenation of the brain and other cells of the body
- Respiratory system delivers oxygen
- Cardiovascular system circulates oxygen
- Central Nervous System regulates both systems
- ABCs must be managed properly to ensure brain viability

Anatomy and Physiology

- Upper Airway

- Nasal Cavity
 - Sensory organ: sense of smell
- Nasopharynx
- Oropharynx
- Epiglottis
 - A leaf shaped structure that prevents food and liquid from entering the trachea during swallowing
- Cilia
 - Filtration
- Mucus membranes
 - Warms and moistens
- **Lower Airway**
 - Larynx
 - Voice production
 - Cricoid Cartilage
 - Trachea
 - Bronchus (Bronchi)
 - Bronchioles
 - Involuntary muscles control the diameter of the bronchioles
- Lungs
 - Protected by the rib cage
 - Pleural membranes
 - **Parietal pleura** - outer membrane that lines the inner chest wall
 - **Pleural space** – the area between the parietal and visceral pleura
 - **Visceral pleura** – inner membrane which lines the outer surface of the lungs.
 - **Alveoli** – gas exchange in conjunction with pulmonary capillaries.
 - **Cilia and mucous membranes**

Gas Exchange

- Air rich in oxygen enters the alveoli during each inspiration
- Blood in the capillaries passes around the alveoli
- Oxygen enters the capillaries from the alveoli
- Carbon dioxide enters the alveoli from the capillary
- Cells give up carbon dioxide to the capillaries
- Capillaries give up oxygen to the cells

Major Muscles of Respirations

- Diaphragm is the main muscle of normal breathing
- Accessory muscles include:
 - Sternocleidomastoid
 - Pectoral
 - Intercostal
 - Abdominal

The Breathing Process

- **Inhalation (active)**
 - Diaphragm and intercostals muscles contract to make the thoracic cavity larger, decreases air press in the lungs
 - Air moves into the lungs
- **Exhalation (passive)**
 - All muscles relax and the thoracic cavity return to a resting position making the thoracic cavity smaller, increasing pressure in the lungs and forcing air out
- **Control mechanism**
 - Central nervous system
 - Receptors in arteries monitor O₂ and CO₂ levels and send signal to the medulla
 - Brain adjusts respiratory rate and effort according the body's need

Assessing for Adequacy of Respirations

- **Rate**
 - Normal Breathing Rates
 - Adult – 12-20/minute
 - Child – 15-30/minute
 - Infant – 25-50/minute
- **Rhythm**
 - Regular or irregular
- **Depth**
 - **Tidal Volume** – amount of air moved during each breath.
- **Quality**
 - Breath sounds present and equal
 - Chest expansion is adequate and equal
 - Effort of breathing
 - Should appear effortless in adults
 - Use of accessory muscles is predominant and normal in infants and children
- **Inadequate Breathing**
 - Rate – outside of normal ranges
 - Rhythm – irregular
 - Quality
 - Breath sounds: diminished or absent
 - Chest expansion: unequal or inadequate
 - Increased effort of breathing
 - Use of accessory muscles
 - Depth (tidal volume): inadequate/shallow
 - The skin may be pale or cyanotic (blue) and cool and clammy
 - There may retractions above the clavicles, between the ribs, and below the rib cage, especially in children
 - Nasal flaring may be present, especially in children

- Agonal Breathing (occasional gasping breaths) may be seen just before death.

Signs and Symptoms of Breathing Difficulty

- Shortness of breath (dyspnea)
- Change in mental status/and or restlessness
 - Shallow or slow breathing may lead to altered mental status (with fatigue or obstruction)
- Increased pulse rate
- Increased breathing rate
- Decreased breathing rate
- Skin color changes
 - Cyanotic, pale or flushed
- Crowing
- Audible wheezing
- Gurgling
- Snoring
 - Indicates tongue obstruction
- Stridor
- Indicates upper airway obstruction
- Coughing
- Irregular rhythm
- Unusual anatomy (barrel chest)
- Patient position
 - Tripod position
- Silent chest
 - May be found in asthma in children and adult patients
- Inability to speak due to breathing efforts
- Retractions/use of accessory muscles
- Abdominal breathing (diaphragm only)

Definitions

Apnea – absent respirations

Atelectasis – collapse of the alveolar spaces

Aspirate – to inhale foreign matter into lungs

Hemoptysis – coughing up blood

Hyperventilation – an increase of air in the lungs above the normal volume

Hypoventilation – a reduction in the amount of air entering the alveoli

Hypoxic Drive – decreased blood O₂ level stimulates breathing

Hypoxia – lack of oxygen in the blood tissue

Orthopnea – dyspnea while lying down, relieved by sitting or standing

Respiration – the exchange of oxygen between the atmosphere and the body cells

Bradypnea – slower than normal respiration

Tachypnea – faster than normal respiration

Respiratory Emergencies

- Asthma
 - Dyspnea accompanied by wheezing
 - It is caused by spasm of the bronchial tubes by swelling of the mucous membrane
 - Predisposing factors
 - Allergies
 - Infection
 - Stress
 - Sudden temperature changes
 - Seasonal changes
 - Pathophysiology
 - Hypersensitivity of the airway
 - Bronchospasm
 - Excessive mucus production
 - Hyperinflation of the lungs
 - Signs and Symptoms
 - Dyspnea
 - Sitting upright
 - Cyanosis
 - AMS
 - Anxiety
 - Wheezing
 - Forced exhalation
 - Diminished lung sounds
 - Respiratory arrest
 - Remember
 - If the patient stops wheezing, no air is moving in or out of the lungs
 - This is a true emergency
 - Respiratory and/or cardiac arrest is imminent
 - Be prepared to ventilate this patient

Pneumonia

- Inflammation in the alveolar spaces
 - Usually caused by various types of infectious organisms or by aspiration of fluid in the lungs
- A lung infection that can be treated with antibiotics
- Predisposing factors
 - Low physical resistance
 - Immunocompromised patients (HIV)
 - Patients who have had pneumonia in the past
 - Elderly patients
 - Inflammation secondary to infection caused usually by virus, bacteria, fungus or cancer
 - May also be caused by inhalation or aspiration of any irritants

- Presentation
 - Chills
 - High fever
 - Chest pain
 - Productive cough
 - Purulent/bloody sputum
 - Weakness
 - Dyspnea
 - Tachycardia
 - Rales and diminished sound in localized area

Pulmonary Embolism

- Sudden occlusion of pulmonary arterial circulation or one of its branches by a clot or other obstruction
- Predisposing factors
 - Prolonged immobilization
 - Thrombophlebitis
 - Use of oral contraceptives
 - Smoking
 - Recent long bone fracture
- Pathophysiology
 - a blood clot or fatty deposit in the venous system breaks loose and travels to the pulmonary circulation where it creates an obstruction to vascular flow.
 - The larger the embolus, the more blockage created
- Signs & Symptoms
 - Sudden onset dyspnea
 - Tachycardia
 - Tachypnea
 - Anxiety
 - Possible Hemoptysis
 - Pleuritic type chest pain (sharp)
 - Most often misdiagnosed as hyperventilation syndrome
 - Shock
 - Cardiac Arrest

Upper Respiratory Infection

- Exposure to virus, bacteria or fungus
 - Low resistance (immuno-compromised)
- Pathophysiology
 - Viral, bacterial or fungal infection with production of cellular debris (“pus”)
- Signs and Symptoms
 - Dyspnea
 - Fever
 - General malaise

- Sinus congestion
- Purulent nasal discharge

Chronic Obstructive Pulmonary Disease (COPD)

- A chronic respiratory disorder characterized by progressive obstructed air flow.
 - Usually associated with a history of inhaled irritants – smoking, pollution, Chronic URIs

Chronic Bronchitis

- A type of COPD
- Clinical description
 - Productive cough for 2-3 consecutive months, for 2-3 consecutive years
- Predisposing factors
- History of smoking
 - Environment/pollution
 - Allergies
 - Exposure to infectious agents e.g. influenza
- Pathophysiology
 - Chronic irritation leads to
 - Excessive mucus production
 - Decreased ciliary production
 - Mucus stagnation
 - Destruction of cilia
 - Inflammation of the airway
 - Presentation
 - Obese patient
 - Cyanotic complexion
 - Dyspnea
 - Rhonchi
 - Associated pedal edema

Emphysema

- A type of COPD
- Predisposing factors
 - Smoking
 - Frequently in the elderly
 - Heavy environmental pollutants (urban, industrial)
 - Progressive destruction of the alveoli and the loss of elastic recoil within the lungs
- Pathophysiology
- Alveolar distention
 - Destruction of the alveolar walls
 - Destruction of the capillary beds
 - Decreased usable alveolar space
 - Decreased elasticity of lungs

- Signs and Symptoms
 - Dyspnea
 - History dyspnea on exertion
 - Accessory muscle use
 - Pursed lip breathing
 - Increased anterior/posterior diameter (barrel chest)
 - Rhonchi
 - Pedal edema
 - Peripheral cyanosis
 - Clubbed fingers

Cor Pulmonale

- Pulmonary hypertension secondary to COPD, which eventually leads to right ventricular hypertrophy, and thus heart failure as a result of “back pressure” build up in the lungs.

Pleuritic chest Pain

- Pain made worse on inspiration or exhalation
- Caused by an inflammation or infection in the pleural space
- Rubbing of the visceral and parietal pleura

Trauma to the Respiratory System

- Simple rib fracture
 - Blunt injury to the chest wall
 - May result in fracture on one or more ribs
 - May have no obvious signs
 - Generally not life threatening unless injury affects the lungs
- Treatment
 - Lungs sounds must be assessed
 - Assess the entire patient to ensure there are no missed injuries
 - Consider c-spine immobilization
 - Administer oxygen
 - Transport in the position of comfort
- Flail Chest
 - Two or more ribs are broken in two or more places creating a section of unattached ribs
- Pathophysiology
 - Results from significant blunt trauma to the chest wall
 - Causes significant respiratory compromise
 - Often causes injury to the lungs
 - Signs usually obvious
 - Causes paradoxical movement
 - There are the opposite directions the chest wall usually moves
 - When the patient inhales, the flail segment collapses
 - On exhalation, the flail segment rises
- Treatment
 - Monitor breathing and assess lung sounds

- Administer oxygen
- Consider c-spine immobilization
- Stabilize with bulky dressing and tape
- Transport

Pneumothorax

- **Spontaneous pneumothorax**
 - Arises as the result of a medical problem
 - A weakened area in the lung, bleb, begins to leak and air begins to fill the plural space
 - This air pressure compresses the lung and causes respiratory compromise
 - This does not have any external signs
 - Lung sounds may be diminished on the affected side
- **History**
 - Chief complaint is generally sudden, unexplained onset of difficulty breathing or shortness of breath
 - Listen for diminished lung sounds
- **Treatment**
 - Monitor breathing and assess lung sounds
 - Administer oxygen
 - Look for tracheal deviation
 - Transport
- **Open traumatic pneumothorax**
 - Injury to the chest and lung
 - Negative pressure of inspiration causes air to enter the chest through the airway and hole created by the injury
- **Treatment**
 - Assess the whole patient
 - Monitor breathing and assess lung sounds
 - Listen for diminished lung sounds
 - Administer oxygen
 - Seal holes with occlusive dressing on three sides
 - Look for tracheal deviation
 - Transport
- **Hemothorax**
 - Results when blood fills the chest cavity
 - May result from blunt or penetrating trauma
 - Jagged rib ends may cause the injury
 - Stab or gun shot wound may cause the injury
 - May also be a sucking chest wound
 - Treatment
 - Assess the whole patient
 - Monitor breathing and assess lung sounds'
 - Administer oxygen
 - Treat for shock

- Seal nay hole with occlusive dressing on three sides
 - Look for tracheal deviation
 - Transport
- **Hemopneumothorax**
 - Results when blood and air fills the chest cavity
 - Results when blood fills the chest cavity
 - May result from blunt or penetrating trauma
 - Jagged rib ends may cause the injury
 - Stab or gun shot wound may cause the injury
 - May also be a sucking chest wound
 - Treatment
 - Assess the whole patient
 - Monitor breathing and assess lung sounds'
 - Administer oxygen
 - Treat for shock
 - Seal any hole with occlusive dressing on three sides
 - Look for tracheal deviation
- **Tension pneumothorax**
 - Results from a missed, improperly cared for, or closed pneumothorax
 - Pressure in the chest is so severe, the injured lung collapses and the mediastinum moves to the unaffected side.
 - Seen when inspecting/palpating the neck
 - Lung sounds are significantly diminished or absent
 - Treatment
 - Monitor the airway
 - Observe spinal injury precautions as needed
 - Administer high concentration O₂
 - Monitor breathing for adequacy
 - Assess and treat for shock, if appropriate
 - Position the patient on the affected side unless it with complicate the injury
- **Hyperventilation Syndrome**
 - a significant increase in the minute volume of air in the lungs creates an imbalance between the CO₂ and O₂ levels in the blood
 - The body responds by trying to increase its respiratory effort thus complicating the problem.
 - Can be compensatory mechanism for an underlying life threatening emergency.
 - Signs and Symptoms
 - Dyspnea
 - Dizziness
 - Anxiety
 - Dryness in the mouth
 - Numbness in the mouth, hands, feet

- Tachycardia
- Chest pain
- Syncope
- Treatment
 - Administer oxygen
 - Calm the patient
 - Encourage patient to slow breathing rate
 - Obtain good history (if possible)
 - Never Use a Paper Bag
 - Look for any medical or traumatic emergency first

Anatomy and Physiology – Infant and Child

- **Airway**
 - Mouth, nose and all other structures are smaller and more easily obstructed than in adults
 - Exception – the tongue is proportionally larger than an adults
- **Anatomical differences**
 - The glottis lies more anterior and superior compared to the adult
 - The narrowest part of the airway is below the vocal cords
 - The size of the airway increases significantly as the child ages
 - The cricoid cartilage is less developed and less rigid
 - The trachea is softer and more flexible in infants and children
 - Do not hyperextend the head and neck
 - **Diaphragm**
 - Chest wall is softer
 - Infants and children tend to depend more heavily on the diaphragm for breathing

Cardiovascular Emergencies and Stroke

Anatomy and Physiology of the Circulatory System

- Blood (fluid)
- Vessels (pipes)
- Heart (pump)
 - When a patient is in shock (hypoperfusion), the problem is with one of these components
- **Blood**
 - Carries oxygen and nutrients to the organs and tissues
 - Carries carbon dioxide and other waste products away from the organs and tissues
 - Regulates body temperature (with blood vessels)
 - Protects against infection
 - Protects against blood loss
- **Vessels**
 - Arteries
 - Major arteries include

- Aorta
 - Pulmonary
 - Carotid (neck)
 - Brachial (elbow)
 - Radial (wrist)
 - Ulnar (wrist)
 - Femoral (groin)
 - Popliteal (knee)
 - Posterior tibial (foot)
 - Dorsalis pedis (foot)
- Arterioles
- Palpable pulses
 - Central
 - Carotid
 - Femoral
 - Peripheral
 - Radial
 - Brachial
 - Posterior tibialis
 - Dorsalis pedis
 - Capillaries
 - Veins
 - Major veins include
 - Superior vena cava
 - Inferior vena cava
 - Pulmonary vein
 - Jugular
 - Venules
- Heart
 - Hollow, muscular organ approximately the size of a fist
 - In the mediastinum between the sternum and the spine
 - Pump of cardiovascular system
 - Propels blood through vessels
 - Pericardium
 - Double-walled membranous sac enclosing the heart and holding it in place
 - Two layers
 - **Visceral** – inner layer (aka Epicardium)
 - **Parietal** – outer layer
 - There is space between the layers
 - Layers of the heart wall
 - Epicardium
 - Same as the visceral pericardium
 - Outermost layer of the heart
 - Myocardium

- Middle of the heart wall
 - Composed of cardiac cells
 - Endocardium
 - Inner lining of the heart wall
- Structure of the heart
 - Atria
 - Top chambers
 - Pump blood into ventricles
 - Receive blood returning to heart
 - Ventricles
 - Bottom chambers
 - Pump blood away from the heart
 - Left and right valve divided by septum
 - Valves
 - Composed of flaps of tissue cupped in one direction
 - Pressure against one side opens
 - Pressure against the other side closes
 - Valves prevent back-flow of blood into chamber during relaxation
 - Atrioventricular
 - Separate atria from ventricles
 - Prevent back-flow of blood into atria
 - Left is mitral/bicuspid valve (2 flaps)
 - Right is tricuspid (3 flaps)
 - Semilunar
 - Separate ventricle from outlet arteries
 - Have three flaps shaped like half moons
 - Prevent back-flow of blood into ventricles
 - Left ventricle pumps into aorta via aortic valve
 - Right ventricle pumps into pulmonary artery via pulmonic valve

Pulmonary Circulation

- Pulmonary Circulation
 - Pumps blood through the lungs
 - Right ventricle pumps de-oxygenated blood through the pulmonic valve into pulmonary artery
 - Blood conduct gas exchange at alveoli
 - Drops off CO₂, pick up O₂
 - Oxygenated blood return to heart via pulmonary vein
 - Enters left atrium for the beginning of systemic circulation
- Systemic Circulation
 - Pumps blood through the rest of the body
 - Left ventricle pumps oxygenated blood through aortic valve into aorta
 - Blood conducts gas exchange at the capillary bed of each organ

- Drops off O₂, picks up CO₂
- Deoxygenated blood returns to heart via superior and inferior vena cavae
- Enters right atrium for beginning of pulmonary circulation
- Blood Pressure
 - Force exerted by blood on walls of vessels
 - Systolic
 - Left ventricle contraction increases arterial pressure
 - Diastolic
 - Left ventricular relaxation
 - Less pressure on artery walls
 - Blood pressure = cardiac output X peripheral vascular resistance x blood volume
 - Cardiac output – stroke volume x heart rate
 - Standard Stroke volume = 70ml

Risk Factors Associated with Cardiovascular Disease

Hypertension

- Higher blood pressure than is normal
 - Not primarily dependent on numbers
- Increases likelihood of coronary artery disease and cerebral vascular disease

Hypertensive Crisis

- Severe hypertension causing end-organ failure
 - Not primarily dependent on numbers

Must have signs/symptoms of CNS, myocardial, hematologic, or renal deterioration.

Arteriosclerosis

- A disease characterized by hardening and thickening of the arterial walls.

Atherosclerosis

- A disorder in which cholesterol and calcium build up inside the walls of blood vessels, forming plaque, which eventually leads to partial or complete blockage of blood flow.

Coronary Arteries

- Supply the heart muscle itself with oxygen and nutrients
- When portions of these arteries become narrowed or blocked, problems will occur.
- Coronary By-pass
 - Vessels removed from some other part of the body (usually legs)
 - Surgically transplanted around occluded part
 - Create detour to by-pass blocked coronary arteries

Angina Pectoris

- Temporary ischemic chest pain that is caused by exertion or stress and relieved by rest.
 - Oxygen supply vs. demand
 - No permanent damage
- Signs and Symptoms of angina
 - Chest pain of short duration
 - Possibly radiating to the jaw or arms
 - Difficulty breathing
 - Diaphoresis
 - Nausea
 - Ischemic pain
- Unstable angina
 - “Changing pattern of onset”
 - More frequent
 - Longer duration
 - Less exertion required (perhaps at rest)
 - Need more NTG to correct
 - If it was the patient who called, have a high index of suspicion

Myocardial Infarction (MI)

- Severe and sustained oxygen deprivation of the myocardium resulting in the death of heart cells; commonly known as heart attack
 - Also called AMI (acute myocardial infarction)
- Caused by
 - Ischemia
 - Total blocked coronary arteries
 - Cardiac cells begin to die due to lack of O₂
 - Foci in conduction system become irritable possible resulting in life threatening arrhythmia
- Typical presentation of MI
 - Sudden, intense, continuous chest pain
 - Crushing, pressure, tight, viselike, heavy, aching, constricting
 - “Ingestion”, “Burning” “Discomfort”
 - May radiate to neck, jaw, arm, shoulder, back
- Signs and symptoms of MI
 - Pale, cool, diaphoretic skin
 - Levine’s sign (holding chest)
 - Anxiety, feeling of impending doom
 - Duration usually >30 minutes
 - Not relieved by rest or NTG
- Associated complaints of MI
 - Nausea
 - Weakness
 - Shortness of breath
 - Palpitations

- Dizziness
- Atypical presentation of MI
 - Patients who have pain in unusual places (not chest)
 - Patients who are pain free
 - Usually elderly or diabetics whose pain mechanism not working correctly
 - Also common in women
 - Complain of shortness of breath; weakness, nausea
 - Can have AMS
 - History of very important for recognition of these patients

Treatment of Chest Pain

- Call for ALS backup
- Reduce anxiety – reassure
- Reduce activity – stair chair
- High concentration O₂
- Position of comfort
- Administer 2 baby aspirin
- Assist patient with self-administration of NTG
- Aspirin protocol
 - A mild blood thinner, keeps blood cells from “sticking” together
 - Given to AMI patients in the hopes it may relieve or limit the progression of an MI.
- Aspirin may be administered if the patient is 35 years of age or older or any patient with a cardiac history (any age)
- Aspirin is contraindicated if the patient
 - Is the hypersensitive to aspirin
 - Has had recent GI Bleeding
 - Has a bleeding disorder
 - Is taking warfarin (Coumadin)
- Nitroglycerin (NTG)
 - Sublingual tablet/spray
 - Transdermal paste/patch
 - **Vasodilates**
 - Coronary arteries allow blood to pool, decreasing preload
 - Headaches (vasodilation in head)
 - Short shell life

Heart Failure

- Reduced cardiac output leading to back-up of blood in the circulatory system
 - Chief complaint usually shortness of breath
 - Patients may have long-standing history of cardiac problems
 - Can be left-sided or right-sided
- **Right-sided heart failure (chronic)**
 - Congestive heart failure
 - Right heart backs up into the right atrium into the vena cavae into the systemic circulation

- Then, fluid leaks out of vascular space into tissues
 - Presentation
 - Jugular vein distention (JVD)
 - Paroxysmal nocturnal dyspnea
 - Orthopnea
 - Ascites, pedal edema
- **Left-sided heart failure**
 - Left heart backs up into left atrium into the pulmonary veins into the lungs
 - Presentation
 - Weakness
 - AMS
 - Fainting
 - Dyspnea on exertion
 - Rales
 - May present as wheezing early
 - Accessory muscle use/positioning
 - Pink, frothy sputum
 - Cyanosis
 - Pallor; cold, clammy, skin
 - Tachycardia
 - Onset of left heart failure
 - May be precipitated by CHF
 - MI
 - Acute chest pain
 - Shortness of breath
 - Weakness
- **Acute Pulmonary Edema**
 - Acute form of left heart failure
 - Hypertension
 - Shortness of breath
 - Rales (course, gurgling lung sounds)
 - Pink frothy sputum
 - Management of heart failure
 - Oxygen
 - Minimize activity
 - Generally transport sitting
 - If AMS, transport supine and consider ventilating
 - When everything gets slow, patient is in imminent arrest
- **Cardiogenic Shock**
 - Cardiac output is inadequate to meet the body's needs at rest
 - Most common cause is AMI
 - Greater than 40% of the left ventricle is damaged
 - Presentation
 - Pulmonary edema
 - Systemic edema (anasarca)
 - Chest pain (may have had silent MI, or have AMS)

- Management of Cardiogenic Shock
 - Standard chest pain treatment
 - Do not administer nitroglycerin
 - Do not elevate legs
 - Sitting is the position of choice, unless patient has AMS
 - Supine and ventilate

AED

- The AED is the device used to correct fatal cardiac dysrhythmias
 - Delivers an unsynchronized counter-shock to the heart muscle
 - This shock “resets” the conduction system to zero, in the hopes that it will resume normally.
- Shockable Rhythms
 - Pulseless ventricular tachycardia
 - Ventricle fibrillation

Aneurysms

- Weakened areas in the walls of arteries
 - Blood leaks into the surrounding tissue, causing a gradual loss of perfusion
 - Rupture can cause a sudden and catastrophic loss of perfusion
- **Abdominal aortic aneurysm**
 - a pulsating mass can be palpated in a small percentage
 - tearing sensation in abdomen, chest, or back
 - hypotension
 - unilateral absence of pulse
 - signs and symptoms of shock
 - history of arteriosclerosis and hypertension

Cerebrovascular Accident

- CVA or stroke is defined as a disruption of blood supply to a region of the brain that causes neurological impairment and death of brain tissue
 - Millions of people suffer new or recurrent stroke each year (internationally)
 - Nearly one quarter of these people die
- Types of stroke
 - Ischemic (85%)
 - Causes
 - Thrombus
 - Embolism
 - Occlusion
 - Hemorrhage (15%)
 - Caused by a ruptured blood vessel
- Definitions
 - **Thrombus** – deposit that forms on the wall of a blood vessel or a cavity of the heart, obstructing blood flow
 - **Embolus** – a mass of undissolved matter moving in the flow of blood through a blood vessel

- **Embolic** - obstruction of a blood vessel by a foreign substance or a blood clot which becomes lodged
- Presentation of CVA
 - Depends on location of damage, but common signs are:
 - Unilateral paralysis
 - Unilateral numbness
 - Language disturbance: aphasia, dysarthria
 - Facial droop
 - Monocular blindness: painless vision loss in one eye
 - Vertigo
 - Ataxia – poor balance, stumbling gait, staggering

Transient Ischemic Attacks

- Temporary ischemia of brain tissue
 - TIAs are to CVAs when angina is to an AMI
 - TIA has no permanent effects
 - TIA is a stroke that quickly resolves

Assessment of CVAs and TIAs

- Scene Size Up
- Initial Assessment
- Focused history and physical exam
 - Time of onset of signs and symptoms
 - Level of consciousness
 - Type of stroke (ischemic vs. hemorrhagic)
 - Location of stroke (signs and symptoms)
 - Severity of stroke
 - Glasgow coma score (3-15)
 - Eye opening
 - Verbal response
 - Motor response
 - Vital signs
 - Monitor frequently
- **Prehospital Stroke Scale**
 - Used to elicit **3 major physical findings** suggestive of stroke as well as the time elapsed from onset of signs and symptoms to EMS arrival
 - **Facial droop**
 - Have patient show teeth or smile
 - **Normal** – both sides of face move equally well
 - **Abnormal** - one side of the face does not move as well as the other side
 - **Arm drift**
 - Have the patient close eyes and hold both arms straight out for 10 seconds
 - **Normal** – both arms move the same or do not move at all

- **Abnormal** – one arm does not move or one arms drifts down
- **Speech**
 - Have the patient say “you can’t teach an old dog new tricks”
 - **Normal** – correct words and no slurring
 - **Abnormal** – slurred speech, inappropriate words/unable to speak
- **Fibrinolytic Therapy**
 - The FDA has approved the use of tissue plasminogen activator (TPA) for the treatment of ischemic stroke
 - IV administration of TPA for patients with acute ischemic stroke and no contraindications is recommended
 - Within 3 hours of onset of stroke symptoms (class I)
 - Patients treated within 3 hours of the onset of symptoms were at least 30% more likely to have minimal or no disability at 3 months compared to those treated with placebo
 - It is critical that prehospital personnel recognize and quickly respond appropriately to an acute event

Cardiovascular Trauma

- **Myocardial contusion**
 - Caused by blunt trauma to chest wall
 - Cardiac muscle is actually bruised
 - Can cause arrhythmias
 - Presentation mimics MI
- **Pericardial tamponade**
 - Caused by penetrating injury to chest, nicking pericardium, heart wall, or coronary vessel
 - **Beck’s triad** (JVD, narrowing pulse pressure, muffled heart sounds)
 - Obstructive shock
- **Traumatic Asphyxia**
 - Caused by sudden severe compression of the chest, producing increased intrathoracic pressure
 - Motor vehicle collisions
 - Trampling
 - Signs and symptoms
 - Cyanosis
 - Hemorrhage of sclera
 - JVD

Bleeding and Shock

- **Arterial bleeding**
 - Bright red, oxygen rich blood spurts from the wound
 - Difficult to control
- **Capillary bleeding**
 - Bleeds ooze and are dark red in color
 - Often clot spontaneously
- **Venous bleeding**
 - Dark, oxygen poor blood flows as a steady stream

- Can be profuse
- Easier to control due to lower venous pressure

Cardiovascular Physiology

- **Perfusion** – the constant flow of blood through the capillaries
- **Homeostasis**
 - Balanced internal environment
 - Compensatory mechanisms by which the body attempts to maintain the conditions in which it functions best
 - Temperature regulation is a homeostatic mechanism
- **Adrenaline (epinephrine)** – an autonomic nervous system compensatory mechanism – the body is reacting to a lack of adequate perfusion
 - Effects of adrenaline
 - Constricts the blood vessels
 - Increases the heart and respiratory rates
 - Increases blood flow to the brain
 - Dilates the bronchioles
 - Causes sweating
 - Dilates pupils
 - Causes nervousness
- **Blood Pressure -- Pulses**
 - Absence of radial pulse – Systolic BP of less than 80mmHg
 - Absence of femoral pulse – Systolic BP of less than 70mmHg
 - Absence of carotid pulse - Systolic BP of less than 60mmHG

Types of Shock (hypoperfusion)

- Failure of the cardiovascular and/or respiratory systems to adequately perfuse and oxygenate the tissues of the body
- Signs and Symptoms of Shock
 - Pallor
 - Altered mental status
 - Tachycardia
 - Pale conjunctiva
 - Orthostatic vital sign changes
 - Delayed capillary refill
 - Sweating
- **Hypovolemic Shock**
 - Hemorrhagic shock
 - Metabolic shock
- **Cardiogenic Shock**
- **Distributive Shock**
 - Anaphylactic shock
 - Septic shock
 - Neurogenic shock
 - Psychogenic shock
- **Obstructive Shock**

- From a cardiovascular cause
- Respiratory shock

Hemorrhagic Shock

- The form of shock that is the result of blood loss, either from trauma or a disease process
 - The natural response to bleeding is blood vessel constriction and clotting
 - Uncontrolled or significant bleeding can lead to shock or possibly death
 - Blood loss may be internal or external
- **Internal Bleeding**
 - **Signs and Symptoms**
 - Pain, tenderness, swelling, or discoloration of the suspected site of injury
 - Bleeding from the rectum, vagina, mouth, or other orifice
 - **Hematemesis** – vomiting blood
 - **Hemoptysis** – coughing up blood
 - **Hematochezia** – blood from rectum
 - **Melena** – dark stool
 - **Hematuria** – blood in urine
 - Tender and/or distended abdomen
 - Signs and symptoms of hypovolemia
- **Internal Bleeding**
 - **Bleeding Control Procedures**
 - Apply a sterile dressing and **Direct pressure**
 - **Elevate** (do not compromise other injuries)
 - **Pressure bandage**
 - **Pressure point** in extremities and head
 - **Bleeding control methods if direct pressure fails**
 - Splints
 - Air pressure splints
 - Tourniquets
- **Signs and Symptoms of Hemorrhagic Shock**
 - Remember PATPODS
 - Pale, cool, moist skin
 - Altered mental status
 - Tachypnea
 - Pale conjunctiva
 - Orthostatic vital sign changes
 - Delayed capillary refill
 - Signs and symptoms of hemorrhagic shock
 - Weak, rapid pulse
 - Nausea/vomiting
 - Thirst
 - Dilated pupils
 - Feeling of impending doom
 - Falling blood pressure (late sign)

- Infants and children can maintain their blood pressure until more than 30% of their blood volume is lost, so they are close to death by the time their blood pressure drops.

Metabolic Shock

- Results from electrolyte or plasma loss
 - Does not involve the loss of whole blood
 - occurs from dehydration, burns, and illness
- Signs and symptoms of metabolic shock
 - Furrowed tongue
 - Poor skin turgor
 - Sunken eyes
 - Presence of burns
 - Recent episodes of vomiting and diarrhea
 - Sunken fontanel in the infant

Cardiogenic Shock

- Result of a massive myocardial infarction
 - At least 40% of the left ventricle is affected
 - The heart is so badly damaged that is unable to pump effectively
 - Blood begins to back in the system
- Signs and Symptoms
 - Chest pain (may or may not be present)
 - Pressure and squeezing
 - May radiate down the arms or into the jaw or neck
 - Epigastric pain
 - Dyspnea/Orthopnea
 - Pulmonary edema
 - Diaphoresis
 - Pallor and/or cyanosis
 - Cool skin
 - Nausea/vomiting
 - Anxiety
 - Feeling of impending doom
 - Hypotension
 - Cardiac arrest
 - JVD
 - Irregular pulse rate/rhythm

Anaphylactic Shock

- A form of shock caused by a violent systemic reaction to an allergen/toxin
- The substance may be:
 - Ingested
 - Injected
 - Inhaled
 - Absorbed

- Anaphylaxis
 - The distinguishing factor between an anaphylactic reaction and anaphylactic shock is hypotension.

Septic Shock

- Caused by a systemic bacterial infection
 - Results in widespread vasodilation
 - Fluid seeps into tissues from the capillaries
 - Hypovolemic component
 - Urinary tract infections are a common cause
- Signs and Symptoms of septic shock
 - Restlessness/confusion
 - Tachycardia
 - Bruising/petechiae
 - Edema
 - Hypotension
 - High fever
 - Warm, flushed, moist skin
 - Chills

Neurogenic (Spinal Shock)

- Results from upper spinal cord injury
 - Severance
 - Severe compression
- Widespread vasodilation
- Compensatory mechanisms not activated
- **Signs and Symptoms of Neurogenic shock**
 - Dyspnea
 - Use of accessory muscles
 - Normal to slow heart rate
 - Hypotension
 - Warm, dry and possibly flushed skin below the injury
 - Loss of neurological function below the injury
 - Hypothermia

Psychogenic Shock

- Results from a transient loss of vascular tone due to an extreme emotional reaction
- Self correcting
- Cannot be distinguished from other causes of syncope in the field

Obstructive Shock

- Tension pneumothorax
 - Diminished lung sounds
 - Tracheal shift away from the affected side
 - JVD
- Pericardial tamponade
 - JVD

- Narrowing pulse pressure
- Muffled heart sounds -- which is? **Beck's Triad**

Stages of Shock

- **Compensated shock**
 - The stage of shock in which the body can still maintain the blood pressure and brain perfusion
 - **Compensated Shock – adults**
 - Systolic BP greater than or equal to 90mmHg
 - Associated sign and symptoms of shock
 - **Compensated Shock – Pediatrics**
 - Agitation
 - Tachycardia
 - Mottling
 - Cool/Cyanotic lower extremities
 - Weak or absent Peripheral pulses
- **Decompensated Shock**
 - The stage of shock in which the body can no longer maintain the blood pressure or brain perfusion
 - **Decompensated shock – adults**
 - Systolic BP less than 90mmHg
 - Associated signs and symptoms of shock
 - **Decompensated shock – pediatrics**
 - AMS/coma
 - Extensive cyanosis of all extremities
 - Weak or impalpable **central pulses**.
- **Terminal Shock (irreversible shock)**
 - **The stage of shock in which fatal damage has already occurred to major organs.**
- **Medical anti-shock trousers (MAST)**
 - MAST are a device placed over the lower half of the torso and the lower extremities used in the treatment of severe hemorrhagic shock
 - Indications for MAST
 - Adult traumatic arrest
 - Adult major blunt trauma
 - Systolic BP <50mmHG
 - Associated signs and symptoms of shock
 - Adult major blunt trauma
 - Systolic BP <90mmHg
 - Unstable pelvic fracture
 - Associated signs and symptoms of shock
 - **Absolute contraindications for MAST**
 - Cardiac related problems
 - Unilaterally decreased breath sounds
 - Pulmonary edema

- Penetrating chest trauma
- Pediatrics (under nine)
- Size (the pants do not fit the patient)
- **Relative contraindication for MAST**
 - Pregnancy
 - Do not inflate the abdominal compartment
 - Impaled object
 - Do not inflate the compartment with the object
 - Evisceration
 - Do not inflate the abdominal compartment

Behavioral Emergencies

- Behavior
 - The manner in which a person acts or performs
 - Any or all activities of a person, including physical and mental activity
- Behavioral emergency
 - Behavior that is unacceptable and/or intolerable to the patient, the family, and/or the community

Causes of Behavioral Alteration

- Common medical causes
 - Hypoglycemia
 - Hypoxia
 - Inadequate tissue perfusion
 - Head trauma
 - Vitamin deficiencies
 - Environmental emergencies
 - Hypothermia
 - Hyperthermia
 - Mind altering substances
 - Alcohol
 - Drugs
 - Organic brain syndrome
- Common psychiatric causes
 - Autism
 - Anxiety
 - Schizophrenia
 - Bipolar affective disorder
 - Situational stresses

Principles for Communicating with Behavioral Emergency Patients

- Maintain eye contact
- Be truthful
- Identify yourself
- Let patient know you are there to help
- Keep patient informed
- Calm, reassuring voice

- Non-judgmental
- Rephrase or repeat part of what patient says
- Acknowledge patient's feelings

Assessment of Behavioral Emergency Patients

- **Scene Size Up**
 - Scene safety
 - Approach every patient cautiously to protect yourself and your crew from injury
 - Make observations that relate to patient care
 - Look for evidence of substance use or abuse
 - Look for signs of violence or destruction of property
 - Examine the general environmental condition
- **Initial Assessment**
 - Assess ABCs
 - Continue to observe the patient for any clues to his underlying condition
 - Be cautious of any overt behavior
 - Determine patients mental status
 - Control the scene as soon as possible
 - Remove anyone who agitates the situation or adds confusion to the scene
 - Stay alert for signs of aggression.

Psychological Disorders

Major Types of Schizophrenia

- Paranoid – feeling of persecution
- Disorganized – displays unorganized behavior
- Catatonic – rigidity, immobility, stupor, or peculiar voluntary movements.
- Undifferentiated – does not fit into any category above.

Anxiety Related Disorders

- **Anxiety Disorder** – condition characterized by dominating apprehension and fear.
- **Panic attack** – extreme period of anxiety resulting in great emotional distress.

Diagnostic criteria for Panic Attacks

Require a discrete period of intense fear or discomfort, during which four or more of the following symptoms develop abruptly and reach a peak within ten minutes.

- Palpitations, pounding heart, or accelerated heart rate
- Sweating
- Trembling or shaking
- Sensations of shortness of breath or smothering
- Feeling of choking
- Chest pain or discomfort
- Nausea or abdominal distress
- Feeling dizzy, unsteady, lightheaded, or faint

- Derealization or depersonalization
- Fear of losing control or going crazy
- Fear of dying
- Paraesthesia (numbness or tingling sensations)
- Chills or hot flashes
- **Depression** – profound sadness or feeling of melancholy.

Screening Mnemonic for major depression: In Sad Cages:

- **Interest** – lack of
- **Sleep**
- **Appetite**
- **Depressed mood**
- **Concentration**
- **Activity**
- **Guilt**
- **Energy**
- **Suicide**
- **Bipolar disorder** – condition characterized by one or more manic episodes, with or without periods of depression.
- **Diagnostic Criteria for Bipolar Disorder**
 - Inflated self esteem or grandiosity
 - Decreased need for sleep
 - More talkative than usual or pressure to keep talking
 - Flight of ideas or subjective experience that thoughts are racing through
 - Distractibility
 - Increase in goal directed activity or psychomotor agitation
 - Excessive involvement in pleasurable activities that have a high potential for painful consequences (buying sprees, sexual indiscretions)
 - Delusional thoughts
- **Psychosis** – extreme response to stress characterized by impaired ability to deal with reality.
- **Suicide** - A person intentionally takes his or her life.
- Most common methods of suicide:
 - Bullet wound
 - Poisoning
 - Strangulation
 - Cutting
 - Other or unspecified

Managing the Violent Patient

- Spitting patients
 - Consider administering oxygen by non-rebreather
- Do not approach violent patients without PD
- Only restrain when necessary for self-protection, or at PD's request
- Restraints
 - Only soft restraints
 - PD assistance
 - Frequent reassessment of distal neurovascular and the ABCs

Obstetrics, Gynecology and Neonatology

- **Ovulation** – the release of an egg from the ovary.
- **Placenta** – the organ that serves as a lifeline for the developing fetus. The placenta is attached to the wall of the uterus and the umbilical cord.
- **Afterbirth** – the placenta and accompanying membranes that are expelled from the uterus after the birth of a child.
- **Umbilical cord** – structure containing two arteries and one vein that connect the placenta and the fetus.
- **Amniotic sac** – the membranes that surround and protect the developing fetus throughout the period of intrauterine development.
- **Amniotic fluid** – clear, watery fluid that surrounds and protects the developing fetus.

Physiological Changes of Pregnancy

- The physiologic changes associated with pregnancy are due to an altered hormonal state, the mechanical effects of the enlarging uterus and its significant vascularity, and the increasing metabolic demands on the maternal system.
- **Reproductive System**
 - Most significant changes occur in the uterus
 - Pre-pregnancy – uterus weighs 60 g (2 ounces with a capacity of approx 10cc)
 - By the end of pregnancy – uterus weighs close to 1000g (2 pounds) while its capacity is now approximately 5,000 ml.
 - During pregnancy the vascular system of the uterus contains about one-sixth (16 percent) of the mother's total blood volume.

- **Respiratory System**

- As maternal oxygen demands increase, progesterone causes a decrease in airway resistance.
- 20% increase in oxygen consumption and a 40% increase in tidal

- **Cardiovascular System**

- Cardiac output increases throughout pregnancy, peaking at 6-7 liters/minute by the time the fetus is fully developed.
- The maternal blood volume increases by 45 percent.
- Due to increase in blood volume, the pregnant female may suffer a blood loss of 30-35 percent without a significant change in vital signs.
- The maternal heart rate increased by 10-15 bpm.

- **Gastrointestinal System**

- Nausea and vomiting are common in the first trimester as a result of hormone levels and changed carbohydrate needs.
- Peristalsis is slowed and constipation and bloating are common.

- **Urinary System**

- Renal blood flow increases during pregnancy.
- Urinary frequency is common.
- The glomerular filtration rate increased by nearly 50 percent in the second trimester and remains elevated throughout the remainder of the pregnancy.

- **Musculoskeletal System**

- Loosened pelvic joints caused by hormonal influences account for waddling gait.
- Postural changes take place to compensate for anterior growth, causing low back pain.

Estimated Date of Confinement (EDC) – the approximate day the infant will be born. This date is usually set at 40 weeks after the date of the mother's last menstrual period (LMP)

Stages of Development

1. **Pre-embryonic stage** - Covers the first 14 days following conception.
2. **Embryonic Stage** – Begins at day 15 and ends approximately 8 weeks.
3. **Fetal Stage** – The period from 8 weeks until delivery.

Some Significant Milestones

- **16 weeks gestation** – the sex of the infant can usually be determined.
- **20th week of gestation** – Fetal heart tones can be detected by stethoscope and movement can be felt.
- **24th week of gestation** – Baby may be able to survive if born prematurely.
- **28th week of gestation** – Baby has excellent chance of survival if born.
- **38th week of gestation** – Baby is considered term, or fully developed.

- **Complications of Pregnancy**

- **Trauma**

- Apply a C-collar to provide cervical stabilization and immobilize on a long backboard.
- Administer high flow, high concentration oxygen.
- Initiate two large bore IVs for crystalloid administration per protocol.
- Transport tilted to the left to minimize supine hypotension.
- Reassess frequently.
- Monitor the fetus.

- **Causes of Bleeding During Pregnancy**

- Abortion

- Ectopic pregnancy
 - Placenta previa
 - Abruptio placentae
- **Abortion** – termination of pregnancy before the 20th week of gestation. The term “abortion” refers to both miscarriage and induced abortion. Commonly, “abortion” is used for elective termination of pregnancy and “miscarriage” for the loss of a fetus by natural means. A miscarriage is sometimes called a spontaneous abortion.
 - **Ectopic Pregnancy** – The abnormal implantation of the fertilized egg outside of the uterus.
 - **Placenta Previa** – Occurs as a result of abnormal implantation of the placenta on the lower half of the uterine wall, resulting in partial or complete coverage of the cervical opening.
 - **Abruptio Placentae** – the premature separation (abruption) of a normally implanted placenta from the uterine wall, poses a potential life threat for both mother and fetus.

Medical Complications of Pregnancy

- **Hypertensive Disorders**
 - **Supine Hypotensive Syndrome**
 - **Gestational Diabetes**
- **Hypertensive Disorders** – Pregnancy induced hypertension (PIH), which includes preeclampsia and eclampsia, occurs in approximately 5% of all pregnancies.
 - **Preeclampsia** - is a progressive disorder and is defined as an increase in systolic blood pressure by 30mmHg and/or a diastolic increase of 15mmHg over baseline or at least two occasions at least six hours apart. **** Remember that blood pressure drops in pregnancy so a blood pressure of 140/90 may be considered hypertensive.**
 - **Eclampsia** – Characterized by grand mal seizures. Also preceded by visual disturbances, development of epigastric pain. Patient becomes edematous and markedly elevated blood pressure.
 - **Supine Hypotensive Syndrome** – Also known as vena cava syndrome, supine hypotensive syndrome occurs when the gravid uterus compresses the inferior vena cava when the mother lies in a supine position.
 - **Crowning** – the bulging of the fetal head past the opening of the vagina during a contraction. Crowning is an indication of impending delivery.
 - **Effacement** – the thinning and shortening of the cervix during labor.

- **Tocolysis** – the process of stopping labor.
- **Puerperium** – the time period surrounding the birth of the fetus.
- **Labor** – the time and processes that occur during childbirth; the physiologic and mechanical process in which the baby, placenta, and amniotic sac are expelled through the birth canal.

Stage One (Dilation)

Stage Two (Expulsion)

Stage Three (Placental)

- **Field Delivery**
 - Prepare area for delivery
 - Administer oxygen
 - Start IV access and infusion of normal saline
 - Place patient on back with knees and hips flexed and buttocks slightly elevated.
 - Monitor fetal heart beat
 - Prepare OB Kit
 - When head crowns; control it with gentle pressure
 - Support head as it emerges
 - Suction the mouth and then the nose.
 - Clamp and cut the cord.
 - Dry the infant and keep him/her warm.
 - Deliver the placenta and save for hospital.
 - Do not delay transport for delivery of the placenta
- **Neonate** – newborn infant
- **Abnormal Deliveries**
 - General Treatment for all abnormal deliveries
 - Administer high concentration oxygen to the mother
 - Prolapsed cord
 - The cord presents through the birth canal before delivery of the head
 - Specific treatment
 - Position mother with head down/buttocks raised using gravity to lessen pressure
 - Insert sterile gloved hand into vagina pushing the presenting part of the fetus away from the cord until a pulse is felt
 - Wrap saline-moistened sterile dressings around the cord
 - Breech Presentation
 - The buttocks or both legs are the presenting part
 - Specific treatment
 - Support the thorax of the newborn as it delivers
 - A full delivery may occur

- If the head does not deliver, place sterile gloved fingers between the newborn's face and the wall of the birth canal to establish an airway
- **Limb Presentation**
 - A limb is the presenting part
 - The delivery cannot occur, and a cesarean section will be necessary
 - Raise the mother's hips and legs, and transport immediately
- **Multiple births**
 - Clamp and cut the cord of each delivered newly born before the delivery of the next baby.
 - Be prepared for multiple resuscitations
 - If the next birth does not occur after 10 minutes, follow local protocol concerning transport and medical control contact
- **Meconium staining**
 - Amniotic fluid that is greenish or brownish yellow rather than clear
 - An indication of possible fetal distress during labor
 - Do not stimulate before suctioning
 - Suction thoroughly
 - Maintain the airway
- **Premature Births**
 - Less than 37 weeks (8 months gestation or less than 5 pounds is considered premature)
 - Always at risk for hypothermia
 - These patients usually require aggressive resuscitation
 - Resuscitation should be performed unless physically impossible
- **Stillbirths**
 - The fetus died while within the womb
 - Tissue decomposition will have occurred
 - Do not attempt to resuscitate this birth
 - Ensure that all expelled material is transported to the hospital with the mother
 - Be prepared for extreme emotional distress from the parents

Allergies, Seizures, and Poisonings/Overdoses

Allergic Reaction

- An acquired, abnormal immune response to a substance (allergen) that does not normally cause a reaction
- Sensitization, or an initial exposure to the allergen, is required
- Subsequent contact with the allergen then results in a broad range of inflammatory responses
- Reaction may be mild or so severe it is life threatening

The Immune System

- The immune system protects the body from foreign material or ANTIGENS by releasing proteins or antibodies.
- A reaction may occur the second time a person is exposed to a particular allergen or may not occur until years later when repeated exposures have produced sufficient antibodies.
- **Pathophysiology**
 - Histamines release (from WBC's) causes vasodilation and "leaking" blood vessels
 - Results in skin redness, hives or Urticaria
- **Respiratory System**
 - tightness in throat/chest
 - cough
 - rapid breathing
 - labored breathing
 - noisy breathing
 - stridor
 - wheezing
 - hoarseness
 - if tissue swelling occurs in the tongue, lips Oropharynx or larynx it can cause life threatening airway compromise
 - stridor is commonly heard in these patients
 - an early sign or airway narrowing may be recognized as wheezing
- **Circulatory**
 - **Increased heart rate**
 - **Decreased blood pressure**
- **Generalized Findings**
 - Itchy, watery eyes
 - Headache
 - Sense of impending doom
 - Runny nose
 - Decreasing mental status

Anaphylaxis

- Severe form of allergic or hypersensitivity reaction to an allergenic antigen
- Patient has come in contact with substance that caused past allergic reaction and complains of respiratory distress or exhibits signs and symptoms of shock/hypoperfusion (anaphylactic shock).
- Anaphylactic Shock
 - System anaphylaxis that produces life threatening changes in circulation and bronchioles consistent with shock.
 - Generalized vasodilation, as the result of histamine release, can cause hypotension
 - This combined with airway compromise, is a life threatening emergency.

Seizures

- Sudden change in sensation, behavior, or movement, usually related to brain malfunction that can be the result of disease, infection, or injury to brain tissue.

- More severe forms characterized by violent muscle contractions call convulsions
- May be brief or prolonged
- Although brief seizures are not harmful, there may be a more dangerous underlying condition
- Rule of trauma – head injury can cause seizures

Causes

- Idiopathic
 - Epilepsy: medical disorder characterized by episodic or sudden onset attack of unconsciousness, with or without convulsions
- Fever (febrile pediatric)
 - Fast rising temperature (spiking)
 - Occurs in 5% of children
 - Generally 6 months to 6 years old
 - Generally siblings will also have febrile seizures
 - Seizures usually subside when fever goes down
- Infection (meningitis)
- Poisoning
- Hypoglycemia
- Trauma (head trauma)
- Decreased levels of oxygen (hypoxia)

Types of Seizures

- Petit mal seizures
 - Characterized by periods where the patient appears to be “daydreaming”
 - The eyelids may flutter, the patient may not be aware that it happened, and there is no loss of consciousness
 - Primarily a disorder of children
- Focal motor
 - Characterized by dysfunction of one area of the body
 - Can often progress to generalized seizure activity
- Psychomotor (Temporal lobe)
 - Characterized by distinct auras
 - Smells
 - Tastes
 - Auditory hallucinations
 - Visual disturbances that include the appearance of scenes that are strange or familiar (déjà vu)
- Grand Mal
 - A seizure involving the entire body
 - Also called tonic/clonic seizures
- Status epilepticus
 - A seizure lasting more than five minutes and/or two or more consecutive seizures with no lucid interval between them

- **Phases of Grand Mal Seizures**
 - Aura
 - Precedes seizure activity
 - Usually a psychic or sensory event with auditory, olfactory, visual or taste hallucinations
 - Hypertonic (5-15 seconds)
 - Period when the patient is rigid with an arched back
 - Clonic (1-5 minutes)
 - Alternating contraction and relaxation of muscles
 - Tonic (15-20 seconds)
 - General body stiffness
 - Postictal state
 - Refers to the period of time between the end of seizure activity and when the patient becomes fully alert
 - This may take anywhere from a few minutes to a few hours

- **Signs and Symptoms**
 - Mood changes
 - Confusion
 - Blurred vision
 - Frothing at the mouth
 - Clenched jaw
 - Loss of bladder control (incontinence)
 - Mouth injuries
 - Aspiration
 - Periods of apnea – most serious problem

- **Emergency Medical Care**
 - Protect the patient from injury
 - Maintain an airway
 - Insert nothing into the mouth expect an OPA
 - Suction when possible
 - Ventilate if necessary
 - Reassess the patient
 - Transport

Poisonings and Overdoses

- Poison – a substance that has an adverse effect on the body
- Overdose – results when a drug is taken in excess or in combination with other agents, to the point where poisoning occurs
- Poisons enter the body
 - Ingestion
 - Injection
 - Inhalation
 - Absorption

Ingestion Poisonings

- Most common route
- Effect may be immediate or delayed
- Effects may be local or systemic
- Medication Overdoses
 - **Depressants**
 - Sedatives
 - Hypnotics
 - Antianxiety agents
 - opioids (narcotics)
 - **Signs and symptoms of depressant OD**
 - respiratory depression
 - altered mental status
 - pinpoint pupils (narcotics)
 - **Stimulants**
 - Amphetamines
 - Methylphenidate
 - Cocaine
 - **Signs and symptoms of stimulant OD**
 - Seizures
 - Tachycardia
 - Hypertension
 - Chest pain
 - Anxiety
 - Delirium
 - Paranoia
 - Psychosis
 - Violence
 - **Psychiatric Medications**
Signs and Symptoms of psychiatric medication
 - muscle spasms
 - dry skin
 - change in temperature
 - change in blood pressure
 - abnormal heart rhythms and rates
 - respiratory depression
 - AMS
 - Seizures
 - Coma
 - Cardiac arrest
- Analgesics
 - Acetaminophen
 - Salicylates (aspirin)
 - APAP (acetaminophen)
 - Hepatotoxic

- Signs and Symptoms of analgesic OD
 - Tachypnea
 - GI distress
 - Decreasing mental status
 - Coma
- Hallucinogens
 - Similar to stimulants
 - Alter perception
 - LSD
 - PCP
- Signs and Symptoms of hallucinogen OD or “bad” hallucinogen use
 - Hypertension
 - Tachycardia
 - Anxious
 - Paranoid
- Alcohol (ETOH)
 - Most commonly abused substance in US
 - Depressant-potentiates depressant drugs
 - Toxicity can lead to coma and/or respiratory failure
 - High risk of aspiration and airway/respiratory compromise
 - Methanol (windshield wiper fluid, sterno)
 - Ethylene glycol (antifreeze)
 - Both can present as mild inebriation
 - Both treated with ethanol (drinking alcohol)
 - Many medical/trauma problems can be masked by intoxication
- Many other problems can mimic intoxication
 - Diabetic emergency
 - CVA
 - Head Injury
 - Epilepsy
 - Hypoxia
 - Drug overdose
- Food Poisoning
 - Caused by bacteria, toxins, viruses
 - Suspect when two or more person have symptoms after eating some food
- Signs and Symptoms
 - Nausea
 - Vomiting
 - Violent diarrhea
 - Botulism is the most severe form of food poisoning
- General signs/symptoms of ingest poisons
 - Nausea
 - Abdominal pain
 - Difficulty breathing

- Vomiting
- Diarrhea
- AMS
- Chemical burns around mouth
- Breath odors
- Treatment of Ingested Poisons
 - A,B,C's
 - Remove substance from patient's mouth PRN
 - Transport
 - Collect substance/container and take to hospital
- **Injected Poisons**
 - IV drug abuse
 - Heroin
 - Cocaine
 - Amphetamines
- **Envenomation**
 - Snakes
 - Bees
 - Spiders
 - Some sea creatures

Signs/Symptoms of injected poisons

- Animal
- Weakness
- Dizziness
- Chills
- Fever
- Nausea
- Vomiting
- Chemical
- Pinpoint pupils
- Nausea
- Vomiting
- AMS
- Depressed respiratory drive
- Treatment of Injected Poisons
- Insect
 - If stinger present, scrape along skin with edge of stiff card
 - Cover with sterile dressings
 - Apply cold compresses to site
- Marine
 - Remove stinging bristles with adhesive tape
 - Wipe with alcohol
 - Cover with sterile dressing
- Snakebite

- Keep site lower than heart
- Cover with sterile dressing
- Immobilize area
- Restrict patient activity
- Do not apply a tourniquet
- Transport to venomous bite center
- **Inhaled Poisons**
 - Poisonous gases
 - Displace oxygen
 - Cause chemical reactions
 - Irritate respiratory tract
 - Oxygen Displacers
 - Carbon monoxide
 - Methane
 - Chemical Reactors
 - Cyanide
 - Hydrogen sulfide
 - Irritants
 - Sulfur dioxide
 - Ammonia
 - Hydrogen chloride
 - Chlorine
 - Phosgene
 - Sodium hypochlorite
- **Signs/Symptoms of inhaled poisons**
 - Cough
 - Hoarseness
 - Confusion
 - Seizures
 - AMS
 - Difficulty breathing
 - Chest pain
 - Dizziness
 - Headache
- **Absorbed Poisons**
 - Entry directly through skin surface
 - Agents
 - Plants
 - Chemicals
 - Insecticides
- **Signs/Symptoms of absorbed poisons**
 - Liquid or powder of patient's skin
 - Burns
 - Redness

- Itching
- Pain
- Irritation
- Difficulty breathing
 - Organophosphates/Insecticides
 - Bronchoconstriction
 - Pulmonary secretions
 - SLUDGEM (parasympathetic release)
 - Salivation
 - Lacrimation
 - Urination
 - Defecation
 - Gastrointestinal distress
 - Emesis
 - Muscle twitching/seizures

Chemical Decontamination

- Dry
 - Remove decontaminated clothing
 - Brush as much from skin as possible
 - Flush skin with copious amounts of water for at least 10 minutes
- Wet
 - Remove contaminated clothing
 - Blot as much from skin as possible
 - Flush skin with copious amounts of water for at least 10 minutes
 - Cover with sterile dressing
- Treatment of eyes
 - Eyes must be flushed with copious amounts of water for at least 20 minutes
 - Flush from bridge of nose to affected eye
 - Hold eye open as needed

Diabetes and AMS

- **Diabetes**
 - Glucose metabolism
 - Normally, food is converted to glucose, which travels across the cell membranes with the assistance of insulin and is used for energy
 - Excess glucose is stored as glycogen and fat
- **Glucose**
 - A sugar molecule in a form that is used by cells for energy
 - Medically, synonymous with dextrose
- **Glycogen**
 - Glucose converted by tissues for storage
- **Diabetes mellitus**

- a chronic disorder of carbohydrate metabolism characterized by hyperglycemia and Glycosuria and resulting from inadequate production or utilization of insulin
- In diabetics, glucose cannot cross cell membranes in sufficient quantities to provide energy, because of the lack of adequate insulin
- **Hyperglycemia**
 - Increase of blood sugar (glucose)
- **Glycosuria**
 - the presence of glucose in the urine
- **Insulin**
 - A hormone secreted by the beta cells of the Islets of Langerhans of the pancreas
 - Essential for the proper metabolism of blood sugar (glucose)
 - A preparation used in medical treatment of diabetes
 - Prepared synthetically or from animal pancreas, usually pork or beef
- **Classifications of DM**
 - Type I: Insulin-dependent diabetes mellitus
 - Usually prevalent in younger patients
 - The pancreas either does not produce any insulin or the insulin is defective
 - These patients take insulin injections once or twice a day
 - Insulin must be kept refrigerated
 - Check the refrigerators of patients with altered mental status
 - Type II: non-insulin dependent diabetes mellitus
 - The pancreas does produce insulin, but not enough to meet the needs of the body
 - Onset usually occurs in older patients (>25 years old)
 - More common than type I
 - These patients take oral medications (Tolinase, Diabinese, Glucotrol)
- **Emergencies Associated with Diabetes**
 - **Hyperglycemia**
 - Excessive blood sugar (glucose)
 - Glucose unable to cross cell membrane to provide tissues with energy
 - Occurs in undiagnosed diabetics or patients who fail to take adequate medication to balance food intake
 - Gradual onset
 - Increases susceptibility to infection
 - **Pattern of onset**
 - The patient eats, the food turns to sugar and enters the blood stream
 - The sugar level in the blood rises higher and higher without insulin
 - The sugar in the blood cannot cross the cell membranes, and stays circulating
- **Diabetic Ketoacidosis (DKA)**
 - Can result from long-term extreme hyperglycemia

- Acidosis occurring in advanced stages of uncontrolled diabetes mellitus due to accumulation of ketone bodies
- Occurs when fats breakdown to form energy because of inadequate insulin to process glucose
- **Signs and Symptoms**
 - **Polyuria**
 - the kidneys filter the excess sugar out of the blood and the patient urinates
 - The longer the problem continues, the more the patient urinates
 - **Polydipsia**
 - The frequent urination causes dehydration
 - The fluid loss causes a feeling of intense thirst, causing the patient to drink
 - **Polyphagia**
 - Since the cells are not getting the sugar they need, the brain tells the patient to eat
 - Because the tissues and organs are not receiving fuel, they break down fats and the organs themselves for energy
 - **Ketones**
 - This produces ketones that are exhaled and causes fruity, sweet breath (acetone)
 - Excess ketone production causes acidosis, which the body tries to correct by hyperventilation
 - **Kussmaul's Respirations**
 - Insufficient sugar to the brain results in AMS and can lead to coma
 - Gradual onset
- **Hypoglycemia**
 - **Insulin shock” is extreme form**
 - Condition in which the glucose in the blood is abnormally low
 - Occurs in anyone with insufficient food intake
 - Can be caused by exertion (using up available glucose)
 - Can be caused by excessive insulin
 - Can be caused by stress
 - **Onset of hypoglycemia**
 - Rapid onset of altered mental status
 - After missing a meal but taking insulin
 - After vomiting but taking insulin
 - After an unusual exercise or physical work episode
 - May occur with no identifiable predisposing factor
 - Hypoglycemia is the most common pre-hospital diabetic emergency encountered
 - Prolonged hypoglycemia will result in brain injury
 - it is true medical emergency
 - **Signs and symptoms**

- Intoxicated appearance, staggering, slurred speech to complete unresponsiveness
- Elevated heart rate
- Cold, clammy skin
- Profuse sweating
- Hunger
- Seizures
- Uncharacteristic behavior
- **Altered Mental Status (AMS)**
 - A mental status which is different from the patient's normal mental status
 - Caused by a variety of conditions
 - Hypoglycemia
 - Hyperglycemia
 - Poisoning
 - Post seizure
 - Infection
 - Head trauma
 - Decreased oxygen level
 - Mental status is the most highly sensitive indicator of hypoxia, hypoglycemia, head injury, and many other pathologies
 - AMS should be considered a sign of a life-threatening condition until proven otherwise

Environmental Emergencies

Thermoregulation

- 2nd law of thermodynamics
 - Heat flows from a warmer to a colder body until temperature is equal
- The body regulated temperature at 98.6F (37C)
- Body mechanisms for temperature regulation
 - Neurological system
 - Hypothalamus
 - Controls metabolic rate
 - Heat production
 - Cardiovascular system
 - Heat distribution
 - Via blood through vasculature
 - Integumentary system
 - Vasoconstriction/vasodilation
 - Perspiration
- Heat generation
 - Basal metabolism
 - Muscular activity (exercise or shivering)
 - From environment

Cold Emergencies

Hypothermia

- Abnormally low body temperature
 - Body temperature below 95F (35C)
- Body's ability to produce and regulate heat unable to meet environmental conditions
 - Does not require extreme cold to develop
- Signs and Symptoms
 - Shivering
 - Amnesia
 - Slurred speech
 - Irrational behavior/AMS
 - Stupor
 - Coma
 - Clumsiness leads to stiffness leads to muscle rigidity
- NYC protocol
 - Remove patient from cold
 - Prevent further heat loss
 - ABCs
 - Oxygen (humidified preferred)
 - Remove wet clothing/apply dry blankets
 - Rewarm based on mental status
 - Alert and responding appropriately
 - Actively rewarm patient
 - Head packs
 - Groin
 - Lateral chest
 - Neck
 - Increase heat in patient compartment
 - Unconscious or inappropriate responses
 - Passive rewarming slowly
 - Blankets
 - Nothing by mouth
 - CPR/defibrillation PRN
 - Longer pulse check
 - Maximum of three shocks
 - Protocol
 - Do not allow patient to
 - Smoke
 - Drink alcohol
 - Drink caffeinated beverages

Frostnip

- Mild form of cold injury
 - Caused by intense vasoconstriction
 - Completely reversible
 - Generally in areas farthest removed from body core

- Signs and Symptoms
 - Sudden blanching of skin
 - Loss of feeling, numbness
 - Sensation of cold
 - Skin not hardening
 - On rewarming
 - Redness
 - Tingling
 - Itching
- Protocol
 - Remove from cold
 - ABCs/oxygen
 - Remove clothing and jewelry
 - Splint and cover extremity
 - Do not rub, massage, or expose to cold
 - Damages tissues

Frostbite

- Exposed or distal areas usually affected
- Water within the cells freezes and damages the cell membranes
- Cold burn
- Signs and symptoms
 - Skin white, waxy, firm to touch
 - Tissues beneath soft and resilient
 - After thawing, skin flushed or mottled
 - Edema and blisters 2 capillary leakage

Heat Emergencies

- Systemic
 - Heat cramps
 - Heat exhaustion
 - Heat stroke
- Local
 - Burns
 - Thermal
 - Chemical
 - Electrical
 - Radiation

Heat Cramps

- Acute painful spasms of voluntary muscles
 - Following exercise in a hot environment
 - Inadequate fluid and salt intake
- Signs and symptoms
 - Muscle cramping in heavily used muscles
 - Pallor
 - Diaphoresis
 - Dizziness
 - Thirst

- Treatment
 - Remove patient to cooler environment
 - Replace fluid and salt (usually oral)
 - Stretch muscle

Heat Exhaustion

- Acute Response to heat exposure
 - Body still attempting to control its temperature
 - Body unable to maintain cardiac output to meet demands of all systems
 - Signs and symptoms are related to inadequate blood flow
- Signs and symptoms
 - Moist, hot, pink skin if vasodilation is being accomplished
 - Ashen and cool if skin is not being perfused
 - Orthostatic vital sign changes
 - Weakness/exhaustion
 - Dizziness/faintness
 - Headache
 - Nausea
- Treatment
 - ABCs
 - Rapid reduction of core temperature
 - Wet sheets
 - Fan
 - Ice packs
 - Neck
 - Armpits
 - Groin
 - Cautions
 - Hyperthermia can become hypothermia
 - Ice can cause shivering
 - Do not wipe with alcohol

Burns

- Burns characterized by degree
- Measured by depth of burn
 - 1st, 2nd, and 3rd degree burns all have to do with skin
- **First degree burns (superficial)**
 - Only epidermis affected
 - Sunburn is most common form
 - Will occur at periphery of more severe burns
 - Skin reddened, dry & Warm
 - Slight edema
 - Heal spontaneously
 - Not included in estimating extent of burn injury (no loss of skin function)
- **Second degree burns (partial thickness)**
 - Epidermis and part of dermis affected
 - Flash injuries and spill scalds
 - Sensation/pain varies with depth of burn

- May be moist and weeping (leaking plasma)
- Pink, red and botchy to pale and colorless
- Edema
- Blister formation
- Can heal spontaneously
- **Third degree burns (full thickness)**
 - Full thickness of epidermis and dermis
 - Heat
 - Exposure to flames
 - Immersion
 - Will not heal spontaneously
 - Cells destroyed
 - Needs grafting
 - Skin charred, darkly colored, or white
 - No pain or sensation (nerves are destroyed)
 - Skin dry, leathery
 - No elasticity, no resilience
 - Can restrict blood flow, chest expansion
- **Rule of 9s – Adults**
 - Head – 9
 - Arms – 9 – 9
 - Legs – 18 – 18
 - Chest 9 – 9
 - Abdomen – 9 – 9
 - Groin – 1
- **Pediatrics**
 - Head – 9- 9
 - Chest – 9 - 9
 - Abdomen 9 – 9
 - Legs – 13. 5 – 13. 5
 - Arms – 9 – 9
 - Groin – 1

Critical Burns

- **Adults**
 - 3rd Degree hands, feet, face genitalia
 - 3rd Degree – 10% BSA
 - 2nd Degree – 20% BSA
- **Pediatrics**
 - Any burn: hands, feet, face, genitalia
 - 3rd degree: any
 - 2nd Degree > 20% BSA (cool only 20% BSA at a time)
- **NYC Burn Center Criteria**
 - Burns covering >15% of the BSA
 - 3rd degree burns > 5% of the BSA
 - Burns covering >9% of the BSA in patients
 - Under 5

- Over 60
 - With pre-existing condition that is known to inhibit healing
- Respiratory burns
- Electrical burns
- Any burn involving
 - Eyes, ears or face
 - Hands or feet
 - Genitalia
- Any burn with associated trauma

Electrical Burns

- Effects are either from current directly or from thermal energy production
 - Possibility of dysrhythmias
- Complicating factors
 - Greater voltage means greater injury
 - A/C (household current) more dangerous than D/C
 - Electricity follows along the path of lowest resistance, seeks ground
 - Vasculature
 - Nerves
 - There is an entrance and exit wound
- Lighting
 - Cardiac dysrhythmias may spontaneously resolve
 - Respiratory arrest may outlast cardiac arrest
 - Medullar respiratory center paralyzed
 - Duration of apnea is critical factor

Chemical Burns

- Fewer than 5% of admissions to burn centers
 - Most often face, eyes, and extremities
 - Wounds are small, but take longer to heal
 - Skin damage may appear like thermal burns
 - Don't be fooled by apparently mild injury

Smoke Inhalation and Respiratory Burns

- Fire interferes with oxygen supply in 4 ways
 - Consumes oxygen
 - Produces CO
 - 200x greater affinity to hemoglobin than oxygen
 - Damages tissues
 - Prevents them from being able to conduct gas exchange
 - Damages airway itself
 - Edema creates anatomical obstruction
- **Smoke**
 - Hot air with:
 - Noxious gases
 - Small particles
 - Toxic chemical
 - Smoke steam, and superheated air injure respiratory tract

- Upper airway unable to regulate temperature
 - Looses ability to protect lower airway
- Airway is better able to regulate hot dry air than steam

CO Poisoning

- Frequently misdiagnosed
- Chief complaints vague
 - Nausea
 - Headache
 - Cherry red color is a late sign
 - Often post mortem
- Signs and symptoms
 - Singed nasal hairs
 - Carbonaceous sputum – black sputum
 - Burns to mouth and nose
 - Respiratory distress
 - Hoarseness, stridor
 - Wheezing

Radiation

- Ionizing radiation
 - Converts atoms to ions
 - Nuclear weapons
 - Reactors
 - Radioactive material
 - X-rays
- Non-ionizing radiation
 - Does not convert
 - Light waves
 - Radio waves
 - Microwaves
- **Types of Ionizing Radiation**
 - Alpha and beta particles
 - Contamination
 - Gamma waves
 - Irradiation
 - **Alpha particles**
 - Weakest and least penetrating
 - Travel a few centimeters in air
 - Stopped by paper, clothing, epidermis
 - If ingested, inhaled or absorbed through broken skin
 - Can affect nearby tissues
 - Vomit treated as hazard
 - **Beta particles**
 - Stopped in dermal layer of skin
 - Not stopped by standard clothing
 - Travel from 1 to several feet in air

- Similar to thermal burns if left on skin
- Vomitus treated as hazardous
- **Gamma Rays**
 - High energy electromagnetic rays
 - Pure energy
 - Travel long distances
 - Penetrate most materials with ease
 - Stopped by lead
 - Damages cells
 - Victim is not contaminated and is not a danger to others

Barotrauma

- Descent injuries
 - Pressure differential in body's air filled cavities
 - Tissue damage from contraction or expansion of gas
 - Most often occurs in ears or sinuses
- Ascent injuries
 - Decompression sickness ("the bends")
 - Nitrogen bubbles form in tissue and blood on rapid ascension
 - CVA
 - Pulmonary embolism

Drowning

- Death by asphyxia resulting/from submersion incident with a return of vital signs
- Causes
 - Swimmers overestimate endurance
 - Intoxication
 - Non-swimmers fall in water
- Dry versus wet drownings
 - Dry (10-15%)
 - Laryngospasm
 - Wet (85-90%)
 - Aspiration
 - Both cause hypoxia
- Salt water versus fresh water drownings
 - **Salt water**
 - Water osmoses into lungs
 - Pulmonary edema
 - Shunting
 - Hemoconcentration and crenation
 - **Fresh Water**
 - Water osmoses in blood
 - Hemolysis
 - Surfactant washout
 - Alveoli collapse
 - Hemodilution

- Both will result in a lack of oxygen

Soft Tissue and Abdominal Injuries

- Function
 - Protection
 - Barrier
 - Waterproof
 - Shock absorber
 - Melanin
 - Temperature regulation
 - Blood vessels constrict to minimize heat loss
 - Dilate when the body needs to give off heat
 - Sensory Organ
 - Nerve endings that respond to stimuli related to touch, temperature, pressure and pain

Layers of the Skin

- **Epidermis**
 - outer most layer
 - nonvascular
 - semi-permeable
 - melanin
- **Dermis**
 - Deeper layer
 - Blood vessels
 - Regulate body temperature
 - Sensory nerves
 - Moisturizes skin
 - Sweat and sebaceous glands
- **Subcutaneous Fat Layer**
 - Body insulator
 - Fat can be utilized for energy as needed

Closed Wounds

- **Contusions**
 - A bruise
 - Capillaries or larger vessel may leak or rupture
 - Signs and Symptoms
 - Tenderness
 - Pain
 - Slight swelling
- **Hematoma**
 - Blood collected beneath the skin
 - Usually clotted, causes swelling
- **Crushing**
 - Can be opened or closed
 - Mechanism of injury important
 - Be aware that there may be underlying injuries

- **Ecchymosis**
 - Bleeding beneath or within the layers of the skin causing discoloration
 - Also known as black and blue

Open Wounds

- **Abrasions**
 - Scraping of the surface causing oozing of blood
- **Lacerations**
 - Tearing of the skin, uneven cut
- **Punctures**
 - sharp instrument penetrates through the skin
 - wound may appear small
 - severe internal damage to vessels and organs
- **Avulsions**
 - Complete
 - Tearing away of the skin
 - Incomplete
 - Tearing of the skin in which a flap is still attached

Dressings and Bandages

- Stop or control any bleeding
- Prevent any further contamination
- Protect the wound from any further damage
- Dressings
 - Any material used to cover a wound
 - Ideally all dressings should be sterile
 - Vary in size and thickness
 - 4X4
 - 8X10
 - Multi Trauma
 - Occlusive
 - Airtight dressing usually using sterile plastic wrap or aluminum foil
 - Bandages
 - Holds dressing in place
 - Must be tight enough to/control bleeding but not to tight as to where circulation is cut off
 - Gauze roll
 - Triangular
 - Adhesive tape

Care for Open Wounds

- Direct Pressure
- Elevation
- Pressure Point
- Pressure Bandage
- Wounds with special considerations
 - **Nose**

- Mainly made up of cartilage
- **Epistaxis:** nosebleed
- **Treatment**
 - ABCs
 - Direct pressure: pinch nose
 - Keep patient sitting up and leaning forward
 - Pressure point: superior labial artery
- **Avulsed or extruded eye**
 - Cover with moist sterile dressing
 - Secure in place with a cup
 - Bandage both eyes to prevent sympathetic movement
 - Make sure not to apply pressure to the eyes
- **Impaled object**
 - Do not remove
 - The only time to remove a impaled object is when the airway is compromised by the object
 - Secure with a bulky dressing
 - Only impaled object you removed is one impaled in the cheek.
- **Amputations**
 - Cutting away from the body of a limb or a protruding part
 - The care provided for stump and amputated part very important in Replantation
 - **Treatment**
 - Control bleeding
 - Try to elevate stump above the heart
 - Moisten a sterile dressing and apply to stump and cover with a dry bandage
 - Wrap amputated part in a sterile moistened dressing
 - Place amputated part in a plastic bag or container and place it on ice or cold packs
 - Do not freeze amputated part

Neck Wounds

- Open neck wounds should be covered with occlusive dressing and taped on all 4 sides to prevent air embolism

Chest Wounds

- Open wounds to the chest due to penetrating trauma should be sealed with an occlusive dressing and sealed on 3 sides

Injuries to the Abdomen and Groin

- Location is from the diaphragm to the groin
 - The diaphragm separates the abdominal cavity from the thoracic cavity
 - Anterior muscles
 - Posterior muscles

- Peritoneal membrane

Damage to Organs

- When ruptured, hollow organs spill their contents into the peritoneal cavity causing extreme pain and rigidity
 - Peritonitis
- Solid organs are most susceptible to laceration as the result of blunt trauma
 - When lacerated, they cause bleeding which results in abdominal distention
- **Solid Organs**
 - Liver
 - Spleen
 - Pancreas
- **Hollow Organs**
 - Gallbladder
 - Stomach
 - Small intestine
 - Large intestine
 - Bladder

Retroperitoneal Cavity

- Located between the peritoneal membrane and posterior muscles
- It contains
 - Kidneys and ureters
 - Adrenal glands
 - Aorta
 - Inferior vena cava

Open/Penetrating Abdominal Trauma

- May be caused by:
 - Gun shot wounds
 - Stab/puncture wounds
 - Deep lacerations
- Penetrating trauma not only damages the superficial tissue, it also damages the underlying organs
 - Bullets seldom travel in a straight line

Eviscerations

- A protrusion of abdominal organs, such as the intestines, through the abdominal wall
- Treatment for eviscerations
 - Do not replace the organs in the abdomen
 - Do not touch the protruding organs
 - Suspect shock
 - Cover the organs(s) using moist sterile dressing
 - Cover with a bulky dressing
 - Wrap the dressing in place with an occlusive dressing

Closed/Blunt Abdominal Trauma

- May be caused by
 - Baseball bat
 - Pipe
 - Fist/foot
 - Steering wheel

Injuries to the Liver and Spleen

- Very difficult to detect
- Treatment based on mechanisms of injury
- Look for signs of shock
- Liver may contain up to 25% of the patients blood

Ruptured Urinary Bladder

- Apt to be ruptured or lacerated because of its location, especially if it is distended
- The nature associated injuries will dictate treatment

Injuries to Kidneys

- Signs and symptoms
 - Bruises over the flank
 - Bruises over the posterior lower rib cage
 - Penetrating injuries of the lower back

Abdominal Trauma: Common Complaints

- Pain radiating to the left shoulder
 - Usually indicated blood beneath the diaphragm
 - Seen in patient with ruptured spleen
 - Signs and symptoms of shock
 - Tender abdomen
 - Nausea and vomiting
 - Skin wounds and penetrations
 - Ecchymosis
 - **Hematuria: blood in the urine**
 - **Hematemesises – vomiting blood**
 - Rigidity of abdomen
 - Suggests spilled digestive juices
 - “Guarded position”
 - knees brought up to the chest, fetal position

Musculoskeletal Emergencies

- Made up of
 - 206 bones
 - 600 muscles
 - specialized connective tissue

- ligaments
- tendons

Types of Muscles

- Skeletal
- Cardiac
- Smooth

Divisions of the Skeletal System

- Axial skeletal system
 - The skull
 - Spine
 - Ribs
 - Sternum
- Appendicular skeletal system
 - Pelvis
 - Arms
 - Legs
 - Hands and feet
 - Fingers and toes

Joints

- A joint is the point of contact between bones or bone and cartilage
- Types of joints
 - Suture
 - Hings
 - Pivot
 - Ball and socket

Bone

- Bone as four basic components
 - **the Periosteum**
 - a dense, white, fibrous covering surrounding the surface of bone
 - consists of two layers
 - the outer fibrous layers
 - the inner (Osteogenic) layer
 - **Spongy bone tissue**
 - Is honeycombed with large spaces filled with red marrow
 - is the largest portion of bone tissue
 - provides some support
 - storage area for marrow
 - **Compact/dense bone tissue**
 - Contains fewer and smaller spaces than spongy bone tissue
 - Thicker in the shaft than at the ends of long bones
 - Contains passageways for nerves and blood vessels
 - Provides most of the support and protection of the body.
 - **Bone Marrow**

The Functions of Bone

- Support soft tissue
- Protects delicate structures
- Movement
- Blood cell production in the marrow
- Storage area for mineral salts and fat

Types of Musculoskeletal Injuries

- Closed (simple)
- Open (compound)
- Fracture Types
 - Incomplete (greenstick)
 - Complete
 - Comminuted
 - Transverse
 - Impacted
 - Spiral
 - Oblique
- Dislocations
- Sprains
- Strains

Special Connective Tissue

- Ligaments connect bone to bone
- Tendons connect bone to muscle
- All swollen, painful, deformities should be treated as fractures.

Special Considerations

- Femur fractures
 - Significant mechanism of injury
 - Blood loss can be significant, up to 1000cc
 - Hypovolemic shock may occur
- Traction splints
 - Only used for mid-shaft femur fractures without pelvic, hip, knee, ankle or lower leg injuries.

Advantages of Splinting

- Prevents movement
- Minimizes risk to nerves and blood vessels
- Reduces pain
- Decreases possibility of permanent damage

Assessment of Musculoskeletal Injuries

- BSI
- Life threats

- Initial Assessment
- Transportation decision
- Rapid or focused assessment
 - **D**eformities
 - **C**ontusions
 - **A**brasions
 - **P**enetrations
 - **B**urns
 - **T**enderness
 - **L**acerations
 - **S**welling
- Other indications
 - Exposed bone
 - Loss of motion
 - Loss of pulse
 - Isolated neurological deficit

Injuries to the Head, Neck, Spine

Anatomy of the Head

- The Skull
 - The skull contains 22 bones
 - Cranial bones
 - 1 frontal bone
 - 2 parietal bones
 - 2 temporal bones
 - 1 occipital bone
 - 14 facial bones
 - Nasal bones
 - Maxillae
 - Mandible
 - Zygomatic (cheek) bones
- **Foramen magnum** is the opening at the base of the skull through which the brainstem exits the skull to connect with the spinal cord.
- **Meninges**
 - Membranous coverings of the brain and spinal cord
- **The layers**
 - **Pia mater**
 - Innermost layer
 - Adherent to the brain itself
 - **Arachnoid** (spider like)
 - Middle layer covers folds of brain and spinal cord
 - Veins are between the dura and the arachnoid layers

- **Dura mater**
 - Outmost layer
 - Closest to the skull and spinal column

CNS Fluid

- A clear fluid
- Protects like a shock absorber

Principal Parts of the Brain

- **The cerebrum**
 - Largest and most superior portion of the brain
 - Divided down the middle into right and left halves called hemispheres
 - Hemispheres are divided into lobes
 - **Frontal region**
 - Motor control
 - Intellectual functions
 - Personality
 - **Parietal Region**
 - Motor
 - Sensory perception
 - **Occipital Region**
 - Receiving and processing visual stimuli
 - **Temporal Region**
 - hearing and smell
- **The cerebellum**
 - Responsible to coordinate messages sent from the cerebrum
 - Injury to this area results in loss of muscular coordination
- **The brainstem**
 - 3 inches long
 - located in the upper part of the spinal cord
 - Controls vital functions breathing, circulation and blood pressure
- **The Pons**
 - Located in the brainstem
 - Responsible to serve as a relay station between the different part of the brain
 - Facilitates communication between the midbrain and the medulla
 - Also coordinates functions between the two sides of the body as well those of the face and jaw
- **The Medulla Oblongata**
 - a continuation of the upper portion of the spinal cord and forms the inferior part of the brainstem
 - responsible for involuntary functions such as heartbeat and breathing

The Nervous System

- The major functions of the nervous system are control and communication through spinal nerves

- Divisions of the nervous system (CNS)
 - Brain
 - Brainstem
 - Spinal cord
 - Functions
 - Receive and process information
 - Organize and analyze information
 - Formulate responses to information received
 - Consumes 20% of the available O₂ and glucose
- Peripheral nervous system
 - Communicates outside the CNS
 - 12 cranial nerves
 - 31 pairs of spinal nerves
 - The nervous system can be divided by function also
 - Voluntary
 - Controls activities that require deliberate or conscious action
 - Involuntary (AKA autonomic nervous system)
 - Controls vital body functions
 - We have limited or no control over it
 - Divides into sympathetic and parasympathetic

Injury Categories

- Blunt trauma
 - Results in an injury with no open wound
- Penetrating trauma
 - Results in an open wound
 - May not be obvious
- Coup/contrecoup
 - This is an injury pattern commonly seen in rapid deceleration injuries
 - Causes injuries on both sides of the brain
 - Can give rise to
 - Concussion
 - Contusion
 - Intracranial pressure

Injuries to Brain

- **Concussion**
 - Defined as transient loss of consciousness or neurologic function due to a blow to the brain
 - The blow to the brain sends shock waves that temporarily disrupt brain function
- **Contusion**
 - Is a bruising of the brain tissue
 - Bruised brain tissue does not function properly
 - There may be specific localized findings that correlate with the site of injury

- More significant than a concussion
- May cause an extended period of unconsciousness
- **Epidural Hematoma**
 - A Hematoma between the skull and the dura mater caused by a laceration of the middle meningeal artery traveling along the inner surface of the cranium
 - **Signs and symptoms of rising intracranial pressure may manifest quickly**
 - the patient may initially be unconscious, experience a lucid interval, then lapse back into unconsciousness
 - pupil dilated on the side of the flow
 - low mortality rate if treated on time
 - **Subdural Hematoma**
 - a Hematoma between the dura and arachnoid membranes, bleeding coming from ruptured or torn veins
 - This tends to be a slow bleed
 - Has a high mortality rate
 - **Intracerebral Hematomas**
 - Rupture of blood vessels within the brain tissue
 - Mimics a CVA
 - Can lead to rising intracranial pressure (ICP)
 - Can follow penetrating wounds

Rising Intracranial Pressure

- A build up of pressure within the cranium from pooling of blood
- The cranium is solid and offers no relief for the pressure being exerted upon the brain tissue by the pooling blood
 - Perfusion of the brain tissue is decreased due to the compression of the vessels
- Signs and Symptoms
 - Pupils unequal but reactive to light
 - **Cushing's Reflex:** a rising blood pressure with a slowing pulse
 - If the bleed is severe, the brain may herniated through the foramen magnum
- Early signs of brain herniation
 - AMS
 - Localized pain
 - Pupil on same side of injury will dilate but still react to light
 - Cushing's Reflex
- Late signs of brain herniation
 - Patient responds to painful stimuli with posturing
 - Challenges may occur in respiratory pattern
 - Irregular breathing patterns
 - Cheyne-Stokes
 - Central Neurogenic hyperventilation
 - Pupil on injured side is fixed and dilated

- Terminal stage of brain herniation
 - Patient loses muscle tone
 - Blood pressure begins to fail
 - Irregular or ataxic respirations
 - Slow and irregular pattern of breathing associated with brainstem injury.

Posturing

- **Decorticate**
 - Patient is rigid and still, arms flexed, fists are clenched and legs are extended
- **Decerebrate**
 - Extremities are rigid and extended, head retracts (hyper-extended)

The Spinal Column

- 33 vertebra
 - 7 cervical
 - 12 thoracic
 - 5 lumbar
 - 5 sacral
 - 4 coccyx
 - cervical and lumbar regions are the ones most likely to be injured
 - 26 vertebral discs
- Spinal Cord
 - 18 inches long/15 mm in diameter
 - Begins at the base of the skull
 - Ends between L1 and L2

Types of Nerves

- **Motor nerves**
 - Stimulate muscle
- **Sensory nerves**
 - Send information to the brain about surroundings
- **Autonomic Nervous System**
 - **Sympathetic System**
 - Nerves arise from the thoracic and lumbar regions of the spinal cord
 - **Parasympathetic**
 - Nerves arise from brainstem and sacral segments of the spinal cord

Injuries to the Spinal Cord

- Since there is little room in the spinal column, the cord is susceptible to injuries
 - The most susceptible sites for injuries in the spine are the cervical and lumbar regions.
- C3, C4, C5 keeps the patient alive
 - The nerve that controls respiration (phrenic) passes between these vertebrae
 - Damage to this area or above results in respiratory arrest

- C5, C6, C7
 - The root of the nerve that exits here controls the Intercostal muscles
 - Injury here causes the patient to become an abdominal breather
 - Injury to the spinal cord above C7 results in loss of sympathetic tone
 - Blood pools in the vessels and the patient becomes hypotensive without a change in the blood volume
 - This is called **Neurogenic shock**
- Complete transection of the spinal cord causes complete loss of sensation and function below that point
 - T4 – nipple line
 - T10 umbilicus
 - L1 groin
- Whiplash
 - Hyperextension of the neck causes injury to the cervical spine and adjacent soft tissues

Pediatrics

Pediatric Trauma

- Injuries that are #1 cause of death in infants and children
 - Most trauma is blunt
 - Falls and motor vehicle collisions
- Less obvious injuries, and there is later deterioration
- Must rely on MOI and signs and symptoms
- Small amount of blood can be extensive for child (50ml for infants)
- **Waddell's Triad**
 - Child first struck at pelvis or thigh by bumper
 - Pelvic/femur fractures result in internal hemorrhage
 - Child also struck at chest/upper abdomen by grill/hood
 - Abdominal/chest injury results in internal hemorrhage
 - Child then thrown forward as brakes catch
 - Large, heavy head hits first, which leads to head injury

Weapons of Mass Destruction

Biological Agents

- Either living organisms (bacterial or virus) or derived from living organisms (toxins).
- Delayed effects (due to the incubation period of the agent).
- Detected by patterns and clusters called Syndromic Surveillance.
- Commonalties for Biological Agents
 - Flu like signs and symptoms
 - Fever
 - Chills
 - Headaches
 - Nausea and vomiting

- Needs incubation period
- Not likely an acute or rapidly developing incident
- Difficult to detect
- Personal Protection
 - Respiratory Protection
 - HEPA Filter Mask
 - Air Purifying Respirators
 - SCBA
 - Splash Protection:
 - Boots and Gloves
 - Emergency Medical Service
 - Body Substance Isolation

Nuclear Agents

- “Dirty Bomb”
- Conventional explosive device laden with radioactive materials
 - Disperses radioactive material throughout environment
- Personal protection
 - Time
 - Shielding
 - Distance
- Medical Treatment
 - Exposure to radioactive agents does not usually produce wounds in need of immediate care
 - Detonation will yield the most acute injuries or death through these mechanisms
 - Blunt trauma
 - Blast or pressure related injuries
 - Thermal Burns
 - Radioactive contamination is an aggravating factor

Chemical Agents

- Nerve Agents
 - Attack respiratory and nervous systems within seconds to minutes
 - Extremely toxic lethal agents
 - Similar to pesticides
 - Signs and symptoms
 - Respiratory distress
 - Agitation and CNS changes
 - Salivation
 - Lacrimation
 - Urination
 - Defecation
 - Gastrointestinal Distress (cramps)
 - Emesis (vomiting)
 - Muscle twitching
 - **Miosis – pupil constriction**

- **Blister Agents**
 - Effects seen on tissue
 - Exposed skin
 - Eyes
 - Lungs
 - Signs and symptoms
 - Reddening skin
 - Appearance of 2nd degree burn to exposed skin anywhere from 2-24 hours post exposure
 - Eye irritation
- **Blood Agents**
 - Bind with red blood cells
 - Prevent transport of oxygen
 - Signs and Symptoms
 - Tachypnea
 - Headaches
 - Altered mental status
 - Seizures
 - Cherry red lips or skin (late sign)
 - Similar to CO poisoning
- **Choking Agents**
 - Common industrial chemicals
 - Chlorine
 - Phosgene (CG)
 - Signs and Symptoms
 - Eye irritation
 - Airway irritation
 - Dyspnea
 - Dizziness

Explosives

- **Personal Protection**
 - No radio transmissions within 300 feet of a suspicious device
 - Use time, distance and shielding to your advantage
 - Be aware of the potential for a secondary device

Medical Treatment for Nerve Agents

- **Mark 1 kit**
 - 2mg Atropine Injector
 - atropine is always the first drug of choice
 - Treats SLUDGEM
 - Relieves smooth muscle constriction in the lungs and gastrointestinal tract and dries up respiratory tract secretions
 - There are not contraindications to atropine when used in the management of nerve agent or organophosphate poisoning
 - 600mg 2-PAM injector (pralidoxime chloride)

- AKA Protopam
 - It reverses respiratory depression and skeletal muscle paralysis resulting from organophosphate/nerve agent poisonings
 - 600mg per dose not to exceed 1.8 grams total
 - Caution: Under no circumstances should the rescuer prophylactically self medicate themselves or patients with atropine or 2-PAM
 - These drugs should be used on symptomatic patients.
- Triage and Treatment of pediatric patients
 - Children greater than 8 years old should be treated via the adult protocols.
 - Asymptomatic patients <8 y/o
 - Monitor every 10 minutes for evidence.
 - Symptomatic patients <8 y/o with signs of exposure
 - Age <1: one (1) pediatric atropine, no 2-PAM, monitor every 3 minutes
 - Age 1-8 years old: one (1) atropine, 2mg one (1) 1 pralidoxime chloride 600 mg, monitor every 3 minutes
- Triage and treatment of adult victims
 - **Black tag (non-viable)**
 - Determined by noxious stimulus triage in the hot zone
 - No management
 - No care is provided
 - **Red tag (immediate)**
 - Non-ambulatory
 - Severe respiratory distress
 - AMS (agitation, CNS changes)
 - SLUDGEM
 - Determined in the warm zone
 - **Yellow tag (delayed)**
 - Non-ambulatory victims
 - Respiratory distress to a limited degree
 - SLUDGEM
 - Determined in the cold zone after decontamination
 - **Green tag (walking wounded)**
 - Ambulatory
 - Asymptomatic
 - Observed but not treated
 - Determined in the cold zone after decontamination

Emergency Mass Decontamination

- Rapid, physical removal of the material from the victim is the single most important action associated with effective decontamination
- Water is the most abundant decontamination agent
- Performed with a fire hose