



Presents

The EMS Quick Study Guide

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Table of Contents

EMS Foundations	1
Well being of the EMT	2
Medicolegal Aspects	3
General A&P Terms and Structures	5
IV Therapy	13
Poisoning & Overdose	17
Neurological	22
Abdominal	26
Environmental	28
Behavioral	32
Gynecological	34
Obstetrical	36
Neonatal Resuscitation	39
Geriatrics	41
Respiratory	43
Cardiovascular	49
Diabetic	53
Allergic Reactions	56
Trauma	58
Hemorrhage & Shock	61
Burns	67
Thoracic Trauma	70
Head & Spine Trauma	72
Abdominal Trauma	76
Extremity Trauma	77
History Taking	78
Techniques of Physical Examination	80
Patient Assessment	86
Communications	92
Documentation	97
Advanced Level Study Help	101
Special Pediatric Emergencies	110

Foundations

EMS: Emergency Medical System. Components are defined by the Nat'l Highway Traffic Safety Administration

- _ Fire service-based
- _ Third service
- _ Private ambulance service
- _ Hospital-based
- _ Volunteer systems

EMD: Emergency Medical Dispatcher, assigns call based on distance to the call, time of day, level of care needed

First Rule of Patient Care: do no harm

Training and Certification: the National Standard Curriculum serves as the foundation for training EMT-Is.

Reciprocity: Mutual exchange of privileges or licenses by two certifying agencies

Licensure: process by which an agency grants permission to an individual to engage in a profession/occupation because they meet the minimum competency/qualifications

Certification: action by which an agency grants recognition to an individual who has met its qualifications.

Medical Direction: medical supervision of an EMS system and the field performance of the EMTs

Protocols: Written instructions, developed by the medical director, for the care of patients with specific conditions, illnesses or injuries

Standing Orders: Field interventions that are completed before contacting medical direction

Continuous Quality Improvement: Evaluation of services provided and the results achieved as compared with accepted standards

- _ Delineate system-wide problems
- _ Elaborate on the causes of the problem _
- Develop remedies
- _ Lay out a plan to implement the remedies _
- Enforce the plan on correction
- _ Reexamine the problem

Ethics: the discipline of dealing with what is good and what is bad

Well being of the EMT

Physical Wellbeing depends on

- Good nutrition
- Physical fitness and weight control
- Sleep - 7-8 hours a day
- Disease prevention: responsibility to serve as a role model
 - a. Cardiovascular disease: exercise, don't smoke, control high BP and cholesterol, monitor triglycerides, reduce stress
 - b. Cancer: change or mutation in the nucleus of a cell. Watch for "CAUTION"
 - c. Infectious disease: airbourne/bloodbourne pathogens that include bacteria and virus. Washing hands is the most basic, effective way to prevent disease transmission.

Exposure	Seroconversion (develop antibodies)	Onset of Symptoms
Incubation Phase		
Window Phase	Carrier Phase	
Time ----->		

- d. Immunizations: EMS workers should be immunized for tetanus, diphtheria, polio, hepatitis B, MMR, and influenza and also checked for TB exposure
 - e. BSI: first rule is to treat EVERYTHING as though it is infectious. PPE = gloves, gowns, goggles, masks
 - f. Exposure - to blood or bodily fluids should be reported immediately to receiving hospital and designated officer
 - g. Cleaning: washing with soap and water, disinfecting: cleaning and using a disinfectant to kill microorganisms (1:10 bleach to water solution), sterilization: using physical (heat) or chemical methods to kill all microorganisms on an object.
- Injury Prevention

Mental Wellbeing

- Stress and anxiety - stress is from physical, chemical or emotional factors
- Critical Incident Stress Management (CISM) - organized, formal peer mental health support network and process
 - o Defusing - 8 hours afterwards
 - o (CISD) Debriefing - 24-72 hours afterwards

Medicolegal Aspects

Preventing legal problems

- _ Proper care within scope of practice
- _ Following state/local protocols and guidelines
- _ Keep proper thorough and accurate documentation

Reduce Negligence Claims

- _ Provide continuing education
- _ Appropriate medical directions
- _ Document everything
- _ Maintain professional attitude and demeanor

Legal Duties/Ethical Responsibilities

- _ Maintain skills
- _ Respond to needs of patients in scope of practice
- _ Report honestly, respect confidentiality
- _ Work cooperatively and with respect

Types of Law that apply to EMT-I

- _ Legislative
- _ Administrative
- _ Common
- _ Civil
- _ Criminal

The best legal protection is appropriate assessment and care coupled with accurate and complete documentation.

Scope of Practice: range of duties and skills an EMS worker is allowed/expected to perform defined by the medical practice act.

Negligence: conduct that falls below the standard of care

Ordinary Negligence: acts of omission that occur in an attempt to deliver proper care

Gross Negligence: willful and reckless giving of care that results in injury to patient

Four requirements:

- _ Duty to act
- _ Breach of duty - below standard of care
 - o Malfeasance: wrong or unlawful act
 - o Misfeasance: legal act performed in a harmful way
 - o Nonfeasance: failure to perform required act or duty
- _ Cause - act or omission caused situation
- _ Injury

Good Samaritan Laws: are not for trained EMS workers, do not count on them

Confidentiality includes (but is not limited to):

- _ Patient history
- _ Assessment
- _ Findings
- _ Treatment rendered

Improper release of info could lead to charges of Invasion of privacy, Defamation, libel or slander.

Types of Consent

- _ Expressed: verbal or written consent
- _ Informed: consent only after all information about risks and treatment options is given
- _ Involuntary: treatment allowed by law (mental problems, incarcerated patients)
- _ Implied: assume an unconscious person would agree to treatment, also juveniles

Abandonment: stopping care without handing patient over to a person of equal or higher training

False Imprisonment: intentional unjustifiable detention of patient against his/her will

Assault: threatening or causing fear of offensive physical contact

Battery: unlawful touching of a person without their consent

Use of Force: appropriate only to provide care for unruly/violent patients. Follow protocols, use only reasonable force, never as punishment

Transportation: same level of care while transporting in conformity with all laws, regulations, and policies

Resuscitation: only stop at physician's directive. Advance directives - what patient wants in case they can't express themselves

Organ donation: if a donor is identified, call Medical Director immediately

Crime Scenes: 1) provide good patient care 2) preserve evidence

Child Abuse: hospital personnel must be alerted when abuse is suspected, doesn't require proof

Physicians: Call Medical Director, let them duke it out. Dr must accompany patient to hospital

Anatomy: study of the structure of an organism and its parts

Physiology: study of an organism's normal body functions

Pathophysiology: study of disease mechanisms

Homeostasis: normal state of balance between all the body's systems. Injury or illness interferes with homeostasis.

Body's building blocks: chemical>organelle>cell>organ>organ system> organism

Organ systems:

Skeletal	Muscular	Circulatory
Respiratory	Nervous	Gastrointestinal
Urinary	Reproductive	Immune
Endocrine	Integumentary	Special Sensory

Body Cavities:

Cranial cavity/spinal canal:	houses nervous and special sensory systems
Thoracic cavity:	cardiovascular and respiratory systems
Mediastinum:	houses the heart, trachea, mainstem bronchi, esophagus and large blood vessels
Abdominal cavity:	houses the gastrointestinal system and urinary system
Retroperitoneal space:	kidneys and major blood vessels
Pelvic cavity:	gastrointestinal, urinary and reproductive systems

Cellular Transport:

Semipermeable:	a cell that allows some substances to enter or leave while restricting others
Permeability:	the rate at which substances pass through a membrane. This is determined by size and charge of molecules
Other regulating factors:	ion pumps, active transport and diffusion
Water:	the only substance that passes freely back and forth, OSMOSIS is the movement of water. Water moves to equalize a solute's concentration either inside or outside the cell
Active Transport:	Requires energy, or ATP. Moves solutes against their concentration gradients
Passive Transport:	Does not require energy, Diffusion and facilitated diffusion <i>Diffusion</i> = continual movement of particles (SOLUTES) from higher to lower concentration until they are scattered evenly, examples are Oxygen, Nitrogen, Carbon Dioxide and Electrolytes (Potassium, Sodium)

Facilitated Diffusion= A specialized transport protein binds to the molecule and moves it through the cell membrane, most important are GLUCOSE and Amino Acids. Still passive because it is going from higher to lower concentration

Tonicity: The number of particles of solute per unit volume
Isotonic: Osmotic pressure equal to body fluid
Hypotonic: Osmotic pressure less than normal body fluids
Hypertonic: Osmotic pressure greater than normal body fluids

Cellular Metabolism and Respiration

Metabolism: combination of all chemical processes that take place in the body resulting in growth, generation of energy, elimination of waste and other bodily functions.

2 steps (with regards to distribution of nutrients in the blood ie glucose, amino acids and fats):

- _ Anabolism = constructive or building phase, smaller to bigger
- _ Catabolism = destructive or breakdown phase, larger to smaller

Krebs Cycle: Mitochondria uses amino acids and fats to produce energy. Amino acids can also be converted to glucose. Can be stored in the liver as glycogen, used as necessary to raise blood sugar.

Cellular Respiration: the mitochondria metabolizes glucose into ATP, CO₂ and H₂O. One glucose becomes 36-38 ATP in an aerobic environment (with O₂)

Tissues

Four types:

- _ Epithelial - external and lines hollow organs, protective barrier and secretes stuff
- _ Connective - binds other tissues together, blood, adipose, fibrous and elastic plus bone and cartilage
- _ Muscle - contracts leading to movement. 3 types: skeletal, smooth and cardiac
- _ Nerve - brain, spinal cord and all nerves. Nerves generate and transmit impulses throughout the body, controlling all processes

Integumentary System: body's external surface: skin, hair, nails, sweat/oil glands. Temp regulation, defense against disease, maintain fluid balance, most nerves and blood vessels run through the dermis, extending small branches into the epidermis.

Skeletal System: 206 bones in the frame. Protect internal organs and with muscles provide movement. Store minerals like calcium. Produce red and white blood cells. 4 types: long, short, flat, irregular.

Axial Skeleton: skull > cranium and face

Spine > 7 cervical vertebra #1 is Atlas, #2 is Axis
12 thoracic, 10 ribs connected + 2 floating
5 Lumbar
5 Sacrum
4 Coccyx

Appendicular Skeleton:

Scapula > shoulder girdle/clavicle
Arm > humerus, radius, ulna
Hand > carpals, metacarpals, phalanges

Pelvic girdle> ilium, ischium, pubis

Leg> femur, patella, tibia, fibula

Feet> tarsals, metatarsals, phalanges

Joints: where two or more bones meet, articulate and move, movement aided by cartilage

3 types:

- _ Immovable, cranium
- _ Slightly movable: spine
- _ Movable: ball and socket, hinge

Ligaments join bone to bone

Tendons join muscle to bone

Nervous System: controls involuntary and voluntary movement made up of Central Nervous System and Peripheral Nervous System.

Nerve cells>neurons

- _ Cell body = soma
- _ Dendrites = receives impulses
- _ Axons = carries impulses away

Synapse - region surrounding the point of contact between 2 neurons or a neuron and its effector organ

Sensory nerves - transmits back to brain

Motor nerves - transmits toward muscles

Nerve impulses are carried by changing the electrical charge of each cell. Sodium, potassium and calcium ions move in and out of the cells, changing their charge.

- _ Resting state - polarized
- _ Nerve impulse hits - depolarized
- _ Impulse moves on - repolarized

Central Nervous System:

Brain> Cerebrum

Diencephalons >hypothalamus, thalamus, pituitary

Brainstem> Medulla (heart rate, breathing, vasodilation, vomit, swallow)

Pons (sleep, respiration)

Midbrain (exit of cranial nerves)

Cerebellum

Spinal Canal - through the Foramen Magnum down to the 2nd lumbar vertebra,

below that it divides into the Cauda Equina

Meninges and CSF:

3 layers cover the brain and spinal cord

- _ Dura Mater
- _ Arachnoid membrane \ CSF circulates
- _ Pia Mater / between these

Autonomic Nervous System: regulates involuntary activities ie. Heart and smooth muscle

Two divisions:

- _ Sympathetic> fight or flight, tachycardia, raise BP, nervousness. Epinephrine and Norepinephrine
- _ Parasympathetic> calm down, nausea, vomiting, fainting, abdominal distress
 - o Acetylcholine
 - o Alpha receptors - vasoconstriction
 - o Beta1 - increase heart rate and strength of contraction
 - o Beta2 - bronchodilators

Endocrine System: regulates body functions ie. Growth, reproduction, temp, metabolism

Hypothalamus

Pineal

Pituitary> called the master gland

Thyroid> growth, calcium maintenance

Parathyroid> calcium maintenance

Thymus

Adrenal> sex hormones, water/salt balance. Epinephrine/Norepinephrine

Pancreas (islets) > insulin and glycogen

Ovaries/Testes> secondary sex characteristics

Feedback Mechanism:

- _ Hypothalamus
 - o Releasing factor
- _ Pituitary
 - o Stimulating factor
- _ The target gland
 - o Hormone produced
- _ End organ
 - o Effect on organ
- _ Hypothalamus
 - o Stops producing releasing factor

Blood - Fluid tissue made of cells and plasma

Average pH is 7.4, 5 or 6 liters of it

- _ Red blood cells - erythrocytes, hemoglobin binds/carries O₂ and transports it
- _ White blood cells leukocytes
 - _ Neutrophils - fight bacteria
 - _ Lymphocytes/monocytes - fight virus and fungus
 - _ Eosinophils/basophils - allergic reactions
- _ Platelets - clot formation

Heart - Circulatory System: heart, blood, and vessels

8-12 oz. Muscle is called myocardium. Specialized, self contained unit

1. Deoxygenated blood> superior and inferior vena cava>

2. Right Atrium> tricuspid valve>
3. Right Ventricle> semi-lunar valve > pulmonary arteries> lungs
4. Oxygenated blood>pulmonary veins>
5. Left Atrium>bicuspid valve
6. Left Ventricle> semi lunar valve> aorta

Cardiac Cycle:

Systolic BP - pressure in the arteries as the left ventricle contracts

Diastolic BP - relaxation phase, pressure in the arteries at rest

Normal 100 - 140
 50 - 90

Cardiac Electrical System

1. Contraction starts at the Sino Atrial node> intra-atrial pathway>
2. Atrio-ventricular node> bundle is His> divides to the right bundle branch and the left bundle branch
3. Purkinjes fibers take the impulse to the individual cells

Cardiac Volume = Stroke volume x heart rate

Regulation and Heart Function - rate and speed

1. Baro-receptors respond to changes in pressure of heart or main arteries
2. Chemo-receptors sense changes in the chemical composition of blood (like low O₂)

Normal pressure is regulated by monitoring:

- _ Blood volume
- _ Constriction of arteries
- _ Force of cardiac contraction

Lymphatic System:

Primary function is to absorb fat from the intestines and to trap infectious organisms like bacteria and viruses.

Immune System: defends the body from bacteria, virus and other foreign matter. Two types of immunities:

- _ Non-specific - mechanical barriers (skin), chemicals and leukocytes
- _ Specific - antigens and cell mediated immunity: lymphocytes
 (HIV/AIDS) patients' have big problems here

Respiratory System: bring in the O₂ and excrete the CO₂. Made up of upper and lower airways. You know the parts, I'm not going to type them in.

Technically speaking:

- _ Ventilation is defined as moving CO₂ in and out of the lungs
- _ Oxygenation is defined as moving O₂ in and out of the lungs
- _ Respiration is the whole process together

Oxygen Saturation is measured by a pulse oximeter and refers to the % of hemoglobin in the blood that is bound to O₂. Usually over 96%.

The majority of CO₂ is transported in the form of bicarbonate ions. Which become very important over in the Acid Base section. Brain stem regulates respiration by sensing excess CO₂ and upping ventilation, or lowered CO₂ and decreasing ventilation.

Backup system, hypoxic system is sensitive to levels of O₂, not as fine tuned.

Digestive System/Gastrointestinal System

Solid	RUQ	LUQ	Hollow
Liver Spleen Pancreas Kidneys Ovaries	Liver Gall Bladder Kidney Large Intestine Small Intestine	Stomach Spleen Pancreas Kidney Large Intestine Small Intestine	Stomach Intestines Gall Bladder Urinary Bladder Uterus Ureter
Main problem	RLQ	LLQ	Main Problem
Injury =Bleeding	Colon Appendix Large Intestine Small Intestine Ureter Urinary Bladder Uterus	Large Intestine Small Intestine Ovary Ureter Urinary Bladder Uterus	Injury=Peritonitis

Fluids and Electrolytes

Water 50-60% of total body weight

Intracellular > 45%

ExtraCellular > 15% \ Intravascular/plasma - 10.5%
/ Interstitial - 4.5%

Homeostasis means intake must equal output.

Regulation:

1. by the pituitary gland > antidiuretic hormone (kidneys take water back in)
2. by thirst
3. by kidneys

Electrolytes:

Cations +	Anions -
Sodium	Chloride
Potassium	Bicarbonate
Calcium	Phosphate
Magnesium	

Acid Base Balance:

Hydrogen is an acid

pH = Hydrogen ion concentration, the balance of acid produced and acid eliminated

The higher the amount of H, the lower the pH

The lower the amount of H the higher the pH

Normal blood pH is 7.35-7.45

Maintain pH with 3 systems:

- _ Buffers = chemical sponges. Bicarbonate (HCO_3)/carbonic acid (H_2CO_3) balance (better with acidosis)
- _ Lungs - regulate the CO_2 and H_2CO_3 in the body
- _ Kidneys - excrete H and HCO_3 as indicated by the pH of the blood. Deals with Alkalosis or Acidosis equally well but takes 10-12 hours.

Respiratory Acidosis:

Breathing too low, too much CO_2 , too much Carbonic Acid (H_2CO_3), low pH

S&S:

- _ Hypoventilation
- _ Shallow respirations
- _ Disorientation
- _ Stupor

Respiratory Alkalosis:

Breathing too high, too little CO_2 , too little Carbonic Acid, High pH

S&S:

- _ Hyperventilation
- _ Numbness, tingling
- _ Mental Restlessness
- _ Agitation, hysterical
- _ Unresponsiveness

Metabolic Acidosis:

Too much H, too much Carbonic Acid (H_2CO_3), low Bicarbonate (HCO_3), low pH

S&S:

- _ Starvation
- _ Renal impairment
- _ Diabetes (diabetic ketoacidosis)
- _ Prolonged diarrhea
- _ Kussmaul breathing
- _ Weakness
- _ Disorientation
- _ Coma

Metabolic Alkalosis:

Too little H, low Carbonic Acid (H_2CO_3), high Bicarbonate (HCO_3), High pH

S&S:

- _ Excess baking soda
- _ Prolonged vomiting

- _ Slow shallow respirations
- _ Muscular tension
- _ Tetany (extremity spasms)
- _ Mental Dullness

Urinary System: removes waste from blood by a complex filtration system. Maintains the proper balance of water and salts. Kidneys, Ureters, Urinary Bladder, and Urethra

Reproductive System: all male and female structures responsible for reproduction. I think we all know this.

IV Therapy

Important tool for cardiac disease, hypoglycemia, seizures and shock also:

- _ Routes for meds
- _ Precautionary measure

IVs come in four types

- _ Crystalloids - dissolving crystals (salts and sugars) in water. Ions cross the cell membrane quickly so for every L of blood lost, give 3L *(3:1 ratio)*
- _ Colloids - Expensive, need refrigerated, not given in field. Large molecules like proteins which do not readily pass through the cell membrane, they stay in the intravascular space longer and the pressure pulls fluid from other spaces. So they are called Volume Expanders.
- _ Blood - expensive, needs typed, needs refrigerated, needs a special filter, given in hospital
- _ O2 Carrying fluids

Administrative Set: 70-110" long

5 Components

1. Piercing spike - sharp, pointy with protective cap
2. Drip chamber - Micro (60 drops per mL) Macro (10, 15 or 20 drops per mL)
3. Flow Clamp - roller clamp controls amount of fluid
4. Drug Admin port - y-shaped inlet, clean with alcohol before using
5. Connector End - connects to the hub of the catheter, also has protective cap

Blood Tubing: larger internal diameter and a special blood filter, usually drip factor of 10 drops/mL. Two types:

1. Y tubing - more flexibility for administering fluids (swapping etc.)
2. Straight tubing

Volume Control: Burette Set. Chamber with measuring lines, when specified amounts need to be administered usually 100-150 mL.

Needle/Catheter

Catheter remains in the vein

Needle facilitates the passage into the vein

3 types:

- _ Plastic over hollow needle, needle is pulled out after insertion in vein leaving the catheter in place, gauge measurements 14-26.
- _ Plastic catheter through a hollow needle
- _ Hollow needle (butterfly)

Gauge Measurements

Gauge measurements 14-26. The smaller the number, the larger the bore.

14-16 gauge for patients in shock, cardiac arrest. 18 minimum for blood/50% dextrose.

Intermittent Infusion Device (Hep Lock/Saline Lock) - short tubing and a clamp, med port and connector useful for a patient who requires venous access but not continuous infusion. Supplies and equipment:

- _ IV cannula
- _ One or two 3 mL syringes with heparin or saline
- _ Intermittent infusion device
- _ Tape/securing device
- _ Venous blood drawing equipment
- _ Antiseptic swab

Procedure Summary

1. Prime the lock with heparin or saline
2. Cannulate the vein
3. Connect the intermittent device to the hub of the IV catheter
4. Inject 305 mL of dilute heparin or saline

Structure of Veins: Three Layers:

1. Tunica Intima - endothelial lining, flat cells to let blood flow. Valves in this layer
2. Tunica Media - muscular and elastic tissue, vasoconstrictor/dilators and nerve fibers in this layer
3. Tunica Externa - connective tissue surrounding and supporting the vessel

IV Site Locations: never try distal to a failed spot, you may have blown the vein above it

Digital veins: use when other sites aren't available

Metacarpal: between the knuckles

Cephalic: very common IV site

Median antebrachial: last resort

Basilic: ulnar border of hand and forearm

Antecubital: probably the most common IV site

Great saphenous: internal malleolus, inner thigh

Dorsal venous network: infants and toddlers

External Jugular: may be more important to manage the airway

Veins of leg: use as last resort, thrombus formation

Performing IV Cannulation: Other notes:

- _ Explain the procedure to the patient
- _ Check the IV fluid to be used
- _ Prepare the Administration Set and the IV bag
 - _ 14-16 gauge for trauma, volume replacement, cardiac arrest
 - _ 18-20 gauge for medical conditions
- _ Never leave a tourniquet in place for more than 2 minutes
- _ Avoid areas of veins where valves are located
- _ Stabilize the vein by anchoring it with the thumb and stretching the skin downward
- _ Bevel of needle should be facing up when entering skin

- _ Never insert the needle/catheter in so that less than half the catheter is outside the skin
- _ Hold the needle stable and use the other hand to slide the catheter off the needle into the vein
- _ Press with middle finger over the skin where the catheter is sitting
- _ Remove needle carefully, leave catheter in place
- _ Needle goes immediately into the sharps container
- _ Connect IV tubing to the catheter hub
- _ Hang bag 30-36 inches above insertion site
- _ Open control valve briefly to check line patency
- _ Cover IV site with ointment, place a sterile dressing on, tape catheter in place
- _ Adjust flow rate for patient's condition
- _ Continue checking drip rate, IV site and patient vital signs periodically, especially for
 - o Critical patients, pediatric/geriatric patients, those whose condition can be worsened by fluid overload, giving a type of fluid/drug that can cause tissue damage

Calculating Flow Rates

$$\frac{\text{Volume in mL}}{\text{Time of infusion}} \times \text{Drip} = \text{Flow rate (drops per minute)}$$

Factors that cause the flow rate to vary:

- _ Vein spasm
- _ Vein pressure changes
- _ Patient movement
- _ Manipulations of the clamp
- _ Bent or kinked tubing
- _ IV Fluid viscosity
- _ Height of the infusion bag
- _ Type of administration set
- _ Type and position of the venous access device

Documentation

- _ **Date and time of venipuncture, type of device, length/gauge, site,** number of attempts
- _ Type and amount of solution, IV flow rate
- _ Any adverse reactions
- _ **Name and ID of person** initiating the infusion
- _ Unsuccessful attempts
- _ Write on tape that in **Bold** above

Troubleshooting: if the IV solution flow is slow or non-existent ask yourself:
Is the tourniquet loose?

Restrictive clothing?
Swelling at IV site?
Flow regulator open?
Tip of catheter against vein wall?
Bag high enough?
Drip chamber filled completely?
Do you feel lucky? Well, do you punk?

Complications:

- _ Pain
- _ Catheter shear - NEVER draw the catheter back over or through the needle once it has been advanced. Always pull the needle out first!
- _ Circulatory overload - S&S headache, flushed skin, tachycardia, hypertension, rales, dyspnea, tachypnea, JVD
- _ Cannulation of an artery - bright red blood that pushes the plunger up, pulse
- _ Hematoma or infiltration - injury to the blood vessel, puncture or dislodged cannula. S&S edema, blanched skin, discomfort, cool site, slow flow, no blood flashback
- _ Local infection - bacteria introduced into IV site S&S swelling tenderness several DAYS after initial treatment
- _ Air embolism - air allowed in the vein from IV tubing, IV set dislodged S&S hypotension, cyanosis, tachycardia, increased venous pressure. Loss of responsiveness
- _ Pyrogenic reaction - foreign proteins capable of causing fever come in from the iv solution or the administration set. Within 30minutes of initial treatment. S&S fever, chills, backache, nausea, vomiting (of course, my favorite), flushed face, sudden pulse change. Cardiovascular collapse can result.

Drawing Blood: the most common reason to draw blood in the field is for blood glucose levels. Use at least a 19 gauge needle to prevent the blood cells from breaking up.

Changing an IV bag: sterile procedures must be used. Do not contaminate the IV spike, after spiking the new bag, make sure the drip chamber fills appropriately. If air becomes trapped in the tubing, clean the med port below the air and aspirate it with a needle and syringe.

Discontinuing the IV Line: Get gloves, sterile gauze and adhesive bandage. Close IV flow control valve. Untape and remove dressing. Hold gauze above site to stabilize and pull the catheter straight back. Apply direct pressure, then tape a sterile dressing in place.

Poisoning and Overdose

Poisoning: exposure to substance that is generally harmful, with no beneficial effects

Overdose: excessive exposure to a substance that has normal treatment uses. Nearly ½ involve prescription drugs.

Types of toxicological emergencies:

1. Unintentional Poisonings

Dosage Errors: accidental by nurses, Drs, family members or self

Idiosyncratic reactions: unpredictable side effects

Childhood poisoning: inattentive care/childhood curiosity. These are the most frequent calls to the poison control centers

Environmental exposures

Occupational exposures

Neglect and abuse: fine line between

2. Drug and Alcohol Abuse/Substance Abuse: millions of \$\$ of injuries and illness each year

3. Intentional Poisonings or Overdose

Chemical warfare: terrorism, war, WMD

Assault or homicide: using poison to commit murder

Suicide attempts: deliberate exposure to a known poison or overdose of a therapeutic drug

Scene size-up comes first.

Assure your safety and that of your team first.

Routes of absorption:

Ingestion: poison enters the body through the mouth and absorbed by the digestive tract. Mushrooms, sleeping pills. Preferred method of care is activated charcoal and/or gastric lavage

Inhalation: toxic fumes or gas inhaled into the lungs. Carbon Monoxide. Move patient to fresh air, provide hi-flow O₂

Absorption: substances may pass through the skin to the blood stream. Pesticides, ag chemicals. Brush off, flush with H₂O, Remove clothing, Protect yourself

Injection: toxic material injected by needles or stingers, deal with the symptoms.

Epi for bee/wasp as necessary, some snakebites have antivenom, Narcan for opiates.

Geographically Specific Types:

Venomous Snakes: coral snakes in FL

Spiders

Marine animals: jelly fish, lion fish

Manufacturing industries: chemical plants, oil refineries

Transportation industries: railroad routes, interstate highways

Toxidromes: groups of drugs that present with the same patterns of toxicity

Management: protect and maintain ABCs. Antidotes may be available, but attention to the basics is most important.

Assessment: Ask:

1. What was taken?
2. How much was ingested?
3. When the poisoning occurred?
4. What has been done for the patient so far?

Signs and Symptoms vary:

Burning, tearing of eyes

Respiratory distress

Cyanosis

Nausea, vomiting, diarrhea

Diaphoresis, salivation

Weakness, dizziness, headache, seizure

Altered level of consciousness

Physical Findings:

Pulse: tachycardia - stimulants, bradycardia - heart meds, pesticides

Respiratory Rate: increased in children may mean aspirin, depressed resps from narcotics, sedatives and CO poisoning

Temperature: elevated = aspirin and stimulants, lowered = alcohol, sedatives, narcotics, pesticides

Blood Pressure: decreased by depressants or narcotics, elevated by cocaine, stimulants

Focused Physical Exam

Respiratory System: can cause resp depression, airway obstruction, distress and wheezing

Cardiovascular System: irregular heart rhythms, chest pain, shock and cardiac arrest

Neurological System: pupil size, narcotics constrict (myosis), stimulants dilate

Care of the Poisoned Patient:

1. Airway, breathing, circulation
2. Follow vital signs, pulse Ox
3. Put on cardiac monitor
4. Position patient to prevent aspiration
5. High flow O2 by mask, cannula or consider intubation
6. PASG as per local protocols
7. Restrain violent/suicidal patient as per local protocols
8. Notify receiving hospital: bring pills, bottles, containers, samples, snakes (dead), spiders (dead)

Activated Charcoal: 1 gram per kg. 30-100g for an adult, 15-30g for a child up to 12

Cholinergics: stimulate the parasympathetic nervous system, block the breakdown of acetylcholine. Pesticides like organophosphates and nerve gas agents like sarin, or soman.

Severe symptoms are called: SLUDGEM - salivation, lacrimation, urination, defecation, gi cramping, emesis, miosis

Bradycardia

Wheezing

Myosis

Coma

Convulsions

Management: Own safety! HazMat only. Atropine, Pralidoxime (2-pam chloride), Diazepam, Activated Charcoal if oral ingestion

Anticholinergics: block the parasympathetic nervous system, also called vagolytic agents.

Atropine, ipratropium, antihistamines, antispasmodics, tricyclic antidepressants

Severe symptoms will be hot, red, dry and mad

Tachycardia, tachypnea

Temporary psychosis

Management: Maintain ABCs. Counter-drugs are rarely given, they are more dangerous than the anticholinergics themselves. Treat the symptoms. Activated charcoal may help.

Narcotics/Opiates: CNS and respiratory depressants. Heroin, morphine, codeine, meperidine, propoxyphene, fentanyl, hydrocodone.

Euphoria

Hypotension

Respiratory depression/arrest

Nausea

Pinpoint pupils

Seizures

Coma

Management: Maintain ABCs. Naloxone (Narcan) antagonizes narcotics (and the users). IV administration may wear off too fast, and wake them up too much. IM dose lasts longer and they awake more slowly.

Toxic Gas inhalation:

Inert gases: displaces O₂ and injury/death is due to asphyxiation. CO₂, methane, exane, propane acetylene. Mental, seizures, cardiac dysrhythmias

Irritant gases: irritate tissues. Highly water soluble irritate upper airways. Less water soluble pass through to the lungs and cause sever tissue damage

○ Immediate reactions: 1-2 hours, red mucous membranes, eye and nasal irritation, cough, sore throat, bronchospastic

○ Delayed: 6-24, laryngeal edema, hoarseness, stridor, non-cardio PE

○ Chronic: recurrent pneumonia and lung disease

Systemic Toxins: gases that poison the cells. CO, cyanide, hydrogen interfere with O₂ transport and delivery. Other agents can damage the liver and kidneys

Sources of Toxic Gases: accidents and fires are the most common. Leaking tanks, truck rollovers, by-products from fires, chemical reactions

Pathophysiology: determines the effects of gas inhalation:

- Water solubility

- Depth and rate of breathing

- Smell: if it smells, we can detect and avoid it

- Concentration of gas

- Length of exposure

- Differences in host: some people are more sensitive

- Smokers: lower resistance to toxic gas

- COPD will have a worse time as well

Management: Protect yourself. Treat the symptoms. Protect ABCs. Hi-flow O₂, intubate if necessary, IV, nebulized bronchodilators may help, prompt transport

Carbon Monoxide Poisoning: colorless, flavorless, odorless, non-irritating gas. Gas heaters are among the most common sources of domestic CO exposure. CO binds with hemoglobin 250x more readily and so O₂ can't, suffocating the patient on a cellular level. Assessment: suspect CO in any fire, smoke or closed space. Pulse ox won't detect. Signs and symptoms:

- Malaise, weakness, headache

- Confusion, dizziness

- Nausea, shortness of breath

- Drowsiness

- Unconsciousness

- Chest pain, may develop AMI or PE

- Cherry red skin - late sign

- Rales, rhonchi

- Seizures, blisters

Management: Protect yourself. Fresh air, Protect ABCs. Hi-flow O₂, ventilate/intubate if necessary, IV, prompt transport

Tricyclic Antidepressants: common are amitriptyline (Elavil), amoxapine (Asendin), clomipramine (Anafranil), doxepin (Sinequan, Adepin), imipramine (Tofranil) and nortriptyline (Aventyl, Pamelor). Block the reuptake of norepinephrine and serotonin in the brain. Some have anticholinergic and cardiac membrane actions. Heat exhaustion and heat stroke. V-Tac dysrhythmias. Very dangerous in an overdose because it only takes a few pills. A typical one-month prescription is more than enough to be fatal. Signs and symptoms vary on the drug, dose and time since ingestion:

- Dry mouth

- Confusion

- Hallucinations

- Delirium

Respiratory depression

Hypotension

Hyperthermia

Seizures

Coma

Management: Protect yourself. Maintain ABCs. Hi-flow O₂, ventilate/intubate if necessary, IV, prompt transport. Medications: Sodium Bicarbonate, Activated Charcoal, Diazepam (seizures).

Bites and Stings: Bees, wasps, spiders, ants, scorpions, snakes, jelly fish

Management: usually unless anaphylaxis is present, no medications are warranted

Snakebites: Of most concern are Coral snakes and Pit vipers. Venom has:

Neurotoxicity: parathesias, paralysis neuromuscular disturbances

Hemotoxicity: coagulant, anti-coagulant, hemolytic, platelet

Cardiotoxicity: decrease cardiac output and BP

Enzymes can lead to tissue destruction

Management: Protect yourself. Maintain ABCs. Hi-flow O₂, IV with normal saline, prompt transport. Antivenom as possible.

Neurological Emergencies

Central Nervous System (CNS) = brain and spinal cord, involved in the serious neurological problems. Affects:

Cognitive Systems: responsible for alertness, awareness, normal wakeful state

Cerebral Homeostasis: balance, maintaining brain perfusion and oxygenation using cerebral autoregulation.

Motor Control: affects tics to seizures, weakness to paralysis

Sensation: alterations in sensory systems accompany weakness > paralysis

Types of CNS Disorders: **VINDICATE**

Vascular: involving circulation problems to the brain and spinal cord

Infections of the Brain, Spinal Cord and Meninges

- Meningitis: viral is more common, milder, can't treat. Bacterial is less common, more severe and can be treated with antibiotics
- Encephalitis: infection of the brain tissue, usually viral
- Brain Abscess: localized collection of pus and debris in the brain. One kind is from bacterial endocarditis - heart valve infection

Neoplastic: tumor metastasizing to the brain. Brain tumor is responsible for 1 out of 5 new-onset seizures in people over 21.

Degenerative: progressive deterioration of the CNS

- Alzheimer's
- Multiple Sclerosis
- Parkinson's

Inflammatory - types of inflammation without infection

- Rheumatoid arthritis
- Systemic lupus erythematosus

Congenital: rupture of a congenital aneurysm is the most common cause of spontaneous intracerebral hemorrhage in a young person

Allergic and autoimmune: lupus cerebritus is an autoimmune inflammatory condition. Severe allergic reactions can cause cerebral hypoperfusion and brain damage

Trauma: head trauma can obviously cause neurological problems

Endocrine and metabolic: glandular, electrolyte, hormonal imbalances may result in neurological symptoms. Hypoglycemia and hypoxia are common and easily cared for.

Assessment:

1. General Appearance: first impression of how sick they appear
2. Level of consciousness: give them a challenging task, memorization
3. Speech: determine if there has been any recent changes
4. Skin: splotchy, bruised looking rash could be sign of meningitis
5. Posture and Gait: determine if there has been any recent changes
6. Vital signs:
7. Head and neck: Ketones on breath can smell like alcohol

8. Thorax and lungs: look for hypoventilation, CO₂ retention and hypoxia
9. Cardiovascular: ECG changes can mimic AMI
10. Nervous system: look for symmetry. Marked differences in the two sides of the body are probably abnormal

Management: Ongoing assessment. ABCs. Assess blood glucose level, treat hypoglycemia. What is normal blood sugar again? 70-100? Start an IV with normal saline or LR

Stroke (Cerebrovascular accident -CVA) and Transient Ischemic Attack (TIA):

Stroke (CVA) results from interruption of circulation to the brain causing ischemia and damage to brain tissue. Neurological symptoms persist longer than 24 hours. Recovery takes place in weeks to months. Two types:

Occlusive: 3 out of 4 strokes, caused by blockage in a blood vessel

Hemorrhagic: caused by bleeding in the brain. Symptom abrupt and severe

Clot Busters: Occlusive strokes only! Must be within 3 hours. Most wake up in the am when it is too late.

Ischemic penumbra: area of tissue potentially viable surrounding the infarct zone.

Cocaine is becoming the most common cause of stroke in young people

Assessment (Stroke): Most common finding is paralysis. Usually hemiplegia, damage on one side of brain affects opposite side of the body. Most have elevated BP. Also seizures, dizziness, loss of consciousness, stiff neck, headache, altered LOC, airway problems, hypoventilation, cardiac dysrhythmias. My favorite: vomiting. Pupillary abnormalities.

Cincinnati Prehospital Stroke Scale:

1. Facial Droop: show teeth or smile
2. Arm Drift: close eyes and hold arms out
3. Speech: you can't teach an old dog new tricks

Management:

Establish and maintain the airway, provide hi-flow O₂ by mask.

Consider intubation if necessary

Nothing by mouth, prepare for vomit

Reassure patients

Start an IV

Cardiac monitor

Measure blood glucose

TIAs: mini-strokes: stroke-like neurological deficits that resolve within minutes to hours. They still should be evaluated at the hospital, because they are at risk for stroke.

Seizures and Epilepsy

Seizure: sudden abnormal brain cell activity. Seizures reoccurring over a span of years is called epilepsy. 3/4th of people with epilepsy have their first seizures before age 20. Four types of seizures:

1. Generalized major motor seizures: tonic-clonic, muscles rapidly contract and relax. Also called Grand mal, last 2-5 minutes

2. Focal motor seizures or simple partial seizures. 1-2 minutes or may spread to body and become generalized.
3. Behavioral Seizure: brief absence, could be temporal lobe epilepsy, also called complex-partial seizure, or in children called petit mal seizure
4. Status Epilepticus: series of seizures without a period of wakefulness between them.

Secondary Causes of Seizures: they are not a disease, they are a symptom.

Infection (meningitis, brain abscess, encephalitis)

Fever

Trauma

Stroke

Tumor

Failure to take anti-seizure meds

Metabolic abnormalities

Drug overdose or alcohol i.e. TCAs

Hypertensive emergency

Liver or kidney failure

Patient Assessment: F A C T S

F- Focus, focal motor or generalized body involvement

A - Activity; what movements took place

C - Color, did they turn cyanotic

T - Time, how long did it last

S - Secondary info like OPQRST for pain, get a SAMPLE history

Postictal state: decreased LOC lasting about 30 minutes. Watch for violent behavior.

Management:

1. give hi flow O2
2. Don't put anything in their mouth
3. Assist ventilation as nec.
4. Be prepared for suction
5. Do not restrain, use padding to protect them
6. Start an IV line
7. Cardiac monitor
8. Check O2 sats
9. Transport in recovery position

Anti-seizure Drugs: diazepam (Valium), lorazepam (Ativan)

Coma and Altered LOC

Causes of coma AIEOU, TIPS

Acidosis, Alcohol

Epilepsy, endocrine

Infection

Overdose

Uremia

Trauma

Insulin
Psychosis
Shock, stroke

Assessment:

1. When was the patient last well? What was the onset?
2. How did the symptoms progress? Pinpoint when things started to change.
3. What symptoms preceded the onset of coma?
4. Clues to drug use
5. Abnormal breathing
6. Evidence of trauma
7. Abnormal pupil response
8. Always check blood sugar

Management:

Establish and maintain the airway
Hi-flow O2
If spinal injury is likely, then immobilize
Monitor vital signs
Transport supine or in coma position
Prepare for vomit
Start IV line for normal saline or LR
Monitor cardiac rhythm
Reassure the patient, even the unresponsive ones.

Syncope and Weakness: partial loss of consciousness. Monitor for cardiac dysrhythmias

Headache: serious causes are tumors, bleeding, hypertension, meningitis, poisoning.

Brain tissue has no nerves to feel pain, so all pain is from stretching or irritation of nearby structures:

Vascular: involves cerebrovascular circulation, constriction or dilation of cerebral vessels. Rapid onset of severe headache could be intracranial bleeding

Non vascular: infection, tumor, muscle spasm

Assessment: In addition to pain, there may be blurred vision, nausea and vomiting, vertigo, stiff neck. Bradycardia, hemiplegia, hypertension, unequal or pinpoint pupils, photophobia.

Management:

1. Monitor ABCs
2. Prepare for vomiting
3. Reduce bright lights
4. Ice pack on painful area
5. O2 10-15L via NRB

Non-Traumatic Abdominal Emergencies

Acute abdomen: abdominal pain not due to injury

It is not necessary for the EMT to make a diagnosis in the field - probably impossible

Digestive System/Gastrointestinal System

Solid	RUQ	LUQ	Hollow
Liver Spleen Pancreas Kidneys Ovaries	Liver Gall Bladder Kidney Large Intestine Small Intestine	Stomach Spleen Pancreas Kidney Large Intestine Small Intestine	Stomach Intestines Gall Bladder Urinary Bladder Uterus Ureter
Main problem	RLQ	LLQ	Main Problem
Injury =Bleeding	Colon Appendix Large Intestine Small Intestine Ovary/Fallopian tube Ureter Urinary Bladder Uterus	Large Intestine Small Intestine Ovary/Fallopian Tube Ureter Urinary Bladder Uterus	Injury=Peritonitis

Common causes of acute abdomen:

Bacterial contamination: infection in the bowel or peritonitis

Chemical irritation: leakage of blood or bile into wrong space

Peritoneal inflammation: bacterial, chemical or trauma

Bleeding: solid organ laceration. Abdominal cavity can hold 1500mL of blood before distention

Obstruction

Four life-threatening acute abdomens

AMI

Ruptured Abdominal Aortic Aneurysm

Ruptured ectopic pregnancy (any woman age 12-50)

Ruptured viscus (any hollow organ)

Localized or diffuse pain: abdominal organs have receptors for pressure, but not for pain.

Focused Physical Exam: evaluate:

General appearance

Tenderness, guarding, rebound tenderness

Pulsating mass - AAA

Management and Treatment

Maintain the airway

Hi-flow O₂

Allow the patient to lie in a comfortable position

Nothing by mouth

Start in IV normal saline or LR

Avoid pain meds that mask the symptoms

Start IV line for normal saline or LR

Monitor cardiac rhythm

Prepare for vomit

Consider AMI

Transport gently but rapidly

Gastrointestinal (GI) Bleeding: rapidly result in hypovolemic shock. Evaluate:

Is the airway open, obstruction due to vomiting blood is common

Is the patient in shock

Is active bleeding present

- Upper GI is bleeding above the duodenum - top of small intestine

- Lower GI is usually lesion in tract below the duodenum

Management: same as above, except more chance of shock

Hematochezia: bright red blood in stool

Melena: dark tarry stool - digested blood

Hematemesis: vomiting blood

Coffee-grounds vomitus: digestion of blood by stomach acids

Environmental Emergencies

Medical condition caused or exacerbated by weather, terrain, atmospheric pressure or other local factors. Risk factors that make it more likely:

- Old or young age

- General health

- Fatigue

- Existing medical conditions (diabetes etc.)

- Medications

Systemic: hypothermia, heat exhaustion and heat stroke

Localized: frostbite, sunburn

Core body temperature (CBT): normal is 37 C or 98.6 F. Most accurate rectally or fresh urine.

Radiation: transmission of heat through space

Conduction: direct transmission of heat by sitting on cold surface

Convection: transfer of heat by circulation of heated particles (wind chill)

Evaporation: loss of heat by vaporization of liquid - only effective means of heat dissipation in high temps.

Heat illness = increased CBT due to inadequate thermolysis

Heat cramps: pains in muscles exercising in hot environment. Excessive loss of salt and water in sweat. Care: move to cool, sips of cool water, IV of normal saline, 15L/min O₂, transport

Heat Exhaustion: more severe loss of fluid and salt.

- Pale, sweaty, hypotensive

- Headache, thirst, normal slightly elevated temperature

Care: move to cool, sips of cool water, IV of normal saline, 15L/min O₂, monitor ECG, transport

Heat Stroke: extreme medical emergency, body can no longer regulate temp.

- No sweat

- Hot, red dry skin

- Lethargy, fatigue, weakness, nausea, vomiting, dizziness ○

- Confused, irrational, altered LOC

- Increased body temp

Care: immediate cooling: ice packs at neck, armpits, wrists, groin. Immersion, fanning, IV of normal saline or LR, 15L/min O₂, monitor ECG, transport

Cold Disorders:

Mild: CBT > 32.2 C or 90 F

Severe: CBT < 32.2 C or 90 F

Compensated: presence of signs and symptoms but with normal CBT

Hypothermia victims stop shivering at 90 degrees

Three primary causes:

Cold water immersion - principle cause of death in boating accidents. Any water less than 98.6. Acute onset, without rescue, chances are low

Cold weather exposure - close 2nd in occurrence, over minutes to hours

Urban hypothermia - debilitated, aged, intoxicated, or all three at once, lack proper thermoregulation, also babies. Chronic onset = hours to days

Signs and Symptoms:

Diminished coordination and psychomotor function

Altered mentation

Cardiac irritability - A-FIB most common, brady down. V-Fib more common in rewarming

They're not dead until they're warm and dead

Treatment:

Remove from cold

Dry off and provide barriers/blankets, insulate

Handle gently, check pulse for 30-45 seconds, begin chest compressions/ventilation/AED as necessary. Cold hearts are resistant to shock (under 86)

Hi-flow O₂, can be warm, moist

Warm fluids if conscious

IV of warm LR

Dress and care for frostbite - NEVER allow to refreeze

Hot packs over carotids, head, lateral thorax and groin

Warm the core first, not extremities - there could be cold acidotic blood and waste in the extremities that will rush in "afterdrop phenomenon"

Frostbite: formation of ice crystals in the extremities

Trench foot: frostbite of feet from wet socks and boots

Treatment: rule out other significant injuries, raise core body temp before extremities, transport asap, protect the site and handle gently, do not break blisters, no smoking, no rubbing. Do not allow to refreeze.

Near Drowning: drowning is death by asphyxiation during an immersion episode, so near drowning is when the process is interrupted and reversed. Drugs and alcohol are involved in 35-75% of drownings. Lakes, ponds and backyard pools. Males 5-8x more likely, also older, younger and African American are higher risks.

Assessment: Signs and symptoms:

Progressive dyspnea

Wheezing

Tachycardia

Cyanosis

Chest pain

Mental confusion

Coma, resp. or cardiac arrest

Treatment:

Mouth to mouth can begin in the water

Stabilize neck if nec.
ECG monitoring
IV of normal saline or LR at TKO

Three types of drowning:

Dry drowning: 10-20% laryngeal spasm cuts off the air
Wet drowning: 80-90% fluid fills the lungs
Secondary drowning: reoccurrence of fluid in lungs (PE or Asp. Pneu) after successful recovery, few minutes up to four days.

Seawater causes an influx of hypotonic serum. Blood can't exchange O₂ and CO₂
Freshwater causes a washout of surfactant and lung loses elasticity.

Diving Accidents:

Pressure increases about 1 pound per square inch (PSI) with each 2 feet in depth. Divers must take pressurized air in scuba gear so the lungs will not collapse

Air Embolism: Divers must exhale on the way up or the volume of gas "trapped" in the lungs will expand. Also it is easier to hold your breath underwater, because the O₂ is under pressure and more gets to the cells. But never hold your breath under water, or upon ascent, the drop in pressure ceases to feed the tissues at the same rate and you could black out. Signs and Symptoms: frothy pink sputum, shortness of breath, vertigo, seizures.

Treatment: High-flow O₂, watch for tension pneumothorax, Trendelenberg, left side lateral trap air in heart. Recompression in hyperbaric chamber

Nitrogen Narcosis: apathetic, slightly euphoric state

Decompression Sickness: the "bends". Nitrogen dissolves into the tissues under high pressure and is released into the bloodstream in the form of bubbles upon a too-rapid ascent. Most cases due to repetitive diving (more than 1 in a 12-hour period). Signs and Symptoms: blotchy red rash, pain in joints, dizziness, paralysis, shortness of breath, Treatment: High-flow O₂, IV normal saline TKO, Trendelenberg, left side lateral trap air in heart. Recompression in hyperbaric chamber

Squeeze Symptoms: severe pain in the ears, sinuses, lungs, airways, teeth, other air spaces, gut, Gradual ascent watch the eardrums.

Assessment for all diving emergencies:

Did you breathe compressed air underwater?
Number of dives, bottom time
Type of equipment
Diver's activities
Type of water, environmental factors, water entry
Companion
Gas mix

In-water recompression
Flew or ran before symptoms

High Altitude Sickness

Acute Mt. Sickness (AMS) unacclimatized people in excess of 8,000 feet.

Dizziness. Headache, irritability, breathlessness, euphoria

High Altitude Pulmonary Edema (HAPE) increased pulmonary artery pressures in response to hypoxia. Shortness of breath, tachypnea, cyanosis

High Altitude Cerebral Edema (HACE) Increased intracranial pressure. Most severe form. Progression from AMS to HACE takes 1-3 days

Behavioral Emergencies

Behavior = how a person acts

Abnormal behavior = deviates from society's norms and expectations

Maladaptive behavior = unable to properly adapt to challenging circumstances

Behavioral Emergency = disorders characterized by abnormal and maladaptive behavior that family/social group can't tolerate

Causes grouped in three categories:

Biological/Organic: diseases, drugs, toxins, biochemical psychiatric disorders

Psychosocial: childhood trauma, bad parents, dysfunctional family

Sociocultural: life events war, death of loved one, economic problems

Management: first and foremost scene and personal safety 10

Useful Interview Skills for Behavioral Emergencies:

1. Listen, use eye contact and empathy
2. Elicit feelings and facts
3. Respond to feelings, validate them
4. Correct misconceptions
5. Provide info on follow up care
6. Offer honest support
7. Ask effective questions
8. Don't lead the "testimony"
9. Structure the interview chronologically
10. Conclude by asking about other events or feelings

Restraining a Patient: Have adequate help, use only necessary force and approved equipment, document all your and your patient's actions

Depression: common reaction to major life stresses, may present as another disease

Suicidal Patients: suicide gesture is a cry for help. Suicide attempt shows true desire to die. Ask directly "Were you trying to kill yourself?"

Legal Issues: know specific regulations for handling these individuals

Substance abuse:

Alcohol abuse = medical, behavioral or social problems related to excessive alcohol consumption

Alcoholism = chronic dependence on alcohol and a pattern of abnormal behaviors. Severe intoxication can result in cardiac dysrhythmias, shock and death. Conditions that may mimic alcohol intoxication: drug abuse, brain tumor, hypoglycemia, meningitis, head injury, stroke, postictal state, DKA, hypoxia

Emergency care: ABCs, hi-flow O2, check blood sugar, transport severely intoxicated patients

Withdrawal Syndromes: Shakes (within 24 hours), seizures (24-48 hours after stopping drinking), delirium tremens (DTs - within 12-48 hours delirium, hallucinations, fever, tachycardia, hypertension. 15% die.)

Drugs: taken by mouth, injected, placed on skin to treat or prevent a disease or condition.

Ethical: manufactured by legitimate pharmaceutical company to treat specific diseases or conditions

Illicit: manufactured illegally for the purpose of abuse

Drug misuse: intentional or accidental use of a drug not as intended

Drug abuse: use of a drug for a non-therapeutic effect - to get high etc.

Drug addiction: overwhelming desire to continue taking a drug to get a desired effect.

True addiction is both psychological and physical. Drug dependence is just psychological.

Drug withdrawal: signs and symptoms resulting from abrupt cessation of use

Five classes of abused drugs:

Stimulants - uppers. Cocaine, meth, speed, caffeine hyperactivity, euphoria, tachycardia, sleeplessness, seizures

Depressants - downers. Marijuana, barbiturates, sleeping pills, antidepressants, tranquilizers. Sluggishness, slurred speech, decreased respiration and resp. arrest.

Hallucinogens - LSD, mescaline, psilocybin and PCP. Unpredictable behavior, hallucinations, tachypnea, nausea, dilated pupils, tachycardia, hypertension

Narcotics - heroin, morphine, methadone... drowsiness, impaired coordination, sweating, resp. depression, constricted pupils, shock, convulsions and coma

Volatile Chemicals - aerosols, glue, gasoline, freon. Altered LOC, swollen mucus membranes of mouth and nose, hypertension, tachycardia, resp. distress, nausea

Assessment: Expect the history to be unreliable, ask "were you trying to hurt yourself?"

Expect a mixture of drugs and alcohol, violent behavior is common

Management:

1. Maintain the airway, assist as necessary
2. Monitor patient for deterioration in respirations
3. O2 by nasal cannula or non-rebreather
4. Watch for vomiting of course
5. Prepare to suction
6. Notify Law Enforcement/Poison Control
7. Measure blood sugar
8. Monitor ECG
9. Place an IV
10. Monitor for shock
11. Restrain patient as necessary
12. Do not be judgmental

Gynecological Emergencies

Gynecological Emergencies can include:

- Multiple types of chronic or acute infection
- Hemorrhage from uterus, fallopian tubes and ovaries
- Ectopic pregnancy

Hormones rise and fall stimulating development of eggs in the ovaries. Menses occur approx. every 28 days. First day of menstruation is the first day of the cycle.

Menarche: first cycle age 8-14

Menopause: anywhere from 35-60

Questions need to be broad enough to get information about the whole area:

- Is there pain or cramping
- OPQRST
- Bleeding or discharge
- Nausea, vomiting change in appetite
- Fever, diaphoresis, sweating
- Change in normal bowel habits, constipation/diarrhea
- Urination, pain with urination, hematuria
- Preexisting or chronic medical problems, surgeries

Dysmenorrhea: pain with menses

Dyspareunia: pain with intercourse

Gravida: total number of pregnancies

Para: total number of live births

G5P2 = five pregnancies, 2 live births

Special Concerns:

- Professional behavior: establish trust and support
- Privacy and modesty: limit people on scene
- Pain: there could be significant pain and stress

General Examination

Vital Signs= BP: hypotension could be internal hemorrhage or infection. Pulse: tachycardia due to dehydration, anemia, infection, pain, sepsis. Respiratory rate: could be increased

Skin = cyanosis could indicate anemia or resp. problems

Genitourinary exam: note presence of blood indirectly. No exams

Abdomen = palpate for masses or tenderness. Rebound tenderness is a sign of significant intra abdominal inflammation

Management: O2, tachycardia, hypotension, severe pain i.e. if BP is below 90 start 2 IVs

Specific Emergencies Include:

- Pelvic Inflammatory Disease (PID): caused by bacteria. Signs and symptoms: fever, lower ab pain, discharge, dyspareunia, guarding. Can lead to sepsis, and infertility
- Ruptured Ovarian Cyst: follicles stimulated by hormones enlarge and can rupture> significant hemorrhage>hypotensive
- Ectopic Pregnancy: implantation of a fertilized egg outside of the uterus. 1 in 200.
Consider this first for any female age 12-50.
- Tubal rupture> massive bleeding> shock.
- Straddle injuries: trauma to perineum due to a fall
- Blunt trauma: MVA, physical assault, falls
- Foreign bodies: don't try and remove, transport asap

Vaginal Bleeding

- Miscarriage= spontaneous demise of a pregnancy. Collect any tissue/clots to take to hospital
- Placenta Previa: abnormal positioning of the placenta over the cervix opening.
Profuse, painless bright red bleeding
- Abruptio Placenta: premature detachment of a normally situated placenta. Severe, constant low pain and dark red bleeding

Sexual Assault: be professional, empathetic, show respect, help them cope, be an advocate for the patient and provide a comforting environment. Preserve evidence, collect clothing, do not wash or urinate

Obstetrical Emergencies

Delivery is a natural process. Normal and uncomplicated deliveries require an EMT to support the mother. Remember there are two patients.

Anatomy:

Ovaries: produce eggs, estrogen and progesterone

Fallopian tubes: passageway between ovaries and uterus

Uterus: hollow pear-shaped muscular organ where the fetus develops

Cervix: inferior narrow neck of the uterus

Vagina: birth canal

Perineum: between urethra and anus

Placenta: exchanges O₂ and nourishment from the mother for CO₂ and wastes from the fetus

Umbilical cord: attaches fetus and placenta has two arteries and one vein

Amniotic sac contains 500-100 mL of amniotic fluid, should be clear Fetus: unborn child

Ovulation is at about day 14 in the cycle

Normal Pregnancy

Full term - 280 days or 40 weeks

LMP = last menstrual period

Increased Respiratory depth and rate

Total blood volume increases by 40-50%

Resting heart rate increases 10-20 beats per minute

Normal blood pressure drops 10-15 mm Hg

EDC = expected date of confinement = due date of baby

Three trimesters, each about 13 weeks

- First trimester: most common time for miscarriages ○

- Second trimester

- Third trimester

GPA = Gravida, Para and Miscarriages/Abortions

History of Present Situation:

In addition to SAMPLE information:

Pertinent medical conditions/history

Current health of mother

Recent injuries, illness, fever

Prenatal care

Drug use (baby may need extra resuscitation)

Regarding the current pregnancy

First day of LMP

Delivery date

Previous pregnancies/deliveries? Any complications?

Previous C-Section?

When did the contractions start, how far apart?

Any other pain/bleeding

Physical Examination

Look for crowning

Management:

O₂

IV

Position on left side to avoid supine hypotensive syndrome

Complications:

Diabetes: preexisting or gestational

Ectopic pregnancy: can only tell by ultrasound

Supine hypotensive syndrome: lay on the left side to avoid the uterus squashing the inferior vena cava

Preeclampsia: hypertension and fluid retention. Mild 140/90, severe 160/110. Rise in 20/10 . Puffiness, excessive weight gain, headache, protein in urine

Eclampsia: seizures. ABC, O₂, IV, valium + magnesium sulfate

Pregnancy induced hypertension is 30/15 above normal baseline BP. Consider 140/90 to be hypertensive

Trauma During Pregnancy:

Due to increased HR and lowered BP, vital signs are challenging to make sense of.

During trauma, the body will preserve the mom first.

Miscarriage= spontaneous demise of a pregnancy. Collect any tissue/clots to take to hospital

Placenta Previa: abnormal positioning of the placenta over the cervix opening.

Profuse, painless bright red bleeding

- Risk factors: multiple pregnancies, rapid succession of pregnancies, over 35 yo, previous history of Placenta Previa

Abruptio Placenta: premature detachment of a normally situated placenta. Severe, constant low pain and dark red bleeding

- Risk factors: history of preeclampsia, chronic hypertension, multiple pregnancies, previous history of Abruptio Placenta, MVA, cocaine use

Uterine Rupture: occurs most commonly after onset of labor

Labor and Delivery

First Stage: Dilation. Beginning of regular contractions to complete dilation of cervix to approx 10 cc. Averages 12.5 hours to 7 hours

Second Stage: Expulsion. 10cc cervix to delivery of newborn. 80 min to 30 min If birth is imminent, do not transport. Place patient in a semireclining position on the firm, comfortable surface. Signs:

Frequent contractions less than 2 min apart

Intense urge to push

Crowning

- Remember, gentle back pressure to prevent explosive delivery/tears to perineum
- Manually rupture amniotic sac
- As head delivers, check for the cord, if wrapped, slip it over head
- Suction mouth first and then nose, preferably before the chest is delivered
- Position head slightly down to drain fluids
- Support head while it rotates and rock shoulders up and down gently
- Clamp umbilical cord 4" from baby and 6" from baby, cut between the clamps
- Record time of delivery. Perform an APGAR test at 1 min and 5 min

Sign	0	1	2
Appearance	Blue Pale	Pink body, blue extremities	Completely Pink
Pulse rate	Absent	<100 beats/min	>100 beats/min
Grimace	No response	Grimace	Cough, sneeze, cry
Activity	Limp	Some flexion	Active motion
Respirations	Absent	Slow, irregular	Good, crying

Third stage: delivery of the placenta 5-20 min

- Do not pull on it
- Do not delay transport
- Place in clean plastic bag or other container for inspection in hospital

Postpartum care: breastfeeding helps uterus contract > constricting blood flow, massaging uterus will help stop bleeding. Hemorrhage of more than 500mL immediately after delivery is cause for concern.

Care of Distressed Newborn see next chapter.

Abnormal Presentations:

Multiple Births. Twins are 1 in 90 live births. 40% are premature. There may be a shared placenta or two placentas

Breech: 3-4% of deliveries, preterm 20-30%. If the head does not deliver within 3 minutes of the torso, or tries to breathe, form a V with your fingers to try and make a tunnel of air to the newborn's face. If the baby's head does not deliver, transport mom with buttocks elevated or in knees to chest position

Prolapsed Cord: cord presents first and may get compressed between the newborn and the mother's pelvis, cutting off fetal circulation before delivery. Insert a gloved finger and try to keep the head from mashing the cord. Pulsations in the cord indicate a viable newborn. Transport with mom in Trendelenberg or knee to chest. Cover the cord with warm moist gauze.

Limb Presentation: Transport asap, requires C-section

Cephalopelvic Disproportion: transport asap, requires C-section

Neonatal Resuscitation

Newborn = first few hours of life

Neonate = first 28 days

Infant > 28 days < 1 year

About 6% of deliveries require some type of life support. Complications increase as birth weight goes down. 20x more likely to die.

Size : best chances for babies 3000-4000 grams and over 36 weeks gestation

Low birth weight is considered under 2500 grams

Moderately low is 1501 to 2500

Very low less than 1500

Extremely low less than 1000

Gestational age

Premature/Preterm born before 37 weeks

Full term 38-42 weeks

Postmature after 42 weeks

Mortality

Live birth: neonate that has any sign of breathing, heartbeat or any voluntary movement

Fetal death: after 20 weeks gestation, before delivery, no signs of life after birth

Early Neonatal death: first week, Neonatal death is first 28 days

Perinatal mortality: total # of fetal and early neonatal deaths per 1000 live births

Postnatal death: 28 days to 1 year

Life OUTSIDE:

Respiratory System: breathing is the most critical and immediate change required.

Stimuli are thermal (cold outside the womb) and chemical (low O₂, high CO₂ and low pH). These factors stimulate the medulla.

Circulatory System: changes are more gradual and are a response to pressure changes. Fetal shunts close: the foramen ovale and the ductus arteriosus.

Thermoregulation: Large surface area, thin layer of fat and can't shiver, so wrap them up quick and cover their heads

Hemopoietic System: Full term newborn has 80-85 mL of blood/kg of body weight. Most have about 300 mL at birth

Care of Newborn in Distress:

Airway: as the head is delivered, suction the mouth first then the nose. Keep the head down a bit from the body to allow fluids to drain

Breathing: Rub soles of feet and back to stimulate. Newborns are sensitive to hypoxia > brain damage. Primary apnea is reversed with stimulation. Secondary apnea requires ventilation

- Use a rolled towel under shoulders. Sniffing position, don't hyperextend the trachea

- If breathing is absent or irregular, BVM at 40-60 breaths per minute
- Circulation/Heart Rate: Cardiac arrest is secondary to respiratory failure. If HR is below 100 beats per minute, ventilate with 100% O₂. If HR is below 60 initiate CPR
- Color: If central cyanosis persists after stimulation and they are breathing, give O₂. Acrocyanosis or peripheral cyanosis (blue hands and feet) can persist for up to 48 hours after birth.
- If an IV is needed: arms, feet and scalp are the most common spots. Fluid therapy is *10 mL/kg of body weight over 5-10 min*. Normal saline or Lactated Ringers.

Meconium: thick greenish black stools that usually pass after birth. Stress can cause it earlier. Neonate can aspirate and this is an emergency > respiratory distress. Vigorous suctioning of the hypopharynx before delivery of the shoulders.

Preterm infants:

- Less Surfactant: reduces surface tensions of fluids in the lungs. Makes diffusion of O₂ and CO₂ more efficient. Without it, newborns are unable to keep their lungs inflated.
- Less fat, translucent skin, cartilage soft, reflexes absent, can't cough, suck, swallow or gag.
- Apnea of prematurity, more prone to SIDS
- Sepsis: generalized bacterial infection. 4x greater chance of developing it

Transport:

- Level I: normal care
- Level II: manage full range of care and most maternal and neonatal complications
- Level III: full range, all complications, neonatologist on staff

From the Basic Class and still matches this book:

Neonatal Resuscitation

Assess and support Temperature, Airway, Breathing and Circulation

****HEART RATE**** is the most important measure of the need for further resuscitation

Heart Rate		Action
More than 100 beats per minute	Frequently Needed	Dry, warm, position head slightly down, suction mouth then nose, stimulate Transport, assess continually
60-100 beats per minute	Less Frequently needed	Establish effective ventilations BVM 100% O ₂ 40-60 times a minute Transport, reassess continually
Fewer than 60 beats per minute	Infrequently needed	Establish effective ventilations : BVM 100% O ₂ 40-60 times a minute Chest compressions - 100 beats per minute, hand-encircling, thumbs to sternum Compression to Ventilation to 3:1 (90 compressions to 30 ventilations or 120 events per minute) ALS backup: Medications, Intubation

Geriatrics

Common Problems due to Falling:

- Reduced mobility and independence

- Poor nutrition due do difficulty preparing food and eating it

- Difficulty with elimination

- Skin abrasions, injuries and circulatory compromise

- Injuries/trauma from falling

- Decreased medical compliance

History of Falls, investigate:

- CNS disorders

- Weakness

- Impaired vision

- Dizziness

- Cerebral vascular accidents

- Medications

Changes in Normal Sensation:

- Vision: cataracts are opacities in the lens, Glaucoma is high ocular pressure that can lead to vision loss

- Hearing loss: can cause a barrier to proper treatment

- Speech: physical and mental changes can impair speech

- Pain perception: things just don't hurt as much

- Continence and Elimination: can be embarrassing and unsanitary

General Assessment: you may be the only person who has seen them in a long time. Take the time to assess their ability to care for themselves and assess their activities of daily living.

Physical Exam: do a full head to toe, like a trauma exam if possible because they may not be able to tell you what's going on with them.

General Management:

- Airway: watch for dentures and other airway obstructions

- Circulation: Don't give too much IV fluids to CHFers

- Transport: ask them to move and you help them, so as not to injure fragile bones

Specific Systems: Ask them "What has Changed?"

- Respiratory complaints - watch for: Pneumonia, PE, CPOD,

- Cardiovascular watch for: CHF, what medications, take orthostatics

- Nervous system: watch for Stroke, and determine when the current issue started.

- o Cincinnati Stroke Scale: Facial droop (smile), Arm Drift, Speech

- o Thrombolytics must be administered within 3 hours to help

- Endocrine: watch for diabetes 20% of the geriatric population has it. Many times geriatric diabetics have COPD too.

GI: these symptoms can be secondary to some other medical problem

- Nausea, Hiatal Hernia, GI bleed, Bowel obstruction

Central Nervous System:

- Stroke
- TIAs
- Delirium: quick onset, caused by infection, electrolyte imbalance, fever, medications etc. and reversible
- Dementia: progressive loss of intellectual function, irreversible
- Alzheimer's: progressive loss of cognitive function
- Parkinson's: degeneration of the basal ganglia causes tremor at rest, sluggish movement and muscle rigidity

Other Special Considerations:

Toxicology: average 4-5 prescriptions routinely > drug interactions > non-compliance > side effects

Substance Abuse: stress, depression, confusion, falls

Environmental Emergencies: sensitive to changes in temperature

Trauma: osteoporosis makes it easy to fracture long bones, pelvis and hip

Cardiac: function and output are already reduced. Shock and blood loss can have a profound effect on perfusion

Head injuries: the brain shrinks, leaving more room to bounce around

Burns: significant cause of mortality. They don't heal as fast, infections abound and stress can cause AMI

Immobilization on a long board may be impossible or traumatic. Watch their backs and necks.

Neglect/Geriatric abuse: frequent calls to EMS, multiple injuries in different stages of healing, lack of food, clothing, shelter, lack of proper medications, hygiene, APS = Adult Protective Services

Respiratory Emergencies

Extremely common: two categories, acute and chronic, both can present as life threatening.

Respiratory System: filters, warming. Humidifying and exchanging more than 10,000L of air per day (adult).

Upper: mouth, pharynx (nasal and oral) larynx and vocal cords.

Lower: trachea, bronchi, bronchioles and alveoli

Respiration= inspiring O₂ and exhaling CO₂

Ventilation = exchanging CO₂

Diffusion= crossing the capillary/alveolar junction

Perfusion = oxygenated blood pumped out to the tissues

Pathophysiology: problems that affect gas exchange (ventilation)

Upper airway obstruction (trauma, epiglottitis, tonsillitis, choking)

Lower airway obstruction (trauma, obstructive lung disease, mucus, bronchospasm airway edema)

Impaired chest movement (trauma, hemothorax, pneumothorax, empyema (pus)

Neurological control problems, depressed CNS function, stroke, disease

Diffusion-Related problems:

Low O₂ in air

Alveolar pathology (COPD, blebs)

Interstitial space pathology, high water pressure, edema

Perfusion-Related Problems

Inadequate blood volume, or hemoglobin levels

Impaired circulation

Chest wall trauma

Assessment Findings: Major focus is recognizing life-threats

Altered mental status

Severe cyanosis

Absent breath sounds

Stridor

1-2 word dyspnea

Tachycardia >120/min

Pallor, diaphoresis

Use of accessory muscles

Focused History

- Ever had this before, known pulmonary problems, ever been intubated,
- Medications, changes in medications

- Possible toxic exposures

General Impression, evaluate the following

- Position- tripod position = moderately severe respiratory distress
- Mentation
- Ability to speak
- Respiratory Effort
- Skin color and appearance

Vital Signs: obtain baseline vitals, Pulse, BP, Respiratory rate/patterns

Head and Neck: pursed lips breathing, JVD, sputum suggests infection

Chest: symmetry, trauma, barrel chest (COPD), retractions

Extremities: carpopedal spasm = low CO₂ levels

Diagnostic testing: Pulse Ox, Peak flow, Capnometry (end of ET tube)

Obstructive Airway Diseases are Asthma (4-5%) and COPD: sometimes divided into emphysema and chronic bronchitis (20% of adult males). Contributing factors:

Stress

Infection

Exercise

Tobacco smoke can cause asthma and COPD

Allergens: food, animal dander, dust, mold, pollen

Drugs: reactions to beta blockers

Occupational hazards: latex allergy

Pathophysiology of obstructive lung disease:

Smooth muscle spasm/bronchospasm: beta receptors respond to sympathetic stimulation>bronchodilation. Beta blockers are bronchoconstrictors

- Aminophylline
- Theodur
- Somophylline, Elixophylline, Brethine
- Proventil, Ventolin, Alupent, Albuterol

Mucus: cilia moves mucus out

Inflammation

Asthma: 8.9 million people have this acute airflow obstructive disease of the lower airway. Hypersensitive bronchial airways that are easily irritated>bronchospasm> limits movement of air>increased mucus> swelling and edema> inflammatory cell proliferation

Most common onset in children and young adults. 1/3 develop it before age 5, 1/3 of children outgrow it, adult onset asthma is usually persistent. 1/4 diagnosed after age 50.

Extrinsic asthma: some specific outside substance causes bronchioles to narrow, more common in children

Intrinsic asthma: no substance identified as causing narrowing. More commonly adult onset

Triggers to Asthma Attack:

Respiratory infections

- Allergens
- Drugs
- Irritants
- Exercise
- Emotions/Stress
- Chemicals
- Changes in environmental conditions

Status Asthmaticus: severe, prolonged asthma attack that does not respond to standard medications. Monitor closely, transport immediately

COPD: progressive and irreversible disease, marked by decreased inspiratory and expiratory capacity of the lungs. Usually a combination of bronchitis and emphysema.

Caused by:

- Overgrowth of airway mucus glands, excess mucus
- Emphysema = destruction of the elastic walls of the alveoli (they trap air and eventually pop)
- Airway has a marked resistance to air movement
- COR PULMONALE = Right Side heart failure due to effort required to move blood to diseased lungs
- Major cause is cigarette smoking
- Quiet sounding chest in a patient who is obviously short of breath is ominous - airways may be too tight to wheeze-----*
- CO2 Retainers = patient who have lost their CO2 drive to breathe, low O2 (hypoxic) is their only drive to breathe. Quite unusual

Signs and symptoms:

- Shortness of breath, 1-2 word dyspnea
- Coughing
- Cyanosis ----- Serious*
- Anxiety, feeling of suffocation, too tired to breath ----- Problems*
- Altered LOC----- Transport*
- Diaphoresis and pallor----- Priority*
- Tachycardia
- Hypertension
- Tachypnea
- Cigarette stains on fingers
- Barrel chest
- Use of accessory breathing muscles
- Audible abnormal breath sounds
- Decreased pulse ox (low 90s is good for COPDers)
- Neck vein distension
- Leg edema

Management of COPD/Asthma

Intubate if: severe respiratory difficulty, cyanosis, BP<70
Or provide high flow O2 on a non-rebreather (85-100% O2) or nasal cannula
6L/min (24-44%)
Transport upright, keep calm, don't exert
Monitor vital signs, pulse ox, ECG
Treat bronchospasm with albuterol (beta 2 agonist) and/or epinephrine IV
solution of normal saline or lactated Ringers or 5% dextrose in water
Transport priority patients

Pneumonia: acute inflammatory condition of the lungs, Bacterial, fungal or viral, 5th
leading cause of death. Group of infections due to many different agents. Disorder of
ventilation due to infection of the lung parenchyma> sometimes atelectasis.

Community acquired: not as severe

Hospital acquired: pseudomonas = gram negative bacteria

Risk factors:

Cigarette smokers

Alcoholics

Cold exposure (chronic hypothermia - homeless people)

Extremes of age

Abnormal immune systems

Assessment: typically acute fever and chills, cough, pleuritic chest pain, crackles

Management: Contagious! Airway support, O2, IV to rehydrate, watch for septic shock,
reduce fever, inhaled Beta-2 agonists may be helpful.

Pulmonary Edema: filling of the lungs with fluid in the interstitial spaces, the alveoli or both.
Classified as either high pressure (cardiogenic, resulting from AMI) or high
permeability (noncardiogenic, hypoxemia, near-drowning, shock etc.) pulmonary edema.

Pathophysiology: result is impaired gas diffusion, particularly O2

In high pressure (cardiogenic) pulmonary edema:

Ischemia leads to left ventricle failure> increased ventricular pressure> pushes
left atrium>pushes back into the pulmonary veins

Increased pulmonary capillary pressure>engorged vessels leak>accumulates in
the interstitial spaces>impairs gas diffusion> alveoli rupture

In high Permeability (noncardiogenic) pulmonary edema the alveolar/capillary membrane is
disrupted

Severe hypotension

Severe hypoxemia (post drowning, post cardiac arrest, severe seizure)

High altitude

Environmental toxins

Septic shock

Assessment: Most common presentation is Acute SHORTNESS OF BREATH. Evaluate
any chest pain, cardiac history, hypoxic episode, shock, chest trauma, toxic gas
inhalation, high altitude. Sign and symptoms: dyspnea, orthopnea (worse lying down),

fatigue, reduced exercise capacity. Wet sounding lungs, crackles, wheezes, decreased pulse ox, and cardiac dysrhythmias. 12-lead ECG may show MA or stress.

Management: High-flow O₂, keep calm, they don't need any more adrenaline, IV if local protocol but KEEP FLOW LOW or TKO. Transport upright.

Pulmonary Thrombo(from a clot) Embolism(break off and float up): blockage of a pulmonary artery by foreign matter. Usually it's a blood clot formed in a pelvic or deep leg vein. 50,000 death annually, 5% of sudden deaths. Around 10% die, and that 10% in less than an hour. Risks:

- Sedentary lifestyle
- Obesity
- Infection
- Cancer
- Thromboplebitis
- BCPs
- Fracture of long bone
- Pregnancy
- Recent surgery
- Blood diseases

Pathophysiology: blood supply to some lung is blocked. Clot breaks off in leg, follows blood through right artia and ventricle and becomes lodged in the lung where it can go no farther> lung tissue ischemic> blood pools>right ventricle pumping against very high pressures> acute cor pulmonale>decreased blood supply

Assessment: Massive PE= cardiac arrest/syncope, altered mentation, cyanosis profound hypotension. Smaller = sudden chest pain, increases with deep breaths, pleuritic chest pain, shortness of breath, respiratory distress, wheezing, hemoptysis, anxiety, shock.

Similar to MI or spontaneous pneumothorax. Tachypnea, tachycardia

Management: ABC, high flow O₂, IV, watch for shock, cardiac monitor, transport in position of comfort

Spontaneous Pneumothorax: sudden accumulation of air in the pleural space. Lung on the involved side collapses. Tension pneumo can also develop.

- More common in men
- Young tall male smokers
- Congenital defect
- Menstruation
- Lung disease
- COPD

Assessment: sudden onset, sharp chest pain, shortness of breath, decreased lung sounds, increased respirations, coughing anxious agitated.

Signs and Symptoms of a Tension Pneumothorax

- Weak pulse

Cyanosis
Hypotension
Decreased breath sounds
JVD
Tracheal deviation (late sign)
Subcutaneous emphysema, crepitus

Management:

Maintain airway, high flow O₂
IV
Cardiac monitor
Transport in position of comfort
Needle decompression as allowed by protocol

Hyperventilation Syndrome: respiratory rate greater than that required for normal body function. Disease states resulting in hyperventilation:

Asthma attack
COPD
MI
Spontaneous. Pneumo
CHF
Diabetic ketoacidosis
Drugs
Psychogenic factors

Assessment: Chest pain, dizzy, faint, numbness, tingling in extremities, altered mental status, tachycardia, palpitations.

Management: don't assume it is just anxiety, there are lots of disease states that cause hyperventilation. Assume illness until proven otherwise. Give O₂, Take a pulse Ox, try to help them slow breathing, if chest pain > IV, transport according to protocols.

Cardiovascular Emergencies

Epidemiology: CVD is number 1 killer, 2600 die each day, High BP, Coronary Heart Disease, AMI, Angina, Stroke, Rheumatic heart disease and CHF, 1 in 5 adults has some form. Risk Factors:

Age: death rates rise with each year of life

Family history: predisposition

Hypertension: major risk factor BP>170/95 = 5 times higher risk

Lipids: high bad cholesterol

Smoking

Gender: males have higher risks

Diabetes

Cardiovascular system

Stroke volume: amount of blood pumped into the cardiovascular system in one heart contraction Amount is usually around 70mL. Depends on:

Contractility: the extent and velocity of muscle fiber shortening

Preload: the passive stretching force on the ventricular muscle at the end of diastole. More blood returning increases the preload, less blood returning decreases it. If the container (vessels) is greater than the fluid, you'll have inadequate preload and a decrease in cardiac output.

Afterload: the pressure the ventricular muscles must generate to overcome the higher pressure in the aorta, and eject the blood out.

Myocardium: Heart muscle

Epicardium: outside of the heart

Pericardium: thick set of two membranes surrounding the heart, inner is visceral, outer is perietal

Blood Pressure: the force that blood exerts against the walls of the arteries as it passes.

Systole: pressure within the arteries during heart contraction, concomitant pumping

Diastole: Relaxation phase, also indicates myocardial perfusion

Cardiac Output: amount of blood pumped each minute. Heart rate x stroke volume.

Cardiovascular system is closed so increasing cardiac output or vascular resistance increases blood pressure. Decreasing cardiac output or vascular resistance decreases BP.

Pulmonary Circulation: transports deoxygenated blood through the lungs, oxygenate it, and return it to the left side of the heart

Systemic Circulation: left ventricle pumps blood out to the body through SEMI-LUNAR (AORTIC) valve to the aorta

Coronary Circulation: where the heart muscle receives its blood supply, right main, left main etc. etc.. Five coronary veins empty into the right atrium via the coronary sinus.

Blood Vessels: closed system, sometimes called "the container"

Elastic, always adjusting their diameter
Responding to local tissue needs, bypassing less important tissues for vitals
Sympathetic nervous system activates dilation and contraction

Inherent Pacemaker Rates of the Heart:

“Foci” or the focus: where electrical impulses start, Organized rhythm is required for perfusion

Complexes: blocks of rhythms

Isoelectric line: midline on an ECG, up is depolarizing, down is repolarizing

Normal Sinus rhythm: (NSR) originates in the uppermost node, the SA (SinoAtrial) node, rate is usually between 60 and 100 beats per minute

AV Junction: if SA or atria fail, the junctional node starts. Usually 40-60 beats per min. (no P-wave will show on the chart)

Junctional Rhythms: any rhythm starting in the AV Node or the AV Junction

Ventricular: If SA, atria and AV junction fail, bundle branches and Purkinje’s fibers, 20-40 beats/min

V-Fib: Totally unorganized, causes the heart to quiver (get the AED)

V-Tac: wide rhythms, electrical impulses starting from the lower bundles (get the AED)

A-Fib: Abnormal heart rhythm

PVC: Premature Ventricular Contraction. Will show as a big fat wave in the middle of all the regular complexes

Trigeminy: PVC one out of every three contractions

Bigeminy: PVC one out of every two contractions

Unifocal PVC: one focal point is firing

Multifocal PVC: multiple focal points are firing

The EKG is just showing the electrical impulses. This is not proof that the heart is, in fact, beating. Check the pulse, there may be no mechanical capture of the electrical signal.

EMD: Electromechanical disassociation

PEA: Pulseless electrical activity

Electrophysiology:

Automaticity: self-generate electrical activity

Excitability: respond to appropriate electrical stimulus

Conductivity: transmits stimulus from cell to cell

Contractility: Contract when stimulated by the appropriate electrical stimulus

Regulation of heart function: comes partially from the brain (autonomic), from hormones if the endocrine system and from the heart tissue

Baroreceptors: sensory nerve endings that sense changes in BP from vasodilation/ constriction

Lower BP in response to increased arterial pressure

- Inhibit medulla
- Excite vagal center

- Decrease force of cardiac contraction
 - Increase BP in response to decreased arterial pressure
 - Inhibit vagal center
 - Activate sympathetic nervous system > norepinephrine and epinephrine
- Chemoreceptors: walls of atria of heart, vena cava, aortic arch and carotid sinus. Increase in CO₂/decreases in O₂ initiate a sympathetic response to increase rate and depth of respiration.
- Chronotropic State: control of the heart rate
 Less than 60 = bradycardia
 More than 100 = tachycardia
- Dromotropic State: rate of electrical conduction
- Inotropic State: Strength of contraction

Electrocardiographic Monitoring: a record of the electrical activity in the heart, transferred to the ECG machine and displayed or printed on paper
 Boxes on the paper represent time: .2 sec largest lines
 Positive impulses go upward, negative go downward

- Flatline: Isoelectric line is produced if no electrical impulse is present
- P-Wave: occurs first and represents depolarization moving through the atria, resulting in atrial contraction. Upright and round, usually 60-100
- PR Segment: pause as the impulse passes through the AV node
- QRS Complex: depolarization moving through the ventricles, ventricle contraction/systole
- ST Segment: Repolarization of the ventricles, shows flat
- T wave: Complete repolarization
- U wave: sometime a small wave before the next P wave

Dysrhythmias : irregularities of the heart rhythm: including

- Myocardial ischemia/necrosis
- Autonomic nervous system imbalance
- Distention of heart chambers
- Acid-base abnormalities
- Hypoxemia
- Electrolyte Imbalance
- Drugs
- Electrical injury
- Hypothermia
- CNS injury
- Atrial dysrhythmias
 - Ischemia
 - Hypoxia
 - Atrial stretching due to CHF
 - Increased pulmonary artery pressure
 - Wandering atrial pacemaker > pacemaker site switches from beat to beat (also MAT multifocal atrial tachycardia)

Atrial flutter 250-350 beats a minute\
Atrial fibrillation> multiple area fire simultaneously

Assessment: LOC, ABCs, SAMPLE, OPQRST

Detailed Physical Exam: JVD, Thorax, Epigastrium (AAA?)

Vitals: BP, heart rate, skin temp, color, condition, pulse Ox

EKG: The EKG is just showing the electrical impulses. This is not proof that the heart is, in fact, beating. Check the pulse, there may be no mechanical capture of the electrical signal.

Management: ABCs, is the patient stable?

Asystole: prompt CPR, O2, intubation, IV line, epinephrine, atropine, transport

PEA: prompt CPR, O2, intubation, IV line, epinephrine, atropine, transport

V-Tac: AED

V-Fib: AED

Other causes of chest pain - potentially life threatening problems

Angina: Angina Pectoris is an intermittent attack of chest pain due to a reduction in blood flow to the heart muscle> exertion, stress, cold weather

Stable

Unstable

Progressive

Preinfarction

AMI: Acute Myocardial Infarction: death of an area of heart muscle due to blockage of blood flow in a coronary artery

Aneurysm: Abnormal dilation of the aorta

Aortic Dissection: sudden tear in the wall of the aorta

Blunt Trauma

Cholecystitis: inflammation of the gall bladder

Pancreatitis

Pericarditis

Pneumothorax

Pulmonary Embolism

Congestive Heart Failure: circulatory congestion due to inadequate flow of blood.

Diabetic Emergencies

Counter Regulatory Hormones: glucagons and epinephrine raise the blood sugar - opposite of insulin

D₅₀ - Medication used to treat hypoglycemia, contains 25 grams of glucose in 50 mL of water

Diabetic Keto Acidosis (DKA): metabolic condition consisting of hyperglycemia, dehydration and accumulation of ketones and ketoacids.

Fingerstick Blood Sugar: testing blood sugar on a glucometer with a drop of blood from the finger. Results in 15-45 seconds.

Glucose: main nutrient for all cells, transported in the blood (blood sugar) approx. 75-100 is normal

Hyperglycemia: elevation of blood sugar level above normal, most common cause is diabetes

Hyperglycemic Hypersmolar Nonketotic Coma (HHNC): blood sugar is elevated but no acidosis is present. Dehydration and lowered level of consciousness

Hypoglycemia: abnormally low blood sugar level, sometime called insulin shock

Insulin: released from the pancreas and together with epinephrine and glucagons, regulated the blood sugar level. Insulin stimulates the production of glucose transport proteins to facilitate the passage of glucose into the cells to be broken down into energy (*Facilitated Diffusion*). Insulin also prevents the breakdown of fatty tissue in the body.

Ketoacids/Ketones: formed when the body metabolizes fats/fatty tissue

Kussmaul Respirations: rapid, deep sighing breaths that help a diabetic blow off excess CO₂, and lower the levels of acid>ketoacidosis

Type 1 Diabetes: require insulin injections to live, usually onset at a younger age

Type 2 Diabetes: non-insulin dependent, onset usually after teenage years, less prone to DKA, most can maintain blood sugar levels with diet.

Diabetes: a chronic disease of the endocrine system caused by a decrease in the secretion or activity of insulin. Diabetics don't make enough insulin to regulate the blood sugar level - it goes too high or too low. When it is too low, the cells start to starve.

Complications of Diabetes

Eye Disease: diabetic retinopathy causes bleeding in the vitreous humor

Kidney disease: diabetic nephropathy>abnormal function> complete renal failure

Nerve disease: chronic pain and decreased sensation, especially in the lower extremities

Increased risk of cardiovascular disease: increased risk and at a younger age

Hypoglycemia: occurs as a result of an imbalance in the amounts of insulin and glucose. Most commonly caused by a patient taking insulin and then not eating enough food.

causes include:

- Medications
- Excessive exercise
- Alcohol
- Poor diet
- Hypothermia
- Liver disease

Assessment: hypoglycemia develops rapidly, over a few minutes to a few hours.

Counter Regulatory hormones are secreted causing early warning signs:

- Shakiness
- Weakness
- Diaphoresis
- Rapid pulse and respirations
- Severe hypoglycemia
 - Altered level of consciousness
 - Slurred speech
 - Neurological deficit
 - Seizure

HYPOTENSION is NOT a sign of hypoglycemia. Look for another cause.

Emergency Care:

- Control the airway
- Give O₂ via nasal cannula at $\frac{3}{4}$ L/min
- Monitor the ECG
- Give OJ with 2 packs of sugar, oral glucose, corn syrup or candy
- Start an IV and draw a blood sample
- Local protocols may allow D50, 50% dextrose (25 g dextrose in 50mL water) intravenously
- Always assume hypoglycemia and give sugar. Never give insulin
- Provide psychological support

Diabetic Ketoacidosis - DKA: diabetic person has inadequate insulin circulating to control blood sugar levels. Also there's excess epinephrine and glucagons present. Blood sugar level rises, fatty tissue breaks down forming ketones and ketoacids> changes blood acid/base balance>frequent urination>dehydration>loss of body chemicals (potassium)> chain of events leads down hill. Takes longer/more problems than hypoglycemia. Usually starts with an infection. Too small dose of (or forgot to take) insulin. Pretty rare. Signs and Symptoms:

- Weakness, nausea, vomiting (of course, more vomiting)
- Abdominal pain
- Polyurea, polydipsia
- Kussmaul respirations
- Altered LOC

Fruity, acetone odor to breath (not always)

Normal BP or mild hypotension

Rapid, weak pulse

Emergency Care:

Control the airway

Give High concentration O₂

Monitor the ECG

Start an IV and draw a blood sample. Fluid bolus usually 500-1000mL normal saline or lactated Ringer's

Watch for shock

Nothing by mouth, Never give insulin

Transport

Psychological support

Hyperglycemic Hyperosmolar Non Ketotic Coma (HHNC): Relative insulin deficiency, high levels of glucose in the CSF> but no ketones present> dehydration of the brain and decreased level of consciousness. Most at risk:

People over 60

Precipitated by infection, extreme cold or dehydration

Gradual deterioration over 4-5 days

No Kussmaul breathing, no fruity breath (because no acidosis)

Managing Diabetic Patients: Always ask?

1. What did you eat today?
2. Did you take your insulin?
3. Has the dosage changed?
4. Are you under any unusual stress?

Physical Assessment: look for:

Altered Mental Status

Kussmaul respirations

Tachycardia

Hypotension

Skin color, temperature

Hydration status

Allergic Reactions

Allergic Reaction: result from exposure to any substance to which an individual is sensitive

Anaphylaxis: Specific type of allergic reaction caused by the interaction of an allergen (called an antigen) and one antibody (IgE)

Allergen: Generic term for any substance to which a person is sensitive

Antigen: an Allergen

Antibody: Antibodies respond to antigens. There are five types of antibodies, part of the immune system that recognizes antigens and stimulates an immune system response

Diphenhydramine: Benedryl. An antihistamine that blocks the effects of histamine

Epinephrine: Adrenaline. Stimulates alpha and beta blockers

Histamine: Cellular substance released into the body during anaphylactic shock, causes bronchospasm, vasodilation and leakage of fluid from vessels

IgE: Ig=immunoglobins. IgE is the only antibody involved in anaphylaxis

Pathology of Anaphylaxis:

Antibodies attack antigens. The severity of the symptoms range from progressive hives to cardiac arrest.

Histamine release occurs first

- Bronchospasm
- Vasodilation
- Leaking of fluid

Histamine stimulates the release of other mediators

- Unpredictable spiral of events

Biphasic (early and late) anaphylactic response is 1 out of 5 people

- Reoccurrence 4-5 hours later> may lead to shock

Presentation, Signs and Symptoms

Upper Airway: hoarse, stridor, edema, runny nose

Lower Airway: bronchospasm, mucus, wheezing, decreased breath sounds

Cardiovascular system: tachycardia, hypotension, dysrhythmia, chest tightness

GI: nausea, vomiting, cramps, diarrhea

Neurological system: anxiety, dizziness, syncope, weakness, headache, seizure, coma

Cutaneous: angioedema, urticaria, pruritus, erythema, edema, tearing of the eyes

MOST COMMON: hives, wheezing, abdominal pain

Methods of Entry into the Body:

Inhalation

Absorption

Injection

Ingestion

Assessment:

Get a good history ask about recent changes in foods, drugs, detergents, cosmetics etc.

Signs and Symptoms of Anaphylactic Shock

- Sense of agitation, confusion, decreased LOC
- Swelling of soft tissues like hands tongue and pharynx
- Wheezing, rales, rhonchi
- Tingling, burning, itching skin
- Abdominal pain
- Tachycardia
- Weak, thready pulse
- Profound hypotension (late sign)
- Weakness
- Diaphoresis
- Cyanosis
- Peripheral edema

Mild Reactions:

Treatment: Benadryl 10-50 mg slow IV push or IM if vital signs are normal, no respiratory symptoms, itching rash/swelling on outside of body.

Moderate and Severe Reactions:

- Aggressive airway management
- Ventilatory support
- Oxygen therapy
- Circulatory support
- Epinephrine .3-.5 mL subcu if:
 - Wheezing or stridor
 - Edema of the pharynx, tongue or soft palate
 - Vascular compromise (hypotension, weak thready pulse, confusion, tachycardia)

Anaphylactic shock:

- Provide reassurance, keep them calm
- Ensure an adequate airway
- Intubate if the patient can't maintain an airway
- Apply EKG pads to monitor
- High flow O2 by non-rebreather
- Start an IV, large bore cannula, normal saline or lactated Ringers, macro drip, BP<90 run it wide open
- Administer epinephrine .3-.5 mg SQ, or IM with an Epi-Pen
- Bronchodilators may be used for stridor or wheezing
- Transport priority patients

Trauma

Statistics: leading cause of death ages 1-44 years

5th leading cause of death nationwide

60% of childhood deaths (MVA, choking)

80% of teenage deaths MVA

Phases of Trauma Care

Pre-event: prevention of intentional and unintentional trauma deaths

Event: actual traumatic event

Post-event: EMS most involved, lifesaving procedures, prepare for transport, prompt transport to appropriate facility

Trauma Systems: 8 Components:

1. Injury Prevention
2. Prehospital triage, treatment, transportation
3. Emergency Dept care
4. Interfacility transportation
5. Definitive care
6. Trauma critical care
7. Rehab
8. Data collection/trauma registry

Trauma Centers: categorized on the basis of resources and programs available:

Level 1: Regional Resource center

Level 2: provides comprehensive care

Level 3: communities with no Level 1 or 2 institutions

Level 4: created with rural and remote areas in mind

Transport Considerations: with patient's needs and condition in mind:

Geographical, topographical, population

Weather, traffic conditions, time of day

Availability of resources

Air transport when ground will threaten survival, weather, traffic or road will delay etc.

Kinematics of Trauma: kinematics is the process of predicting injury patterns resulting from the forces and motion of energy. Perform an overall assessment of the scene and the kinematics of the situation.

Energy Principles and Newton's Laws:

Newton's 1st Law of Motion: a body at rest will stay at rest and a body in motion will stay in motion until acted upon by an equal and opposite force

2nd Principle of physics: Law of Conservation of Energy = energy cannot be created or destroyed. It can change its form. Forms of energy are mechanical, thermal, electrical and chemical

Newton's 2nd Law of Motion involves force and the effects of acceleration or deceleration

Force = Mass x Acceleration
Force = Mass x Deceleration

Airbags decrease the decelerating force considerably

Kinetic Energy (KE) refers to an object's weight and speed, when weight is mass and speed is velocity:

$KE = \frac{1}{2} M \times V^2$

Speed is the determining factor in predicting the damage that occurs

Types of Trauma

Penetrating: invasive injury to the body where an opening in the skin is created

Blunt: skin remains intact, but internal organs may be damaged

- Compression
- Sheer (change of speed)

Motor Vehicle Collisions

Impact 1: vehicle vs. object
Impact 2: body vs. inside of vehicle
Impact 3: internal organs vs. solid structures of body

Types of Collisions:

Head on: forward motion stops abruptly, occupant keeps moving at speed of car
Down and under, or up and over

Lateral/Side/T-Bone: lateral stop can mean intrusions - damage pelvis, torso, extremities. lateral slide - damage head, neck, thorax

Rear End: difference in speed of the two cars is the damaging velocity
Rapid acceleration of front car = back & neck injuries

Rotational: common injuries with head on and lateral

Rollover: same injuries as lateral, but more chances/places to hit, unrestrained=ejection= very bad

Restraints: unrestrained occupants in MVAs are 6 times more likely to die

Unrestrained: over and up = aortic rupture, hemothorax, chest/rib fracture
Down and under = knees and/or femur fracture, hip, vascular injury, hemorrhage

Lap Belts: most commonly used. Thorax 12, Lumbar 1 and 2 injuries, submarining

Diagonals: should be used with lap belts. Look for clavicle injuries

Air Bags: cushion forward (or side) motion, can produce significant injuries on their own

Hemorrhage and Shock

Perfusion: The process by which oxygenated blood is delivered to the body tissues and wastes are removed.

Diffusion: movement of particles from an area of greater concentration to an area of lesser concentration.

Fick Principle: the quantity of O₂ delivered to a body organ is equal to the amount of O₂ consumed by the organ plus the amount carried away. There are four necessary components to get O₂ to the cells:

1. Inspiration of adequate O₂ in air, no blockage in airways
2. On-loading O₂ to RBCs at the lungs, adequate numbers of RBCs, and good capillary/alveoli contact
3. Delivery of RBCs to the tissue cells, adequate pump and fluid to flow
4. Off-loading O₂ from RBC to tissue cells, good capillary contact, pH balance and temperature

Cellular Metabolism: aerobic=with air=allows body to use food for energy more efficiently

Cellular respiration = food (glucose) being broken down for energy in a series of reactions

By product produced = pyruvic acid. In low O₂ states, this is converted to lactic acid

O₂ plays role in preventing accumulation of lactic acid

Cardiovascular system

Stroke volume: amount of blood pumped into the cardiovascular system in one heart contraction Amount is usually around 70mL. Depends on:

Contractility: the extent and velocity of muscle fiber shortening

Preload: the passive stretching force on the ventricular muscle at the end of diastole. More blood returning increases the preload, less blood returning decreases it. If the container (vessels) is greater than the fluid, you'll have inadequate preload and a decrease in cardiac output.

Afterload: the pressure the ventricular muscles must generate to overcome the higher pressure in the aorta, and eject the blood out.

Blood Pressure: the force that blood exerts against the walls of the arteries as it passes.

Cardiac Output: amount of blood pumped each minute. Heart rate x stroke volume.

Cardiovascular system is closed so increasing cardiac output or vascular resistance increases blood pressure. Decreasing cardiac output or vascular resistance decreases BP.

Blood Vessels: closed system, sometimes called "the container

Elastic, always adjusting their diameter

Responding to local tissue needs, bypassing less important tissues for vitals

Sympathetic nervous system activates dilation and contraction

Blood: 3 functions:

Transportation: delivers O₂ and nutrients, carries away wastes

- Plasma 55% of blood, fluid with proteins
- Erythrocytes: Red Blood Cells, most numerous of all blood cells, \ contains hemoglobin, a proteins that binds to O₂ \ together 45%
- Platelets - formed elements that make clots / total blood volume

Regulation: buffers regulate pH balance

Protection: leukocytes protect body against injury and disease, 1 for every 700 RBCs

Hemocrit: volume % of RBCs in whole blood. Normally 45mL of erythrocytes, 55mL plasma

Men: usually have 45

Women: usually 43

Blood: 8% of total body weight

70kg/154lbs person typically has 5L (5.2 quarts) of blood

Viscosity: blood flows more slowly than water. Viscosity is determined by the ratio of plasma to RBCs, WBC and platelets. The less plasma, the more viscous > the greater the resistance and more difficulty flowing.

Soft Tissue Trauma: injuries to skin and surrounding structures. Treatment: control bleeding and combat shock/hypoxemia

Closed wounds:

Contusion: bruising below dermis cause by blunt trauma

Hematoma: swelling caused by leaking blood vessels below the dermis

Crush injuries: blood vessel injury and internal organ rupture. Symptoms pain, paresis, paresthesia, pallor, pulselessness (late)

- Crush syndrome prolonged compression - beyond 4-6 hours

Compartment Syndrome: surgical emergency, bleeding and swelling in a closed area compromise circulation and cause tissue ischemia

Open Wounds

Abrasions: outermost layer rubbed off, road rash, treatment: clean remove contaminants

Lacerations: tear, split or incision treatment: control bleeding, monitor for shock

Punctures: sharp, pointed objects damage tissues, internal organs, treatment: control bleeding, monitor for shock

Avulsions: loss of full thickness of skin, treatment: cleanse area, return skin to normal position, control bleeding, bulky dressing

Amputations: partial or complete loss of limb. Major bleeding can be fatal.

Treatment: control bleeding and save amputated part in a sterile dressing>plastic bag>ice. Don't hold transport to look for part.

Hemorrhage: external or internal break in the vascular system. Adult can lose about 500 mL without harm while loss of 300 mL may kill and infant.

External: soft tissue injury

○ Arterial blood: bright red, spurts with pulse, least frequent, most serious ○

Venous blood: dark red, flows slow and steady, typically deeper cuts ○

Capillary: medium red, oozes slowly

Stages of Hemorrhage:

	Stage 1	Stage 2	Stage 3	Stage 4
Intravascular loss	15%	15-25%	25-35%	Over 35%
Compensation	Vascular bed	Cardiac output slows		
Blood Pressure	Maintained	Increased Diastolic	Decreased Systolic	Significantly decreased systolic
Pulse Pressure	Normal	Narrowed	Narrowed	
Heart Rate	Normal	Reflex tachycardia	Marked Tachycardia	Extreme tachycardia
Respirations	Normal	Increased	Marked tachypnea	Pronounced tachypnea
Renal Output	Normal	Almost normal	5-15 mL/hour	
Skin	Pale	Diaphoretic	Diaphoretic, cold, pale	
Mental State	Anxious	Anxious, Confused	Altered Mental Status	Confusion, lethargy, unconsciousness

Assessment: visible blood loss is not a good way to judge the severity of an injury

Body's response to bleeding:

1. Local vasoconstriction
2. Form a platelet plug
3. Coagulation
4. Growth of fibrous tissue

Management of Bleeding Wounds and Shock

1. BSI
2. Direct Pressure
3. Elevate if extremity
4. Additional dressings
5. Pressure dressing and bandage
6. Pressure to appropriate arterial pressure point
7. Elevate patient's legs
8. Apply high flow O₂
9. Cover patient with blanket
10. Initiate immediate transport
11. Reassess vital signs

Internal Bleeding: usually chest, abdomen. Pelvis or retroperitoneum

Signs and Symptoms:

- Coughing up red froth
- Vomiting coffee grounds or bright red emesis
- Melena
- Hematochezia
- Red urine
- Dizzy
- Rapid, gasping breaths
- Orthostatic hypotension
- Pain, tender, rigid abdomen
- Restlessness, nausea, weakness
- Weak rapid pulse
- Cold clammy skin, sweating

Shock: body's response to poor perfusion

Baroreceptors: sensory nerve endings that sense changes in BP from vaso dilation/constriction

Lower BP in response to increased arterial pressure

- Inhibit medulla
- Excite vagal center
- Decrease force of cardiac contraction

Increase BP in response to decreased arterial pressure

- Inhibit vagal center
- Activate sympathetic nervous system > norepinephrine and epinephrine

Chemoreceptors: walls of atria of heart, vena cava, aortic arch and carotid sinus. Increase in CO₂/decreases in O₂ initiate a sympathetic response to increase rate and depth of respiration.

Ischemia: vasoconstriction gives little blood to capillaries > stagnation > tissue ischemia and aerobic metabolism > too much lactic acid > higher pH > metabolic acidosis. Capillaries start leaking and wastes start washing out of the cells.

Stages of Shock

Compensated	Decompensated	Irreversible
Earliest phase, body takes corrective action	Progressive shock, treatment will sometimes result in recovery	Can't be helped by medical intervention
Altered mental status	Increased anxiety and confusion	Marked decrease in consciousness
Increased pulse rate	Additional increase in pulse	Profound hypotension
Increased respirations	Additional increase in respirations	Decreased respirations rate and effort
	Narrowed pulse pressure	
Pale, cool skin	Cool, clammy skin	
	Nausea, vomiting	

	Sweating, thirst	
	Ischemia starting	

Patients at the most risk of shock: Trauma patients, elderly, pregnant women.

Types of Shock:

All types of shock occur due to an underlying lack of tissue perfusion. (Fluid loss, significant vasodilation, pump failure):

Respiratory

Anaphylactic: exposure to substance you are extremely allergic to causes a reaction between the antigen and the antibody, large histamine release

Neurogenic: severe spinal or brain injury makes nervous system unable to control blood vessel dilation (no epinephrine), blood pools up in a container that is too big

Cardiogenic: profound failure of the pump due to AMI, obstruction, heart failure

Hypovolemic: Most common, loss of blood or fluid

Psychogenic: fainting

Metabolic

Septic: infection leads to massive vasodilation

Cardiogenic shock may be differentiated from hypovolemic shock by the following:

Chief complaint - chest pain

Heart rate

Signs of CHF such as JVD

Dysrhythmia

Other types of shock (Neurogenic, Anaphylactic, Septic) can be differentiated by:

Mechanism that suggests vasodilation

Warm, flushed skin

Lack of tachycardia

Managing Shock

Ensure a patent airway

Provide adequate oxygenation and ventilation

Restore perfusion

Repair or stop the cause

Fluid Replacement: IV lines counter blood loss by introducing fluid into the intravascular space > restoring circulatory volume. Most commonly used solutions:

Lactated Ringers, isotonic

0.9% sodium chloride (normal saline), isotonic

5% dextrose in water (d5W), hypotonic glucose

PASG: inflatable garment sometimes used on patients with severely low blood pressure or unstable pelvic fractures.

Most common indication for use is hypovolemic shock.

Criteria for use is systolic BP under 90 when obvious signs and symptoms of shock are present.

Contraindications: pulmonary edema., ruptured diaphragm, cardiogenic shock, pregnancy, respiratory distress, evisceration, impaled object in abdomen

Burns: soft tissue receives more energy than it can absorb without injury: thermal, chemical, electric or nuclear. 10,000 deaths a year. Always perform a complete trauma exam to see if there are other injuries.

Damage depends on:

- Type of Exposure
- What part of body was exposed
- Length of contact

Three Zones of Intensity

- Zone of Hyperemia (Peripheral) - increased blood flow
- Zone of Stasis (intermediate) - surrounds critically injured area
- Zone of Coagulation (Central) - most intense contact with the thermal source

Focus on the airway, breathing and circulation first, then treat the burns

Probability the Airway is obstructed:

- Stridor (airway is 80% narrowed)
- Facial/.intraoral burns
- Soot in nose/mouth
- Edema
- Coughing/wheezing./hoarse voice

Airway: do not delay the decision to intubate the patient. The airway may swell shut any minute (laryngeal edema)! Use a normal sized ET tube.

Breathing: high concentration, humidified O₂

Circulation: if performing IV therapy, initiate a large bore catheter in a peripheral vein in an unburned extremity

Burn Severity:

1. What is the depth of the burn? Superficial (no blister), Partial thickness (blister), Full thickness (all layers, nerve endings destroyed)
2. What is the extent of the burn? Rule of 9s, or palms
UPGRADE CLASSIFICATION if:
3. Are critical areas (the face, upper airway, hands, feet, genitalia) involved?
4. Any other pre-existing medical conditions
5. Is the patient under 5 or over 55?

Minor	Moderate	Major/Critical
Full-thickness <2%	Full-thickness 2-10%	Full-thickness involving Hands, Face, Airway, Genitalia
Partial-thickness <15%	Partial-thickness 15-25%	Full-thickness >10%
Superficial <50%	Superficial > 50%	Partial-thickness >25%
		Smoke inhalation
		Burns complicated by Fractures
		People over 55 or under 5
Children	Children	Children

	Partial-thickness 10-20%	Full-thick, part thick, 20%
		Hands, Face, Airway, Genitalia

Management:

1. BSI
2. Stop the burning process
3. prevent further tissue injury
4. Maintain the airway
5. Give O2
6. Provide fluid resuscitation
7. Provide rapid transport
8. Provide pain management
9. Use clean technique
10. Psychological and emotional support

Specific Types of Burn Injuries:

Inhalation: 20-35% of all patients admitted to burn centers. Happens in closed environments i.e. building, car, plane. Dangers are:

Heat

Fire consumes O2, none left to breathe

Production of Carbon Monoxide and other toxic gases

- o Displaces O2 on the hemoglobin
- o 250x the affinity that O2 has for hemoglobin

Supraglottic: thermal injury to the airway from superheated air

Infraglottic (rare): lung parenchyma and toxic material inhalation

Chemical Burns: alkalis, acids and organic compounds. Find out the type, concentration, volume, mechanism of injury, time of contamination etc. Treatment:

Brush off any dry chemicals

Rinse for at least 20 min. with water

Most by strong acid or alkalis. Fumes can burn too, esp. resp. tract. Don't get any on you. Consider calling HazMat. Brush dry chemicals off, then flush with water. 15-20 minutes after patient says it's stopped burning.

Electrical Burns: three types:

Direct Contact burns - current to skin, Arc injuries - current jumps air to skin.

Source, voltage and type of current are invaluable to the attending physicians

- o Entrance Wound
- o Exit Wound

Flash burns (no electrical current passes through body)

If possible start two large bore IV lines for Lactated Ringer's or normal saline

The human body is primarily water and makes a good conductor. 2 dangers of electrical burns: 1) large amount of deep tissue injury, always more than the entrance wound suggests. 2) Patient might go into cardiac arrest from electrical shock. Get out the AED, they have a good chance

Lightning Injuries: 30% of those struck by lightning die. Pathway of tissue damage is often over rather than through the skin. Linear, feathery, pinpoint burns, patient may also suffer cardiac and respiratory arrest (most common causes of death).

Radiation Exposure: accidents usually involve sealed radioactive sources. Three types of radioactive particles:

Alpha: large, travel few mm, minimal penetrating capability, stopped by paper, clothing and skin, least dangerous external exposure, most dangerous internal exposure if inhaled, ingested or absorbed

Beta: 1/7000 the size of Alphas, more energy and penetration power. Usually enter via damaged skin, inhalation or ingestion

Gamma: most dangerous form of penetrating radiation. Only lead shields protect, internal and external hazard, localized skin burns and extensive internal damage

EMS Response: 200-300 feet upwind, PPE, SCBA. Contain the spread of contaminants, otherwise treat patient as usual.

Thoracic Trauma

Chest Injuries: 16,000 deaths, 20% of all traumatic deaths, second leading cause of trauma death. Rapid transport is their best chance = less than 10 min in the field.

Chest Injuries that interfere with Ventilation

Clavicle: most commonly fractured bones, usually not significant injury

Rib Fracture: most commonly 3 through 8, more likely in adults, significant if underlying organs are damaged by force or broken bone ends

Sternal Fracture: not common, mortality rate 25-45% unstable chest wall, myocardial injury, cardiac tamponade

Flail Chest: 2 or more ribs broken in 3 or more places > paradoxical motion > hypoxia and hypercarbia

Pulmonary Contusion: bleeding in interstitial and alveolar areas of the lung, 50% with blunt chest trauma have it, profound hypoxemia may develop

Closed Pneumothorax: air enters the pleural space, negative pressure won't allow lung to inflate > lung collapse. Treatment: needle thoracentesis

Open Pneumothorax (sucking chest wound): penetrating trauma creates opening into the intrathoracic cavity. Air freely enters/exits the pleural cavity. Severe ventilatory dysfunction, hypoxemia, death. Seal with occlusive dressing, create flutter valve to prevent tension pneumo

Tension Pneumothorax: air enter the pleural space but cannot exit, pressure builds and collapse the lung. Heart becomes compressed. Trachea deviates over away from the collapsed lung.

Airway injuries: Esophagus, Trachea, Bronchi - penetrating trauma can rupture airway structures. Not common, but more than 30% mortality rate when they do happen

Diaphragmatic rupture: abdominal contents can rupture through the thin diaphragm wall and enter the chest cavity. Compressed lungs, heart function poorly > shock

Traumatic Asphyxia: severe crush to chest and abdomen. Forces blood up to thorax, neck, face can lead to seizure coma death.

Injuries that interfere with Circulation

Hemothorax: blood collects in the pleural space, symptoms are loss of blood and hypotension

Hemopneumothorax: air and blood accumulate in the pleural cavity

Myocardial Contusion: electrical problems, bruising to complete rupture

Pericardial Tamponade: Blood (150-200 ml) fills the space between the heart and its liner, the pericardium, heart is compressed and can't expand to receive blood > cardiac output decreased > hypotension

Myocardial Rupture: Compression ruptures chamber walls, septum, valves

Aortic Rupture: high energy accidents, sheer forces tear the heart and aortic arch. 80-90% fatal within an hour

Management of airway and respiratory complications is a priority.

Transport unresponsive patients supine, immobilized on a backboard

Protect the cervical spine

High concentration O₂

Intubation for apneic, agonal respirations

Positive End Expiratory Pressure (PEEP)

1 or 2 large bore (14-16 gauge) IV lines of lactated Ringers solution with a macro set en route

Head and Spinal Trauma

Head injuries kill 50,000 people a year. Head, face neck and spinal injuries are closely related.

Maxillofacial Injuries: compromised airway due to significant bleeding/swelling is the biggest threat. With closed injuries to the head, suspect cervical spine and brain injury.

Management:

- Spinal precautions

- Assess the airway, use suction as necessary

- Secure/maintain airway

- Assure adequate ventilation and oxygenation

- Control bleeding, care for avulsions

LeFort fractures I (maxilla to nasal fossa), II (pyramid of the nasal bones and medial orbits) and III (floating face)

Of the facial bones, nasal bones fractured most often. Do not use nasal airways, nasogastric tubes, or nasal intubation on patients with basal skull or facial fractures.

Blowout Fracture: signs and symptoms: recessed globe, impaired movement, double vision, edema, ecchymosis, epistaxis

Eye, Ear and Dental Trauma: address life-threatening injuries first

Ear: barotitis is caused by changes in barometric pressure. Treatments specific to injury:

- Direct pressure to lacerations

- Ice to swelling

- Cover, protect avulsions

- Irrigate chemical injuries 2-3 minutes 3 or 4 times

- Cover traumatic perforations to prevent further contamination

- Yawn, swallow to clear eustachian tube

Eye: blunt or penetrating trauma from MVA, sports, fights, chemicals, animal bites.

Assessment:

- History: mechanism of injury, previous medical history, medications

- Pupil reaction: Unequal, delay in response

- Extraocular movements: tracking movement, blurred vision

- Contusions: pain, photophobia, tear-shaped pupil

- Corneal Abrasion: foreign body sensation > gentle irrigation

- Foreign body: foreign body sensation while open/closing eye > copious irrigation

- Traumatic hyphema: blood in anterior chamber > immobilize spine, elevate head

- Globe or scleral rupture: decreased vision, soft eye, pupil irregular, hyphema >

 - immobilize spine, elevate head, protect globe from dehydration

Never remove an impaled object, secure it, cover BOTH eyes to limit eye movement

Irrigate a chemical injury for at least 20 minutes

Control bleeding with gentle direct pressure (except on the globe)

Dental Trauma: Most common trauma are fractures and avulsions of the anterior teeth, tongue and surrounding mucous membranes. Teeth can be reimplanted, within an hour is best.

Management:

Remove teeth or fragments, suction airway

Do not rinse the tooth, try to save in milk or sterile saline

Advise the ED

Anterior Neck Trauma: injuries to the base of the neck carry the highest mortality rate. Major vessels, lungs, esophagus, trachea, cervical spine. Laceration of major vessels > rapid exsanguinations, or significantly compromise the airway.

Assessment: Penetrating Trauma

Shock

Active Bleeding

Tenderness

Crepitus

Hematoma

Pulse deficit

Neurological deficit

Esophageal tears > subcutaneous emphysema, neck hematoma, oropharyngeal or nasogastric blood. Reflux = high mortality. Semi-Fowler's may help prevent reflux.

Management:

Secure airway, ventilate as necessary

Treat for shock

Control hemorrhage

Rapid transport

Head Trauma: assume spinal injury with any head trauma. Control bleeding with gentle pressure. Open skull fracture = break in skin, closed = no broken skin. Depressed = fragments forced inward, nondepressed = fragments retain normal alignment

Assessment:

History

Level of responsiveness > very important in the evaluation of brain injury!

Pupils: sluggish to react

Obvious penetration, impalement, deformity

Blood or CSF from nose or ears

Raccoon eyes (12 or more hours later)

Battle's sign = occipital bone, basilar skull fracture (12 or more hours later)

Monitor closely to identify changes in level of responsiveness

Brain Injury: Concussion, contusion, open injuries, hematoma and hemorrhage

Signs and Symptoms:

Headache

- Unequal, dilated or nonreactive pupils
- Loss of consciousness
 - Retrograde amnesia = no recall of events before injury
 - Antegrade amnesia = no recall of events immediately after recovery of consciousness
- Decorticate posturing = arms flex in to the core
- Decerebrate posturing = arms extended, rotated internally
- Hemiplegia = paralysis on one side of the body
- Paraplegia = paralysis of lower extremities
- Quadriplegia = paralysis of all four extremities
- Intracranial Pressure (ICP): pressure within the intracranial compartment > increases lead to further brain injury and death. ICP is rising when:
 - Level of responsiveness drops
 - Progressive paralysis
 - Projectile vomiting
 - Unequal pupils
 - Cheyne-Stokes respirations (early sign)
 - Cushing reflex or triad (late sign)
 - Increasing BP, especially systolic
 - Increasing respirations
 - Decreasing pulse rate

Management:

- Maintain cerebral oxygenation and perfusion
- Protect the cervical spine
- Elevate the head
- Hyperventilate (1 breath every 3 seconds)
- Allow leakage of fluid from nose or ears
- Document current level of responsiveness, previous loss of responsiveness, on going status, memory deficits
- Intubate GCS less than 8

Glasgow Coma Scale - know it, love it, rate your friends for fun

Eye opening		Motor response		Verbal response	
Spontaneous	4	Obeys command	6	Oriented	5
To voice	3	Localizes pain	5	Confused	4
To pain	2	Withdrawn (pain)	4	Inappropriate Words	3
None	1	Flexion (pain)	3	Incomprehensible	2
		Extension (pain)	2	None	1
		None	1		

Spinal Trauma: work to preserve as much function as possible for the patient. Always care for the patient as if the injury is unstable. Trauma affects vertebrae, ligaments, intervertebral disks and the spinal cord.

Mechanisms of Injury:

Compression: force directed along axis of spine. Fall on feet, head hit

Hyperextension: head force backwards violently> tears of ligaments and vertebral instability

Hyperflexion: spinal structures flexed violently downward> tears ligaments of posterior spine. Wedge fractures or V-shaped compression fractures

Rotation: dislocation of vertebral joints (usually in combination with flexion)

Whiplash= hyperflexion and then hyperextension

Assessment:

Mechanism of injury (MVA, diving, falls>15', GSW

Pain

Deformity

Paralysis

Unexplained shock> spinal shock/neurogenic shock resulting from complete transection of the spinal cord> loss of vascular control

Treatment:

Immobilize c-spine (joint above=head, joint below=pelvis so get the long board out) Do not apply traction - DUH!

Airway

High concentration O2

One or two large-bore IV lines of normal saline/LR en route

Abdominal Trauma

Abdominal region is most difficult region to identify problems. Unrecognized abdominal injury is major cause of death in trauma patients. Rapid transport to surgery is their best hope.

Blunt trauma: MVAs are the major cause

- Compression injuries: organ of abdomen crushed between solid objects
- Shear injuries: rupture of solid organs, tearing vessels and ligaments

Penetrating injuries: stabbing, GSW, impaled objects

- Intestine is the most frequently injured organ in penetrating trauma
- Do not remove impaled objects in the field. Stabilize and transport

Solid organs: loss of blood into the abdominal cavity will lead to shock. *The most reliable indicator of intraabdominal bleeding is unexplained shock.*

- Liver and spleen primary sources of exsanguinations
- Blood, bile escape > shock and peritoneal irritation
- Spleen injury refers pain to left shoulder (Kehr's sign)

Hollow organs: release their contents: acids, enzymes or bacteria >peritonitis

- Sepsis, infection, abscess formation
- Pain, tenderness, guarding, rigidity, fever, distension (late sign)

Retroperitoneal Organ Injury: many times from pelvic/lumbar fractures > kidney and ureter contusion/lacerations

Pelvic Organ Injury: associated with severe retroperitoneal hemorrhage. 6.4-19% mortality rate.

Vascular Structure Injury: potential for massive hemorrhage > hypovolemia.

Inferior vena cava, renal, mesenteric, iliac arteries and veins

Evisceration: do not replace organs, cover with moist, sterile material

Abdominal Trauma in Pregnancy: keep in mind the normal changes of pregnancy when assessing a pregnant patient. Heart rate is normally higher, BP normally lower. 48% increase in blood volume.

Management:

High flow O₂

Transport on backboard tilted to the left to minimize uterus weight on the inferior vena cava (Supine Hypotensive Syndrome)

History Taking

History comes from a variety of sources:

- _ Patient \ Weigh reliability of what they are telling you
- _ Family \ Based on:
- _ Friends, Bystanders / Mental Status, memory, whether they trust you
- _ Law Enforcement / whether they have something to gain

Techniques of History Taking

- _ Setting the stage: needs to be the proper environment, put patient in ambulance if that is more private. Stay 2-3 feet away, shake hands, take notes unobtrusively
- _ Open Ended vs. Closed ended Questions: each have their place
 - Tell me about the pain. - Do you have pain now?
 - What changes your discomfort? - Does it hurt when you breathe?
- _ CC: Chief Complaint: main part of the health history and identifies in the patient's own words, the symptoms for which the patient is seeking medical care:
 1. Why did you call the ambulance today?
 - Facilitation = "Go on" "I'm listening" maintain eye contact -
 - Reflection = repeat what you've heard
 - Clarification = get more detail on the important points
 - Empathetic response = "You sound upset" "That must hurt a lot" -
 - Confrontation = occasionally useful to reel them back in
 - Interpretation = synthesize what you've been told

HPI = History of Present Illness = detail evaluation of the Chief Complaint with a full, clear, chronological account of the symptoms. OPQRST

PMHx = Past Medical History = record of any significant past injuries, hospitalizations, operations, diseases with regards to current conditions:

- _ Preexisting medical problems/surgeries _
- Medications
- _ Allergies
- _ Medical care
- _ Family History
- _ Social History

Current Health Status: patient's present state of health before the incident for which emergency care has been called.

Standardized Approach to History

- _ Signs and Symptoms
- _ Allergies

- _ **M**edications
- _ **P**ertinent past history
- _ **L**ast oral intake
- _ **E**vents leading up to the present situation

Sensitive Topics : be calm and professional, non-judgmental, remind them you are there to help. Special Challenges:

- _ Silent Patient: look for body language, give them time
- _ Talkative: let them talk, steer them to the point
- _ Multiple symptoms: ABCs first with both medical and trauma, find out what is bothering them the most.
- _ Anxious: speaking too quickly or too slowly, watch body language. Do not over-reassure
- _ Angry/Hostile: patient may displace anger to EMTs. Do not respond with anger, do not remain if you are in danger
- _ Intoxicated: Don't be judgmental, don't challenge them or disrespect them
- _ Crying: could be fear or pain, response could seem out of proportion to situation. Remain objective and empathetic
- _ Depressed: use empathy, don't tell them everything will be alright
- _ Sexually Attractive/Seductive: act professional in all cases, patients are not dating material. Have partner chaperone if necessary
- _ Confusing behavior/history: be patient, try to get consistent story, be professional and try to narrow down to the cause
- _ Patient with limited intelligence: Speak clearly, and in normal tones to patient first. Get help from family/friends as necessary or possible
- _ Language Barrier: get a translator or interpreter if possible
- _ Hearing impaired: sign language translator, read lips, write notes avoid jargon
- _ Sight Impairment: Announce yourself, explain why you are there, tell them what you are doing
- _ Family and Friends: important resource for collateral data

Techniques of Physical Examination

Inspection: the act of visually evaluation the patient

Palpation: the process by which the examiner feels the texture, size, consistency and location

Percussion : gently striking or tapping a part of the body to evaluate the size, borders and consistency of internal organs - and to discover the presence of fluid in body cavities

Auscultation : listening for sounds within the body to evaluate the condition of the heart, lungs, pleura, intestines, or other organs, or to detect fetal heart sounds.
Most commonly with a stethoscope

Vital Signs: typically pulse, respirations and blood pressure. Temperature also, but not in the field. RE Vital signs:

- _ Evaluate as a set. One will not provide info by itself
- _ No one value is normal for everyone. Normal varies largely, also by age
- _ Vital signs need continued monitoring, every 5-10 minutes, 15 for stable patients _
- Height and weight needed to calculate drug doses, estimate will do

Equipment:

- _ Stethoscope
- _ Blood pressure cuff
- _ Fingerstick glucose meter
- _ Cardiac monitor - ECGs and oscilloscope readings, recording devices, alarm to set to alert you to variations
- _ Pulse oximeter - sends infrared beam of light through finger to figure O2 sats _
- Peak flow meter - measures rapidly exhaled breath
- _ Capnometer - measures end tidal CO2

Evaluation of Mental Status: one of the best indicators of a person's condition, based on a combination of factors:

- _ Appearance and behavior: Level of Consciousness (LOC) use AVPU
 - Terms used to describe LOC: Normal, Drowsy, Obtundation, Stupor, Coma
 - Dress, grooming, personal hygiene: observe and record
 - Facial expression and affect: "affect" is outward manifestations of emotions. A "flat affect" means emotionally unresponsive
- _ Posture and Motor Behavior: Purposeful or Non-purposeful
 - Decerebrate: arms extended internally rotated, feet extended forced plantar = serious nervous system pathology
 - Decorticate: Arms flexed at elbow/wrists, legs may be flexed = serious nervous system pathology
 - Opisthotonic: Acute arching of back, head bent on neck, heels bent back on legs severe muscle spasms seizure, tetanus
 - Rigidity, Tremor, Motor Tics
 - Ataxic: unable to coordinate movements

- _ Speech and language: Quantity, Rate, Loudness, Fluency
 - Aphasia: brain injury makes patient unable to speak/speak clearly
 - Dysphonia: difficulty speaking, could be brain injury or laryngitis
 - Dysarthria: impaired speech due to tongue or other muscles, mental function normal
- _ Mood: may be indication of underlying illness either physical or psychiatric
- _ Orientation: Time, place, person, events A & O x3 = Alert and Oriented x3

Making a General Survey: universal overview of the patient's general condition.

Documented appropriately:

- _ LOC
- _ Signs of Distress
- _ Apparent state of health
- _ Skin color temp and condition
- _ Weight
- _ Posture Gait activity
- _ Dress grooming personal hygiene
- _ Breath odors
- _ Facial expression
- _ Vital Signs
- _ Additional assessments: pulse oximetry, blood glucose, cardiac monitoring

Anatomical Regions

Examining Skin and Nails: Skin is largest organ of the body. Check:

	Normal	Abnormal
Color	Normal for ethnicity	Pale, blue lips oral mucosa and tongue, yellow, rashes, bruises, scars, discoloration
Moisture	Dry	Diaphoretic, or too dry, cracked
Temperature		Note changes
Texture		Note smooth or rough
Mobility and turgor : elasticity	Freely mobile	tenting
Lesions		Scars, wounds, birthmarks, moles, bruises

Examining and Normal and abnormal findings of Head/Neck Etc.

	Normal	Abnormal
Head and neck		DCAP BTLS, ecchymosis, JVD, nuchal rigidity (meningitis, whiplash), Tracheal deviation, subcu emphysema
Scalp Skull		
Eyes	PEARRL, Conjugate gaze, direct, consensual	Unequal pupils, slow reactions or nonreactive, dilated pupils, constricted

	pupil reaction to light	pupils: all signs of various degrees of brain injury, drug use, fear, shock, stroke
Ears		Lacerations, bleeding, CSF, battle's sign,
Nose		Skull fracture may leak CSF
Mouth		Foreign material, broken teeth, dentures. May need suction

Respiratory System

Surveying Respirations: Assess Rate, Depth and Quality:

Respirations: Adult 12-20

Child 18-26

Infant 20-30

Newborn 40

Watch abdomen too, count when they don't know you are counting

Signs of Respiratory distress:

- _ Nasal flaring
- _ Paradoxical chest motion
- _ Use of Accessory muscles
- _ Pursed lip breathing
- _ Noisy breathing: stridor, grunting, gurgling _
- Obvious difficulty
- _ Cyanosis: blueish lips and skin

Anterior and Posterior Chest

	Normal	Abnormal
Chest	Equal chest rise and fall	DCAP BTLs, asymmetry, impairment of movement, retractions
Thorax	Percussions: Symmetrical	Reproducible differences
Lungs	Equal breath sounds	Pleural effusion, COPD makes more air in lungs than usual percussions will be hyper-resonant
Breath sounds	Vesicular: rustling/swishing Bronchial at anterior sternum Bronchovesicular Tracheal	Consolidation (filled with fluid) Compression, high pitched Rales/Crackles (fluid in alveoli), Wheezing (squeaking), Rhonchi (gurgling), Diminished, absent

Cardiovascular System

Evaluate Four areas:

- _ Arterial Pulse - check for rate (bradycardia - tachycardia), regularity/rhythm (skipped or extra beats), and character/amplitude (strong, weak...):
 - radial (most often for conscious patients)

- carotid (patients with shock or poor circulation)
- femoral (also patients with shock or poor circulation) -
brachial - infants
- _ Blood pressure: normotension = normal limits normal = 90-140 over 60-90 mm Hg. Varies with age, sex and body size
 - Hypotension: continuous low BP under 90/60 -
 - Hypertension: continuous high BP over 140/90 -
 - Cuff too small = false high
 - Cuff too big = false low
 - Orthostatic Hypotension: BP drops when they stand up (10-20 mm Hg), pulse rate increases (10-20 bpm)
 - Pulse pressure = the difference between Systolic and Diastolic pressures normal is 40. early shock, pericardial tamponade, or tension pneumothorax can cause decrease
- _ Jugular venous pressure and pulsation: distension is abnormal pressure, CHF, cardiac tamponade. Venous pulsations are rarely palpable
- _ Heart: find the PMI (point of max impulse) 5th intercostal space medial to the left midclavicular line where the apical beat is observed

Examination of the Abdomen, Normal and abnormal findings of

General approach: they need to be supine. Auscultate before Palpate (go alphabetical 📖)

- _ Skin : scars, striae, dilated veins, rashes, lesions
- _ Contour : flat or protuberant
- _ Pulsations : small upper abdominal aorta movement may be seen, excessive may = aneurysm
- _ Auscultate :
 - Absent bowel sounds: suggests abdominal pathology -
 - Decreased: listen for a period of time
 - Increased: anxiety, diet, hunger
 - Bruits: high pitched whoosing of blood in arteries _

Palpate:

- Tenderness: pain with movement or palpation -
- Guarding: deliberate tensing
- Muscular Rigidity: suggests peritonitis -
- Rebound tenderness: also peritonitis

Female Genitalia Normal and abnormal findings of: Male examiner have a female partner present. Note Inflammation, Discharge, Bleeding, Swelling

Male Genitalia Normal and abnormal findings of: Female examiner have a male partner present. Note Inflammation, Discharge, Bleeding, Swelling

Extremities: Assess for:

- _ Signs of inflammation: swelling, tenderness, heat, redness, decreased function _
- Crepitus: palpable or audible crunching made by movement
- _ Deformities
- _ Muscular strength

- _ Symmetry: are injuries bilateral or on one side _
- Atrophy, loss of muscle mass
- _ Pain: try to localize complaint without causing more pain _
- Tenderness same as above
- _ Peripheral pulses (feet - dorsalis pedis and hands - radial): Increased, normal, diminished, absent
- _ Motor function (feet and hands):
- _ Sensory function (feet and hands):

Spine: Inspect the spine from side and from behind, gently palpate for symmetry, tenderness and spasm

Nervous System

Remember symmetry: evaluate everything in terms of bilateral tests: strength, sensation and reflexes. Results must be parallel to the other side of the body. Organize by:

- _ Mental Status and Speech - LOC, note any deterioration, use AVPU, Glasgow Coma Scale
- _ Motor System - observe body in motion and at rest. Voluntary and involuntary movements
 - Muscle tone: small amount of tension in a normal muscle with an intact nerve supply
 - Muscle strength can grade 1-5 (5 is normal), move, press against your hand, squeeze your fingers
 - Muscle coordination: series of rapidly alternating movements _

Sensory System: compare pain, temperature and touch bilaterally

- Pain: with a pin, but don't cause bleeding
- Temperature : may skip if pain is normal, identify warm and cold sensation

Parasthesias: numbness or tingling in the arms or legs. Can indicate spinal cord damage or local circulatory problems

Considerations for Examining an Infant or Child:

Infants - under 1 year

Child - age 1-8 years old

Differences to keep in mind:

- _ Internal organs are larger in proportion to adult, all packed in small space _
- Head is larger in proportion to body, injuries common
- _ Bones are softer and more flexible, will bend, may not break
- _ Nervous system is not as well developed, response to stimuli may be slower

Approach to Children: remember they may fear strangers. Enlist the parents, be patient.

Initial Evaluation:

- _ Responsiveness use AVPU

- _ Respiratory Status: most serious pediatric problems and cardiac arrests start with a primary respiratory event. First sign is TACHYPNEA, prevention is better than resuscitation
- _ Circulatory status: slow irregular pulse is a poor sign. Evaluate skin temp, color, condition and capillary refill (may not be good indicator esp. in cold)

General Guidelines for recording examination information: all findings negative and positive need to be documented according to local protocols.

Patient Assessment

SOAP Format : Subjective, Objective, Assessment, Plan

Symptom : subjective indication of a disease or condition as perceived by patient -
complaint, history etc.

Sign: objective finding, vital signs, what you see

Six Phases of Scene Assessment

1. Scene size up: scene safety is #1

- BSI
- Dispatch is based on:
 - _ Patient condition/medical history
 - _ Scene condition
 - _ Number of patients
- Previous Knowledge
- On-Scene Observation

2. Initial Assessment

- _ General Impression = immediate sensory assessment of the situation combined with the patient's chief complaint
- _ Consider c-spine
- _ Level of consciousness (AVPU)
- _ Chief Complaint
- _ A
- _ B - BVM inadequate resps <10 or >30 15 L/min
- _ C
- _ Prioritize/Transport Decision

Assessing Effective Ventilation

- _ Rise and fall of chest wall
- _ Auscultation of lungs
- _ Skin Color
- _ Heart rate
- _ Pulse oximetry

Pulseless Patient

- _ Medical patient over 12 (AHA 8 years old) start CPR and apply AED
- _ Medical patient under 12 (AHA 8) start CPR
- _ Trauma patient start CPR

Pulse<60 Pulse>100 - Potentially life threatening especially with hypotension, chest pain or severe dizziness. Rule of Thumb: if there's a radial pulse, the systolic is approx. 80 mmHg. Carotid 60, Femoral 70, Brachial 70

Skin, Temperature, Color and Condition

- _ Warm, pick dry is normal. And using diaphragm muscles for inspiration
- _ Pale cold clammy - could be shock
- _ Hot and dry - heat injury, overdose or infection

- _ Red - alcohol, cocaine, anaphylaxis, stroke, heart attack, hyperthermia
- _ Yellow - jaundice, liver disease, gallbladder disease, kidney disease
- _ Mottled red, pale, blue - poor perfusion, often seen in cardiac arrest
- _ Capillary refill < 2 seconds, most useful under 6 yo

Priority Patients:

Poor general impression	Difficulty breathing	Altered Mental status
Chest pain/cardiac	Unresponsive	Can't follow commands
Hypoxia	Multiple trauma	Hypertension
Uncontrolled bleeding	Severe pain anywhere	Shock

3. Focused History and Physical Exam Medical

Medical: Limited and is specifically related to the acute problem of the day. Use OPQRST

Assess: what ever is related to the complaint

Take: baseline vitals

Unresponsive Medical: do a rapid assessment

Position patient to protect the airway

Assess:

- _ Head
- _ Neck
- _ Chest
- _ Abdomen
- _ Pelvis
- _ Extremities
- _ Posterior

Take: Baseline vitals, SAMPLE history from family, bystanders

Look for: medical tags

4. Focused History and Physical Exam Trauma

Trauma: What is the mechanism of injury? Prioritize/make a transport decision based on:

- _ Ejection from the vehicle
 - _ Death in the passenger compartment
 - _ Fall of more than 20 feet
 - _ Vehicle rollover
 - _ High speed crash
 - _ Vehicle vs. Pedestrian crash
 - _ Motorcycle crash
 - _ Unresponsive or altered mental status
 - _ Penetration of head, chest, abdomen
- Infants/Small Children
- _ Falls of more than 10 feet
 - _ Bicycle collisions
 - _ Passenger in any medium speed collision

Rapid Trauma - look for:

D eformation
C ontusions
A brasions
P enetration/punctures
B urns
T enderness
L acerations
S welling

No Mechanism of Injury?

- _ Focused history and physical exam of injuries
- _ Assess baseline vitals
- _ Obtain a patient history

5. Detailed Physical Examination

Detailed assessment: organized, subjective and objective exam
For priority patients, do this en route to the hospital

6. Ongoing Assessment

Continue through definitive field management and transportation

- Stable every 15 min
- Unstable every 5 min
- _ Mental Status
- _ Monitor the airway
- _ Monitor breathing rate and quality
- _ Reassess the pulse rate and quality
- _ Reassess priority
- _ Reassess vital signs
- _ Repeat focused exam re: complaints
- _ Check interventions: Definitive field management
 - Airway maintenance
 - IV Fluids
 - Cardiac
 - PAGS
 - Splints, bandages
 - Blood glucose

Transport: Three R's Right person, right place, right amount of time

Receiving facility depends on:

- _ Patient Condition
- _ Available facilities: Special centers
 - ☒ Multisystem trauma
 - ☒ Burns
 - ☒ AMI

- ☞ Spinal
- ☞ Pediatric
- ☞ Neonatal
- ☞ Hyperbaric chamber
- ☞ Behavioral/Psych

Medical Direction: contact receiving facility re:

- _ Nature of incident
- _ Number of patients coming
- _ Life threatening problems
- _ Care being rendered
- _ Results of care
- _ ETA
- _ Other as required by facility

Run Reports = well documented as to why the facility was chosen

Helicopters will not fly when:

- _ Lightning, wind, weather
- _ Weight limitations, heavy patients
- _ Life threatening problems
- _ Combative patients
- _ Ground transport would be faster

Clinical Decision Making: ability to quickly integrate an enormous amount of information from multiple sources to form a correct treatment plan

Practice Environment: the field is a unique environment to apply medical skill and therapies.

Major Trauma: injuries or mechanisms that place the patient at great risk of death or disability

Major Medical: patient can also be at great risk, and can have multiple presentations

Protocols/Standing Orders/Algorithms: provide well-defined guidelines for specific patient problems/presentations

Critical Thinking: Concept formation is a pattern of understanding based on initial info gathered:

- _ First impression
- _ Info from dispatch
- _ Patient environment
- _ Patient's chief complaint
- _ Mental status (affect)

Data Interpretation : comparison of current info with past education and experience to draw conclusions

Application of the principle: formulate a working diagnosis. Initial interventions are selected on cumulative interpretation

Evaluation: Constantly reassess vital signs and physical stats

Reflection: constantly reassess yourself and your training/responses/correct diagnosis

Fundamental Elements of Critical Thinking:

- _ Adequate fund of knowledge
- _ Focus on specific and multiple elements of data
- _ Information stimuli
- _ Identify and deal with medical ambiguity
- _ Differentiate between relevant and irrelevant data
- _ Analysis and comparison with similar situations
- _ Recall of contrary situations
- _ Articulate assessment-based decisions and construction of arguments

Patient acuity spectrum: wide range of patient presentation, illness or injury and people respond to all of these with varying degrees of pain, anxiety and fear

Biggest Challenge: moderately ill or injured patient can be the most difficult to correctly identify and treat

Think under pressure: develop habits of evaluation and management. Technical aspects and procedures should be second nature. Mental Checklist:

- _ Stop and think
- _ Scan
- _ Decide and act
- _ Maintain clear and concise control
- _ Regular continual re-evaluation

Facilitating Behaviors: patterns and actions that promote efficient and appropriate patient care

- _ Stay calm
- _ Anticipate change
- _ Ask yourself 2 questions
 1. What is the current working diagnosis and the best treatment plan
 2. What additional problems could the patient potentially develop and how should they be treated?

Communications

The EMS Team communicates via written, electronic and verbal means with:

- _ Callers and dispatch center
- _ Among the EMTs
- _ Back up units
- _ Emergency Dept.
- _ EMS System Admin
- _ Public safety units
- _ Disaster networks

Medium for messages

- _ Face to face
- _ Radio or phone
- _ Leaving voice mail
- _ Write a note
- _ Email
- _ Fax
- _ Pagers with text

Verbal Communications:

Semantics: meaning of words. Unambiguous is best. Codes, symbols and acronyms must be standardized.

Noise: anything that interferes with communication. Use feedback and confirm the message was received

Telephones: use internally, externally, routine and emergency

Advanced 911 systems: include a visual display of caller's phone # and address

Dedicated land lines: continuous direct connection from one location to another, means no busy signals

Cellular phones: excellent reception and better continuity in transmission than typical radios. Easy to use and cost is decreasing. Used at:

- _ Dispatch
- _ On scene
- _ Scene to hospital
- _ Delivery of on-line medical direction
- _ 12-lead electrocardiogram (ECGs)
- _ Faxes and computer data

Radios: primary means of communication between EMS teams and dispatch. Standard 25 kHz. Radio system consists of:

- _ Base station : most powerful, 80-150 watts
- _ Mobile radios : mounted on vehicles, 20-50 watts, 10-15 miles, multiple channels
- _ Portable radios : handheld 1-5 watts, multiple channels
- _ All of the above receive and transmit, so called transceivers

Types of Communication:

Simplex: one direction at a time, pro: finish your message without interruption

Duplex: 2 separate frequencies are paired. Simultaneous transmission and reception

Multiplex: transmits simultaneously 2 or more different types of information in either or both directions over the same frequency.

Digital Communications: data or sounds that are converted into digital code for transmission. 12.5 kHz channels, higher security, integrated voice and data on one channel for enhanced signal capabilities.

Trunking: pooling frequencies and directions of transmissions to the next open frequency in a communications system. Sharing means faster access, efficiency, privacy

Radio frequency: the number of times per minute a radio wave oscillates:

- _ VHF (very high frequency) low band 32-50 MHz,
 - pros: greatest distance travel, use rural/forest, follows the curve of the earth.
 - cons: simplex transmission, limited to voice, FCC allows no telemetry
- _ VHF high band 150-174 MHz;
 - pros: metropolitan areas
 - cons: simplex, travels straight lines, no curve of earth
- _ UHF 450-470 MHz, channels 1-10 are designated by FCC as EMS may be paired for duplex operation
 - pros: least susceptible to electronic interference, excellent penetration
 - cons: straight lines
- _ 800 MHz Frequency
 - pros: metropolitan areas, send voiceless info to computers in vehicles
 - cons:

Additional Equipment:

- _ Pagers: alphanumeric alerts
- _ Repeater systems: increase range of portable and mobile radios, mounted on vehicles or on towers
- _ Recording equipment: active record kept of radio and phone communications can be played back for media broadcast, education, disciplinary hearings and litigation. Professionalism is paramount

FCC: controls and regulates all radio communications

- _ Licensing and allocation of radio frequencies
- _ Establishing technical standards for equipment
- _ Establish and enforce rules and regulations for radio equipment operation
- _ Monitors frequencies for appropriate usage
- _ Spot check base stations and dispatch centers for licenses and records

Written Communications:

- _ Document vehicle maintenance
- _ Medical equipment
- _ Drug and fluid expirations
- _ Incident reports
- _ Call reports

- _ Most important is the Run Report
 - o Patient's condition and treatment
 - o Written legal record of each case
 - o Clinical info to the ER staff
 - o All confidential

Electronic Information: real-time capturing of information

- _ Biotelemetry - electrical activity in the heart is picked up by an ECG, converted to audio and transmitted to hospital. Hospital receiver picks it up and converts it to an oscilloscope
- _ Oscilloscop - TV-like screen that displays an electrical current, like impulses of the heart's conduction system
- _ Computers - can be used to gather and document patient information
- _ Faxes - provide earlier notification to the hospital of patient's information. Must be in a secure location, because the fax could be read by anyone

Types of Communication: Routine, Emergency and Patient Care/Medical

- _ Routine: daily work messages
- _ Emergency
 - o Incident occurrence
 - o Recognition
 - o System access and dispatch, EMD needs
 - ☞ Location/Address, age, sex
 - ☞ Type of emergency
 - ☞ Call back #
 - ☞ Other specifics
 - o Prehospital care
 - o Patient stabilization and transport
 - o Delivery to hospital
 - o Preparation for the next event

Run Times - EMTs communicate with Dispatch:

- _ En route to the scene
 - _ At the scene
 - _ En route to the hospital
 - _ Arriving at the hospital
 - _ In service and returning to quarters
 - _ Off the air at quarters
- _ Medical Communications between EMTs and medical direction/receiving hospital:

Purpose of medical communications is to obtain orders for patient care in the field.

 - o Also solicit advice
 - o Prep hospital to begin care
 - o Help to deal with those refusing care

- Terminate resuscitation
- Clarify DNRs
- Deal with on-site non-EMS doctors

Oral Report - description of the case given by the EMT to medical direction or receiving hospital. Standard format:

- _ ID# and level of training of provider
- _ Description of scene
- _ Patient's age and sex
- _ Chief complaint
- _ Associated signs and symptoms
- _ Pertinent history of present illness
- _ Pertinent past medical history, meds, allergies
- _ Physical exam findings
 - Level of consciousness
 - Vital signs
 - General appearance, degree of distress
 - Trauma index or Glasgow Coma Scale (15 is normal)
 - Pertinent positives/negatives of physical exam
- _ Treatment given so far
- _ Response to treatment
- _ Advanced life support given or standing orders
- _ Orders being requested
- _ Name of patient's physician
- _ ETA at hospital

Treatment Orders - directive given to EMT by Medical Direction. Very important to report changes.

Communication basics:

Echo - immediately repeat back each transmission received.

- _ Press the button, wait one second before speaking
- _ 2-3 inches from mouth
- _ "Go ahead" = ready, "Stand by" = not ready
- _ Give number, then individual digits
- _ Do not cut the sender off
- _ Don't use patient's name on the radio
- _ Use "Affirmative" and "negative" instead of "Yes" and "No"
- _ Echo medical direction/treatment orders back to physician
- _ Inappropriate language can lead to a fine

System Maintenance: check radios regularly. Recharge batteries as manufacturer specifies. Spare batteries handy, carry portable radios in cases and never set drinks on the radio console.

Communication with the Public:

You are always on display, to remember the impression you are making, and make it a good one. Consider all your calls are a public relations/education effort.

- _ News Media: patient comes first. Be yourself, and know exactly what you can release and what you can't according to department policy

Communication in Disaster Situations: disaster plans that anticipate breakdowns must be in place. Incident Command System (ICS) should be put in place asap. ICS is designed to control direct and coordinate emergency response operations and resources.

Hinderances to communications:

- _ Overloaded radio frequencies
- _ Incompatible frequencies between agencies
- _ Damage to the communications infrastructure
- _ General Equipment failure

Documentation

Documentation: the process of recording patient information

Proper documentation includes:

- _ Record of the scene
- _ Patient's CC
- _ Patient's condition
- _ Nature and extent of emergency care given
- _ Changes in the patient's condition
- _ Patient's name, address, age and sex
- _ Administrative information ie disposition of the call

Reasons for Documentation

- _ #1 Continuation of care, supplying vital info to the ER staff
- _ Point out improvements with treatment or deterioration
- _ Treatments administered
- _ Description of the scene ie. Damage to an accident victim's car
- _ Legal record of the case
- _ Record of procedures performed under auspices of licensed physician
- _ Demonstrates protocols are being adhered to
- _ In compliance with law and meeting the standard of care
- _ Tally up different procedures, provides statistics

Run reports

- _ Guide system improvements
- _ Training programs
- _ Revenue collection
- _ Research
- _ Billing and administrative data
- _ Operational statistics
- _ Training tools
- _ Permanent Record - most lawsuits against EMT-Is relate to improper care
- _ May be used in a criminal trial where EMTs testimony can reveal guilt or innocence

Types of Run Reports

Present Types: Bubble sheets to fill in the blanks, write narratives, these are scanned.

Also reports with carbon paper in between

Future: electronic clipboards/pens to automate data collection and transfer it to the hospital

Rules for Documenting

If it wasn't documented, you didn't do it, and if you didn't do it, don't document it.

- _ Be accurate and complete, precise and comprehensive
- _ Be objective, don't assume anything
- _ Be specific, don't generalize
- _ Write legibly, clearly and concisely. Make sure carbon copies are legible too

- _ Use a ballpoint pen so information can't be tampered with
- _ Use correct spelling, carry a dictionary if you need one
- _ Use abbreviations and acronyms with care, and only those approved by your EMS system
- _ Keep your run report clean
- _ Promptly record information - the longer you wait, the more you will miss. Do not delay or compromise patient care
- _ Be consistent
- _ Be professional - the report will be scrutinized by all sorts of people. Don't use jargon, slang, libel/slander, irrelevant opinions
- _ Check for accuracy and completeness
- _ Practice the skills

Systems of Narrative Writing

- _ Majority is patient information
- _ Demographics, history, and physical examination data
- _ All systems should start with patient's age, sex, CC and how patient was initially found
- _ SOAP Format writing
 - o Subjective
 - o Objective
 - o Assessment
 - o Plan
- _ Head to Toe Method
- _ Body Systems: better suited to nursing
- _ Chronological method - everything written with a time in front, what was done and when

Information in the run report

- _ Dispatch information
 - o Location /address, nature of call
 - o Priority level
 - o Run number
 - o Dispatch time
- _ Care being provided before arrival - first responders or bystanders
- _ Chief Complaint (CC) in the patient's own words if possible
- _ Important Observations
 - o Child or elder abuse
 - o Presence of suicide note, weapon or drugs
 - o Mechanism of injury
 - o When information is sensitive, note who provided that information
 - o When patient refuses treatment, note all assessment findings
- _ Present Medical History note OPQRST as appropriate, also pertinent positives (signs and symptoms which help substantiate or identify the patient's condition or

- response to treatment) and negatives (absence of signs and symptoms, or lack of response to treatment)
 - Patient's behavior
 - Safety related information incl. disposition of weapons
 - Information for crime scene investigators
 - Disposition of valuable personal property
- _ Past Medical History: surgeries, hospitalizations, illnesses, injuries, allergies, medications, last oral intake, name of pt's physician
- _ Physical Assessment Findings: how pt found on arrival. Baseline vital signs, level of responsiveness, findings of secondary exam, reassess vital signs
- _ Treatment provided: check appropriate box, or describe in narrative section. What was done, who did it and at what time. Note on or off-line medical direction and ID # of physician
- _ Response to Treatment: changes both positive and negative
- _ Demographic information: Name, age, sex, birthday, address and phone number
- _ Use of support services: report all mutual aid services used, helicopter, coroner, extrication
- _ Anatomical Figure: circle or shade affected areas on the drawing
- _ Run times: record call occurred, dispatch, en route to call, arrival at scene, transfer of care, back in service
- _ Run Disposition: note if patient is gone, refuses transport or is handed to another ambulance crew. Note hospital pt went to, and radio or telephone communication with receiving facility or medical direction
- _ Signatures: all personnel responsible for the run sign the report, or initial and record ID#

When a Mistake is Made

- _ Fixing mistakes: draw a single horizontal line through the incorrect entry, indicate it is an error and initial it. Write the correct info next to it.
- _ Documenting late entries: submit additional information with time and date, reason for correction, have a witness, use different colored ink. Some systems have separate correction forms
- _ Document Deviations from Protocols, and if medical direction was notified.
 - Document delays responding, gaining access to or transporting the patient
 - Questionable medical direction
- _ Tampering with run reports or anything that looks like tampering, can be used in court against an EMT, even if there was no bad intent
- _ Falsifying Information: make sure you don't do it

Confidentiality: one of the major responsibilities of an EMT. Run report is considered confidential. If used for quality improvement or training, pt's name should be blacked out.

Other Documentation Necessary:

- _ When the run is cancelled, by whom and why

- _ When the patient refuses transport: document your advice, physician's advice, complete narrative and signed/witnessed refusal form
- _ Multiple casualty incidents: complete a run report for each pt. Follow protocols for temporary reports when there is no time to complete the report until transfer of care at the hospital
- _ Special Situations: suspected child or elder abuse, equipment failure, complaints about EMS care or demeanor. Crimes, infectious disease exposure, accident, injury, childbirth, animal bites. Keep a copy of supplemental reports for your own records

Advanced Level Study

- Anoxia: Lack of O₂
- Hypoxia: low levels of O₂ to the cells, reduced O₂ supply to the cells, leads to anaerobic metabolism > metabolic acidosis > cellular depression > cellular death
Treatment: O₂, it increases the patient's ability to compensate for the hypoxia
- Hypoxemia: insufficient oxygenation of the blood
- Atelectasis: alveolar collapse
- Compliance: stiffness or flexibility of lung tissue
- Adult Respiratory Distress Syndrome (ARDS): pulmonary insufficiency. Alveolar edema leaking into the capillaries
- Apnea: absence of breathing
- Dysrhythmia: disturbance of the normal rhythm of the heart.

Airway: primary objective - each patient has a patent airway and optimal ventilation.

Normal breathing takes:

- _ Patent airway
- _ Intact ventilatory musculoskeletal system _
- Unobstructed air passageways
- _ Adequate pulmonary bloodflow
- _ Appropriate neurologic stimulation

Upper Airway:

- Nose: filters, warms and humidifies the air. Nostrils/nares in front, palatine at the floor, nasal septum divides the nose with superior/middle/inferior turbinates (conchas), Cribriform plate has small holes for the olfactory nerve to conduct smells. Four pairs of sinuses - frontal, maxillary, sphenoid, ethmoidal
- Mouth: Oral cavity made up of cheeks, hard and soft palates (top of mouth), tongue (covers bottom of mouth, most common cause of airway obstruction) and teeth (32), hyoid bone (only bone in axial skeleton that doesn't touch any other bones - ligaments only)
- Pharynx: Throat, back of soft palate to top of esophagus. Air food and liquid pass through. Three regions - nasopharynx, oropharynx, and laryngo-(or hypo)pharynx (begins at top of epiglottis)
- Larynx: triangle-shaped structure connecting the pharynx with the trachea. Main cartilage is the thyroid cartilage. Below this is the cricoid cartilage - the only complete ring in the trachea. Between them is the cricothyroid membrane.
- _ Protects the airway
 - _ Produces sound/voice

Vagus nerve endings: line the larynx so stimulation of the pharyngeal and laryngeal mucus membrane may cause bradycardia, hypotension, and decreased resp. rate

Lower Airway: Runs from the glottic opening to pulmonary capillary membrane.

Trachea: Conducts air to the lungs. 10-15 cm long tube, between larynx and bronchi, anterior to esophagus

Right and left main bronchi: split at the carina

Secondary bronchi: one for each lobe of the lungs 3 right, 2 left

Bronchioles: tertiary branches 10 right and 8 left

Alveoli: clusters of air sacs, 1-2 cells thick, primary site for O₂ and CO₂ exchange

Beta 2 receptors of the sympathetic nervous system are situated throughout the tree.

When stimulated, they lead to bronchodilation

Serous membrane: a two-layer epithelial membrane that lines body cavities and covers the surface of organs. Pleura is the one around the lungs. Two layers with a little liquid in between for lubrication:

- _ Visceral - closely covers the lungs
- _ Parietal - lines the inner surface of the chest wall, diaphragm, mediastinum.

Lungs: rest on the base of the diaphragm - upper portion called the apex

Hilum: slit in the medial surface where primary bronchi, pulmonary blood vessels and nerves enter. Lungs move freely except at the hilum.

Pediatric Airways: Differences

- _ Overall size is smaller
- _ Larger tongue in proportion to mouth
- _ Large, floppy epiglottis
- _ Weak neck muscles
- _ Tonsils and adenoids posterior pharynx
- _ Larynx is higher and funnel shaped
- _ Cricoid cartilage is the narrowest portion of child's upper airway (Glottis is the adults)
- _ More dependent on diaphragm for breathing

Respiration: exchange of gases between the body cells and the atmosphere. Three parts

1. External respiration - the exchange of gases between circulating blood and air, carried on by expansion and contraction of the lungs
2. Internal Respiration - exchange of dissolved gases between the circulating blood and interstitial fluids in the peripheral tissue
3. Cellular respiration - actual use of O₂ by the cells in the process of metabolism

Ventilation: the process of moving air in and out of the lungs. Includes inspiration and expiration. The insp. Starts as an impulse in the Medulla transmitted through the Phrenic nerve. Diaphragm goes down, decreasing air pressure in the lungs, pulling air in. Hering Brueuer reflex - stretch receptors keep the lungs from popping.

Respiratory volume: 500-800 mL of air

Tidal volume: amount in one breath cycle

Alveolar air: air that reaches the alveoli = approx 350mL

Minute volume: air exchanged in one minute

Average adult male lung capacity = about 6 L

Exchange and Transport of O₂ and CO₂

Red blood cells (RBCs) - transport O₂ and CO₂ with a protein called hemoglobin
FiO₂ - concentration of O₂ in inspired air. Pressure stays high in O₂ (104) and low in CO₂ (50) to make the O₂ move across the alveolar/capillary membrane in to the blood stream until gas pressures are equal on both sides. CO₂ levels vary inversely with ventilations.

O₂ is transported in arterial blood in 2 ways:

1. PO₂ - physically dissolved in plasma (3%)
2. SaO₂ - chemically attached to hemoglobin

O₂ diffuses from an area of greater concentration (the bloodstream) to an area of lower concentration (the tissues). Cells constantly use O₂ in the Krebs cycle so a low PO₂ (pressure) constantly exists.

Carbon Dioxide or PCO₂ has a partial pressure of 50 mmHg. CO₂ is carried to the lungs in three ways:

1. PCO₂ - dissolved in plasma (10%)
2. Coupled with hemoglobin (20%)
3. Combined with water as carbonic acid and its components (70%)

Nitrogen: Atmospheric air is 78% nitrogen. It serves no metabolic function, but is necessary to maintain inflation of body cavities that are gas filled.

Stimulus to Breathe: stimuli from brain needed for the pattern of inspiration/expiration.

Medulla Oblongata and the Pons are the resp. centers of the brain, control rate and depth

- _ Medulla Oblongata: central chemo-receptors sense Hydrogen when CO₂ combines with water (H₂CO₃) and then breaks down into H and HCO₃. The Medulla is connected to the respiratory muscles by the vagus nerve
- _ Pons contains pneumotaxic and apneustic areas that help regulate breathing movements
- _ Aortic Arch and carotid body also have chemoreceptors that sense increased CO₂, increased blood acid levels (H) and decreased blood O₂ levels

Assessment: Airway is always the first step

Initial impression, level of consciousness/responsiveness

- _ airway -patency
- _ breathing/respiratory function
- _ circulation

Pulse Oximetry: take on all patients as a vital sign. Take it BEFORE administering O₂ and repeat it through assessment, treatment and transport. Test it on yourself first to see if it's working. You can get false readings from:

- _ CO/cyanide poisoning

- _ Excessive ambient light on sensor probe
 - _ Patient movement
 - _ Hypotension (low perfusion)
 - _ Hypothermia
 - _ Vasoconstrictive drugs on board
 - _ Nail polish
 - _ Jaundice
 - _ COPD patients may be normally low
- SaO2 reading of 95-99% is ideal
- _ 91-94% mild hypoxemia 4-6 L O2 with nasal cannula
 - _ 85-90% moderate hypoxemia 15 L/m O2 with a non-rebreather
 - _ under 85% severe hypoxemia intubate or BVM with 15L/m O2

Assessing Intubation Placement - end tidal CO2 detectors

1. Disposable colorimetric
2. Electronic monitor

Breath Sounds: listen for epigastric sounds after intubation. Apex of lungs right and left, mid clavicular right and left and mid axillary right and left

Movement and Use of O2 in the Body depends on (Fick Principle):

- _ Adequate inspired O2
- _ Movement of O2 from alveoli to capillaries to arteries _
- Adequate RBCs
- _ Proper tissue perfusion
- _ Efficient off-loading of O2 at the tissue level

Oxygen Sources (Canisters) - all at

- _ D 400L
- _ E 660L
- _ M 3450L

Flow meters

- _ Bourden gage (no back flow protection)
- _ Pressure compensated flow meter (must be upright) _
- Constant flow selector valve

Equation for tank life in minutes:

$$\frac{\text{Tank pressure in PSI} - 200 \text{ (minimum safe level)} \times \text{Tank Factor}}{\text{Liters/minute you're using}} = \text{Tank life in minutes}$$

Precautions:

COPD patients 1-3L via nasal cannula, 24-28 venturi mask
 Don't apply to Premature infants

O2 Delivery Devices

Nasal Cannula	No re-breathing inspired air	1-6 L/min, 24-44% O2
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Simple face mask	Requires tight seal, watch for hypercarbia	8-12 L/min, 40-60% O ₂
Nonrebreather	No ambient air, never let bag deflate they can't breath	10-15L/min, 60-100% O ₂
Venturi mask	Mixes ambient air with O ₂ , must be snug	24, 28, 35 or 40%
Nebulizer	Delivers albuterol or other bronchodilators	8L/min O ₂

Ventilation: Patients whose breaths per minute are under 10 or over 30 need ventilatory assistance

- _ Open airway
- _ Overcome resistance in lungs
- _ Maintain a closed system
- _ Allow patient to passively exhale between breaths

Without O₂ 10 mL/kg or 700-1000 mL delivered over 2 seconds

With O₂ 6-7 mL/kg or 400-600 mL over 1-2 seconds

Mouth to Mouth	16-17% O ₂	Don't do this, get your BSI
Mouth to Mask	16-17% or 50% with O ₂	Set O ₂ to 10, reduces risk of contamination
Bag Valve Mask	Adult 1000-1600 Child 500-700 Infant 150-240	2 person best seal O ₂ at 15 L/min
O ₂ Powered Device	Burst of O ₂ with a button 100% @ 40L/min limited to 30 cm of H ₂ O	Steady stream if you hold the button down. Watch for gastric distention
Automatic Ventilator (ATV)		Can't detect obstructed airways

Cricoid Pressure: Sellick Maneuver

- _ Prevent gastric distention/regurgitation/aspiration pneumonia _
- _ Compresses esophagus between cricoid ring and cervical spine _
- _ Contraindicated in cervical spine injury

Ventilating Pediatric Patients:

- _ Mask must fit securely bridge of nose to cleft of chin _
- _ Don't hyperextend the neck
- _ Folded towel under shoulders
- _ Bag with at least 450 mL for children, 250 for infants _
- _ At least 20 breaths/min
- _ Over 8 years old use adult BVM with extreme care
- _ Watch for chest rise and fall, key to force and tidal volume
- _ Broslow system/Broslow tape is a pediatric tape measure and a series of sets of equipment sized according to the measurement on the tape

Ventilating Stomas: tight seal around the stoma. Seal mouth and nose if leaking
Tongue: most common cause of airway obstruction in an unresponsive patient. Epiglottitis can occlude the airway at the level of the larynx

Airway Adjuncts: Maintain a patent airway

Oropharyngeal- measure corner of mouth to earlobe. Patient must have no gag reflex.

Use with a BVM, counters obstruction of tongue, facilitates suction.
Doesn't isolate trachea, can't have clenched teeth. For pediatric use a tongue blade, it must be the right size

Nasopharyngeal - measure tip of nose to earlobe, size of pinky, stretch to just below the base of tongue. Patient can have gag reflex/clenched teeth but no skull fractures, nasal obstructions, or nosebleeds/injury

Advanced Airways - intubation is the best way to secure an airway. Use an ET (endotracheal within or through the trachea) tube. Use when:

- _ Unresponsive patient and other methods don't work
- _ Patient can't protect the airway
- _ Prolonged artificial ventilation is needed
- _ Upper airway compromise (burns, trauma etc.)
- _ Unresponsive patient with no gag reflex
- _ Decreased tidal volume/slow respirations
- _ Airway obstruction due to foreign bodies, trauma or anaphylaxis

Advantages to intubation

- _ Seals the trachea
- _ Facilitates ventilation and O2 because tight face seal is no longer needed
- _ Prevents gastric insufflation
- _ Direct route to trachea for suction
- _ Effective route for some medications: epi, atropine, lidocaine, naloxone

Disadvantages

- _ Complicated skill using specialized equipment
- _ Vocal cords must be visualized
- _ Bypasses warming/filtering/humidifying part of upper airway
- _ Must be continually reassessed, accidental displacement is common

Contraindications: avoid epiglottitis

Complications

- _ Bleeding
- _ Laryngeal swelling/spasm
- _ Vocal cord damage
- _ Mucosal necrosis
- _ Barotrauma
- _ Dental trauma
- _ Misplacement in esophagus or right bronchus

Laryngoscope: used to move the tongue and epiglottis out of the way of the vocal cords.

Made up of two pieces

1. Handle - holds the batteries for the light
2. Blade comes in sizes 0 (newborn) to 4 (adult)
 - _ Curved blade - Macintosh, leaves more room to visualize glottic opening, less gagging due to position - insert blade into vallecula
 - _ Straight blade - Miller, Wisconsin, Flagg, goes under the epiglottis

ET Tube - flexible translucent tube open at both ends.

- _ Proximal end is standard 15mm adapter to connect various devices to deliver positive pressure ventilation
- _ Distal end is beveled to go between the vocal cords
- _ Balloon cuff to occlude the remainder of the tracheal lumen, Use syringe to inflate. Pediatric has no cuff.
- _ Marked with measurements to help ensure correct positioning
- _ 2.5 to 9 mm across and 12-32 cm long
- _ Average size 7.5 - 8 for women 8-8.5 for men
- _ Right size is really important

Stylet - semi-rigid plastic coated wire to help form the tube for easier placement

Tube Holder/Tie down - or use tape to hold in place

Intubation Procedure:

1. Measure and select the right size tube
2. Curve stylus as needed
3. Tip of curved blade is advanced into the vallecula. Straight blade is inserted under the epiglottis
4. Never use the teeth as a fulcrum
5. When you can see the vocal cords, place the ET tube through the opening
6. Use the syringe to inflate the cuff, and then remove syringe immediately
7. Secure the tube with a holder/bite block or tape

Once the tube is in place, there is no need to synchronize ventilation with chest compressions

Complications

- _ Hypoxia - can take too long, attempt no longer than 30 seconds
- _ Injury to teeth and tissue
- _ Misplaced tube in esophagus, right bronchi
- _ Difficulty - short fat necks, small receding chins, beards, large tongues, facial/neck injury/burns, fractured mandible laryngeal injury

Field Extubation: usually sedation addresses intolerance of tube when gagging. Also concern is laryngospasm after extubation. To extubate:

- _ Ensure O₂, suction, patient responsiveness
- _ Suction oropharynx
- _ Deflate distal cuff!!!

- _ Remove tube on cough or expiration

Combitube: ET tube and a large pharyngeal tube molded together

- _ Easy insertion
- _ Blind, no equipment needed, don't need to see cords
- _ Patient's head in neutral position
- _ Ventilate the correct tube once in position
- _ Self-adjusting/positioning posterior pharyngeal balloon
- _ Diminished gastric distension and regurgitation
- _ No face seal needed

Disadvantages:

- _ Can't seal trachea
- _ Only use on unconscious adults
- _ Difficult to intubate around

Contraindications

- _ Never use in a responsive patient with a gag reflex
- _ No patient under 4 feet tall
- _ No patient who ingested a caustic substance or with esophageal disease

Pharyngotracheal Lumen Airway: two-tube, two-cuff system

1. Short, wide tube with large cuff
 2. Longer tube travels through the first, extending past the distal end
- No matter where each tube lies, the patient can still be ventilated

- _ Easy insertion
- _ Blind, no equipment needed, don't need to see cords
- _ Patient's head in neutral position
- _ Ventilate the correct tube once in position
- _ Can occlude esophagus
- _ Diminished gastric distension and regurgitation
- _ No face seal needed

Disadvantages:

- _ Hard to identify tube location
- _ Tissue tearing
- _ Aspiration of blood/vomit in upper airway
- _ Balloon can displace
- _ Adults only
- _ Oral use only
- _ Extremely difficult to intubate around

Contraindications

- _ Never use in a responsive patient with a gag reflex
- _ No patients under 16 yo
- _ No patient under 5 feet tall or over 6'7"
- _ No patient who ingested a caustic substance or with esophageal disease

Laryngeal Mask Airway: silicone rubber mask with an inflatable outer rim

Foreign Bodies in the Airway

Adults commonly choke on food and dentures

Children choke on toys, coins and food

Stridor - high pitched noise heard on inspiration

Cyanosis - bluish color to skin with hypoxia

Assessment: is it partial or complete obstruction?

- _ Retractions - sucking in of soft tissues of the chest during inspiration
- _ Tracheal tugging - adam's apple appears to be pulled upward on inspiration, means there is an airway obstruction
- _ Treatment - complete obstruction - Heimlich maneuver
- _ Laryngoscopy, use McGill forceps to remove

Suction:

- _ Use soft tip to avoid damage, suction on the way out only
- _ Can use saline to clear tube between suction attempts
- _ Hazards - cardiac dysrhythmia from hypoxia, can stimulate vagal nerve, can stimulate coughing.

Gastric Distention -

Air trapped in stomach > decreased lung expansion, resistance to BVM, regurgitation, aspiration, gastric rupture

Put patient in left lateral position and exert moderate pressure on the epigastrium

Gastric Tube - placing a specialized suction tube into the stomach

Complications:

- _ Nasal, esophageal or gastric trauma
- _ Accidental ET placement
- _ Supragastric placement
- _ Tube obstruction

Facial Injuries

Assessment: gurgling, stridor, facial trauma

Treatment: Manage airway, in line stabilization, suction, roll whole body

Laryngeal Edema/Spasm

Glottis is the narrowest part of the adult's upper airway. Swelling/spasm narrows resulting in asphyxia.

Laryngeal edema - can result from anaphylaxis, epiglottitis and inhaling smoke

Treatment for swelling - if allergic reaction or anaphylaxis, epinephrine can save life

Pediatric Emergencies

Neonate -	Birth to 1 month
Young Infant -	1 to 5 months
Infant -	6-12 months, may have fear of separation, minimize separation, decrease parental anxiety
Toddler -	1-3 years, may fear separation, loss of control, keep it simple, play with equipment, do not ask permission - they will refuse
Preschooler -	3-5 years, fear bodily injury/mutilation, loss of control, the dark, being alone, keep it simple, be honest
School Age -	6-12 years, fear bodily injury/mutilation, loss of control, death, provide choices, explain longer term consequences
Adolescent -	12 to 15 years, fear loss of control, altered body image, peers, allow them to be part of the decision regarding their care, give info sensitively, be honest, teach coping

Anatomical Differences:

Occlusion of the airway is one of the major causes of pediatric death in the prehospital setting

Airway is smaller and more likely to get obstructed

- Larger tongue in proportion to the mouth
- Large, floppy epiglottis
- Airway is narrowest at the cricoid cartilage
- Vocal cords are more superior and more anterior than an adult's (around 1st or 2nd vertebra)

Skeletal structure is smaller

- Internal organs packed in a smaller space
- High incidence internal injuries - most often the liver

More multisystem injuries

- Bones are softer break less, bend more

Head is much larger in proportion to an adult

- Large, heavy head exerts pressure on spine
- Fontanelles (soft spots) on the tops of infant's heads until 18-24 months
 - ③ Bulge with pressure
 - ③ Depressed with dehydration

Nervous system more immature

- Nerves less well insulated
- Nerves less well-developed
- Does not know how to move out of the way of an object

Approaching the Pediatric Patient

Keep control of the scene

Keep parents informed and calm

Get the child's age and weight

What is the level of comprehension?

Who can offer emotional support

Who knows the medical history

Family-centered Care: involves the parent/guardian in care of the pediatric patient

Assessment: scene size-up: is the scene safe? In what position was the child found? Do the history and the injuries match?

Pediatric Assessment Triangle (first 30-60 seconds):

- Appearance
- work of breathing
- circulation

Initial Triage decision: if immediate treatment is necessary, then rapid

- LOC - AVPU

- ABCs 90% of cardiopulmonary problems start as respiratory problems
 - ③ Respiratory distress is hypoxia, where work of breathing is increased
 - ③ Respiratory failure is the inability to maintain adequate O₂ in the blood
 - ③ Apnea is the absence of airflow (breathing) for more than 15 seconds
 - ③ Signs and symptoms: nasal flaring, retractions, head bobbing, grunting, stridor, prolonged expiration, slow irregular resps. Dyspnea causes bradycardia
- Vital signs: respiratory rate and quality, pulse rate and quality, BP (over 3), pupils, skin temp. color and condition

Broselow Tape: resuscitation tool referencing proper range of vital signs as well as resuscitation equipment

History: get info from the parent/guardian/caregiver. SAMPLE history

Detailed physical: Infants and young children go toes to head. Older children head to toes

Managing the ABCs:

Allow the parent to hold infant and young children

Unconscious children, towel under shoulders will hold head in a sniffing position. Hyperextension can occlude the airway

Blocked airway? Never blind sweep the back of the mouth - abdominal thrusts for older children, chest thrusts and back blows for infants

OPAs: must use the right size - corner of mouth the earlobe, use tongue depressor to hold the tongue up, NPA: proper size, tip of nose to tragus ET tube can double as an NPA

Suction: no greater than 120 mm Hg, use a flexible tip. Monitor heart rate so they don't vagal out and brady down

Intubation equipment: ET tube should be the size of the pinkie finger or $\text{Age}/4 + 4 = \text{mm ET}$
Tube, blade sizes go down to zero

Bag Valve Mask Ventilation: at least 20 breaths/minute, O₂ set at 15 L/min with a 450 mL bag

Nasal Canula @ 2-4 L/min O₂

Blow by O₂ from a cup and hold the mask close to face

IV Therapy: very important to ill and injured children

Do not try to start a line in the cases of:

Traumatic injury - transport asap

Epiglottitis or other severe resp. distress

Intraosseous Infusion: Children 6 and under. Inserting a needle in the long bone of the leg. The tibular plateau

Severe shock

Cardiac arrest

Unconscious

Can't get an IV anywhere else

Fluid Administration: Isotonic (LR or normal saline) 20 mL/kg in less than 20 minutes

Kid's weight in kg x 20 for example:

$$20 \text{ lbs} / 2.2 = 9.09 \times 20 = 181.1 \text{ 30}$$

$$\text{lbs} / 2.2 = 13.6 \times 20 = 272 \text{ 40 lbs} /$$

$$2.2 = 18.18 \times 20 = 363.6 \text{ 50 lbs} /$$

$$2.2 = 22.72 \times 20 = 454.4 \text{ 60 lbs} /$$

$$2.2 = 27.27 \times 20 = 545.4 \text{ 70 lbs} /$$

$$2.2 = 31.81 \times 20 = 636.2 \text{ 80 lbs} /$$

$$2.2 = 36.36 \times 20 = 272.2$$

Pediatric Resuscitation: cardiac arrest usually results from respiratory arrest/hypoxemia

Asystole: flatline on the cardiac monitor: To treat asystole:

CPR

Ventilate with BVM 15 L/min O₂

Intubate
IV with LR or normal saline
Epinephrine

V-Fib: chaotic looking rhythm with varied waveforms, no P waves, QRS complexes or T waves. Rarely occurs in children except congenital heart disease, acidosis, hypothermia, drug toxicity. To treat V-Fib:

CPR
Ventilate with BVM 15 L/min O₂
Defibrillate up to three times with 2 joules/kg

Intubate
IV with LR or normal saline
Epinephrine
Repeat defib at 4 L/kg
Repeat epinephrine

Pediatric Respiratory Compromise:

Upper Airway Obstruction:

Foreign body: toddlers/preschoolers most common. Abdominal thrusts for children back blows and chest thrusts for infants

Tonsillitis

Croup (laryngotracheobronchitis): children 3 months to 3 years. Viral infection, slow onset, upper resp infection and low fever, Hoarse with stridor (subglottic edema) and a barking cough. O₂, transport in position of comfort

Epiglottitis: inflammation of the epiglottis, most often 3 years to 7 years. Bacterial infection, progresses rapidly and can lead to complete airway obstruction and respiratory arrest. They look very ill, stay very quiet, tripod position, drooling, muffled voice and stridor. They need nebulized epinephrine. Keep them comfortable and calm

Lower Airway Obstruction:

Asthma: reactive airway disease, any age, response to allergy exercise, infection, family history, drugs reverse bronchospasm. High flow O₂, transport

- o Status asthmaticus: severe, prolonged attack which can't be stopped with traditional bronchodilators

Bronchiolitis: 6-18 months, any time or year, viral infection, mild fever, cough runny nose which progresses to respiratory distress. No history of asthma, drugs may not be effective

Pneumonia: infection of the lower airway and lung. Common in infants, toddlers and preschoolers. Bacterial or viral. Fever, rales, rhonchi, pain in chest, grunting respirations

Pediatric Shock: inadequate delivery of O₂, and is the body's response to poor perfusion. A child may lose up to 20% blood volume before a change in appearance. Leading cause of shock in kids is gastroenteritis with dehydration.

Palpate peripheral pulse and listen to apical heart rate for clues on hypovolemia

Compensated shock: BP normal, compensate longer than adults

Decompensated shock: hypotensive and shows signs of inadequate perfusion, often irreversible

Signs of shock:

- o Altered level of responsiveness
- o Hyperventilation leading to respiratory failure
- o Tachycardia
- o Normotension progressing to hypotension
- o Cool, or cold clammy skin
- o Prolonged cap refill
- o Oliguria - lack of urine production
- o Acidosis

Dehydration: threat to infant and child because they are greater proportion of water than adults (they are 65%), decrease in cardiac output>renal failure>shock>death

Fever

Viral gastrointestinal disorder

Nausea, vomiting, diarrhea

Treatment:

Moderate to extreme: IV of normal saline of LR

High flow O₂

Seizures/Epilepsy: 8% of pediatric transports, many are febrile (fever) seizures. Make note of duration, aura, level of responsiveness, parts of body involved, postictal period, incontinence

Simple Partial: no loss of consciousness, motor signs or sensory symptoms

Complex Partial: psychomotor or temporal lobe seizures; purposeless activity

Absence: formerly called Petit Mal, loss of consciousness, short periods of staring

Clonic: jerking muscle activity

Tonic: stiffening of the body

Tonic-Clonic: formerly called Grand Mal, total loss of consciousness with convulsions

Myoclonic: Start/stop abruptly, single or multiple myoclonic jerks

Atonic: drop attack, unexpected lack of muscle tone

Akinetic: lack of movement

Unclassified\

Treatment:

Nasal airway, suction, ventilation is apnea or prolonged hypoventilation If due to a fever, reduce fever with moist cloths, tepid water, fanning

Prolonged seizures, IV Valium or Ativan may be required, rectal diazepam is available for age 2 and older

Status epilepticus: continuous seizure of more than 30 min. or a series of seizures with no conscious period in between.

Meningitis: inflammation of the membranes around the brain and spinal cord. Viral or bacterial. Bacterial is much more serious and contagious. Symptoms:

Fever, dehydration, disorientation

Bulging fontanelle

Loss of appetite, poor feeding, vomiting

Seizures

Respiratory distress, cyanosis, rash

Older children: Kernig's sign, headache, nuchal tenderness

Later symptoms of bacteria in the bloodstream: chills joint pain, sore throat, headache, red spots, exhaustion

Treatment:

BSI, could be contagious, use a mask

Maintain the respiratory and circulatory efforts

Monitor vital signs and cardiac status

High flow O₂

IV bolus of 20 mL/kg as necessary

Make comfortable, transport, watch for seizures

Poisoning: extremely high risk because they are so inquisitive. Kids 18 months to 3 years account for 30% of all accidental poisonings. Household products, medications, toxic plants, contaminated foods. School age and adolescents poison themselves with alcohol, organic solvents, and drugs.

Trauma: 20-40% of pediatric deaths due to trauma are preventable. Most common: Falls, then MVA, accidental injury, sports related injury, assaults/abuse.

Assessment: ABCs

Treatment: IV saline or LR for hypovolemia

Head trauma: most common cause of death because their big, heavy heads hit first. Manage airway, O₂, intubate as necessary

Spinal Trauma: more flexible, lack of neck muscle, serious injury can occur without external signs of injury. 60-70% of pediatric neck fractures are at C1 or C2

Child Safety Seats: Cervical spine is still susceptible to maximum flexion. If child's head sticks up over the seat, the head can hyperextend during a rear-end collision. Use the seat for immobilization unless the child is critically injured and will deteriorate. Inspect the seat for damage too. Then pad the body and head to prevent further movement.

C-spine devices for children: make sure it fits. It is much worse to hyperextend the kid's neck to force the collar on than to secure it with towels etc.

Backboards: Short of long can be used, pad under their torso to bring the spine into alignment. Pad around the sides of the board

KEDs/Vest Devices: Adult vest is not recommended because in-line spinal position can't be achieved

Helmets: Removal is recommended to bring the spine in line. Their heads are already so big you have to pad under their shoulders, the helmet just makes it worse.

Chest and Abdominal Trauma: more flexible, fractured ribs are associated with a high mortality rate due to the force required to break the ribs. Flail segments rare. Liver, kidney and spleen are most commonly injured. Treatment: O₂, transport definitive care at the hospital.

Hypothermia: CBT below 95 F, 35 C. Children more susceptible due to large body surface area compare to weight. Look for signs and symptoms:

95 degrees - Shivering, increased resps, may be alert

90 degrees - Muscular rigidity, decreased resp rate, atrial fibrillation, impaired cognition, loss of dexterity

86 degrees - Decreased cerebral blood flow, tachycardia, tachypnea, supraventricular dysrhythmia

80 degrees - bradycardia, bradypnea, V-fib, decreased O₂ uptake, rigid extremities, metabolic rate decreased by 50%

77 - hypotension, blood to kidneys reduced 30%

68 - unconscious, no reflexes, unresponsive pupils etc.

Treatment: move to warm environment asap, warm blankets, maintain airway, high flow O₂, CPR if no pulse, if heart rate, handle gently to prevent V-Fib. Use heat packs, but don't let them directly touch the skin

Drowning: third leading preventable cause of death. 2,000 annually. Focus on ABCs. Do not intubate a child that has been submerged but has a heart rate - stimulating the vagus nerve may cause asystole.

Water rescue: distress in water but is alert

Submersion: water-related distress, transported to ER

Drowning: considered fatal. Drowning-related death is if they die within 24 hours

SIDS: Sudden Infant Death Syndrome: unexplained after post-mortem exam. Third leading cause of death in children age 1 month to 1 year. 3,400 annually. Peak age 2-4 months. 95% occur by 6 months. More males, during sleep, more in winter esp. January. Native Americans/Blacks, premature, multiples, soft bedding, overheating, young cigarette-smoking moms.

Try to determine the scene as the baby was found, esp. if they have been removed from the bed
Continue CPR if the parents started

Be compassionate, don't give the impression of any wrongdoing

Stress that SIDS can't be predicted or prevented

Child Abuse/Maltreatment

Child Abuse: any recent act or failure to act that results in imminent risk of serious physical or emotional harm, death, sexual abuse or exploitation by a parent or caretaker. 1 million children annually, over half are under 7, 56% of those are under 4. The most important thing for an EMT to remember is to be nonjudgmental. Document everything. Treat physical injuries as appropriate. Protect the child from further abuse. Reporting is mandatory to hospital/local authorities:

Physical abuse: Bruises, welts, burns (glove), fractures, dislocations, wounds in various levels of healing, inappropriate reactions, acting out behavior, withdrawal

Sexual abuse: bruises, bleeding on genitals, torn underwear, pain on urination, STCs

Emotional abuse: withdrawal, fearfulness, lags in development, sleep disorders

Neglect: failure to thrive, malnutrition, unclean, poor teeth

Maltreatment: intentional physical abuse or neglect, emotional abuse or neglect and sexual abuse

Neglect: failure of a parent or guardian to provide for the child's basic needs and an adequate level of care

Shaken Baby Syndrome: can cause fatal intracranial trauma without signs of external head injury. Retinal hemorrhage, CNS injury, bleeding, concussion, soft tissue swelling, skull fracture, hypotension

Special Needs: any condition that interferes with usual growth and development: hearing impaired, mental retardation, tracheotomy, gastrostomy, cerebral palsy, spina bifida, etc.

Cognitive Disabilities: some degree of impaired adaptation in learning, social adjustment or maturation. Actual physical evaluation is all the same, the major difference is the child's level of understanding and ability to communicate

Physical Disabilities: some limitation of mobility, attend to ABCs and don't let devices get in the way

Chronic Illnesses: any disease/situation that extends for a prolonged period

Assistive Technology

- Tracheotomy: temporary or permanent. Airway trauma or weak respiratory muscles. Watch for mucus plugs
- Central Venous Access Devices: extended access to a vein. Several types of devices, but they all end at the superior vena cava or the right atrium. Implanted ports are accessed using a Huber needle
- Vagus nerve stimulator: over 12 yo, stops the progression of seizure activity
- Apnea Monitors: alarm sounds if a breath is not detected in a certain period of time
- Gastrostomy Tube or Button: children who can't take food by mouth. The tube may have become dislodged, there may be internal bleeding

Medications: find out what they are taking and when their last dose was

Latex Allergies: especially in kids with spina bifida, assemble a latex-free kit

Family Issues: Stressful for the entire family

General Considerations: special needs kids are at risk for medical complications or traumatic events. Infections, decreased reflexes, paralysis. Look for Medical Tags, ask for Emergency Information Form (EIF)

Pain Management: pain in children is often underestimated, includes verbal and nonverbal expressions

Family Involvement: always keep the parents and caregivers involved

Transport Guidelines: critically ill or injured kids need a pediatric trauma center