Learning Objectives

• Identify the role of the Emergency Medical Services for Children program.
• Identify age-related illnesses and injuries in pediatric patients.
• Outline the general principles of assessment and management of the pediatric patient.
Learning Objectives

• Identify modifications in patient assessment techniques that assist in the examination of patients at different developmental levels.
• Describe the pathophysiology, signs and symptoms, and management of selected pediatric respiratory emergencies.

Learning Objectives

• Describe the pathophysiology, signs and symptoms, and management of shock in the pediatric patient.
• Describe the pathophysiology, signs and symptoms, and management of selected pediatric dysrhythmias.
• Describe the pathophysiology, signs and symptoms, and management of pediatric seizures.

Learning Objectives

• Describe the pathophysiology, signs and symptoms, and management of hypoglycemia and hyperglycemia in the pediatric patient.
• Describe the pathophysiology, signs and symptoms, and management of infectious pediatric emergencies.
Learning Objectives

• Identify common causes of poisoning and toxic exposure in the pediatric patient.
• Describe special considerations for assessment and management of specific injuries in children.

Learning Objectives

• Outline the pathophysiology and management of sudden infant death syndrome.
• Describe the risk factors, key signs and symptoms, and management of injuries or illness resulting from child abuse and neglect.
• Identify prehospital considerations for the care of infants and children with special needs.

Paramedic’s Role in Caring for Pediatric Patients

• Prehospital care and interfacility transfer
• Reduce mortality and morbidity for children
• Participate in school, community, and parent education programs
Paramedic’s Role in Caring for Pediatric Patients

• Provide documentation for
  – Prehospital trauma registries
  – Epidemiological research
  – Surveillance

Paramedic’s Role in Caring for Pediatric Patients

• Improvement of knowledge and clinical skills is important
  – Continuing education programs include
    • Neonatal Resuscitation Program
    • Neonatal Advanced Life Support
    • Pediatric International Trauma Life Support
    • Pediatric Advanced Life Support
    • Pediatric Education for Prehospital Professionals
    • Prehospital Pediatric Care
    • Teaching Resource for Instructors of Prehospital Pediatrics

Paramedic’s Role in Caring for Pediatric Patients

• Other ways to enhance continuing education and clinical skills
  – Read textbooks and journals
  – Internet study
  – Attend regional conferences and seminars
  – Working or volunteering at pediatric emergency departments, pediatric hospitals, or a pediatrician’s office
EMS for Children

• 1985: Emergency Medical Services for Children (EMS-C) Demonstration Program established through grants provided by the Maternal and Child Health Bureau of the U.S. DHHS and by the NHTSA, a division of the U.S. DOT
• Designed to enhance and expand EMS for acutely ill and injured children

EMS for Children

• Defined 12 basic components of an effective EMS-C system
  – System approach
  – Education
  – Data collection
  – Quality improvement
  – Injury prevention
  – Access
  – Prehospital care
  – Emergency care
  – Definitive care
  – Rehabilitation
  – Finance
  – Continual health care from birth to young adulthood

Are you familiar with any Emergency Medical Services for Children injury prevention programs in your area?
EMS for Children

- EMSC grants and organizational efforts aimed at improving emergency care for children have resulted in specific programs targeted to prehospital care providers
  - Continuing education programs
  - Educational resources for instructors
  - Equipment guidelines
  - Protocols for prehospital management
  - Quality improvement procedures for evaluating prehospital care for children
  - Designation of facilities with special capabilities for pediatric care

EMS for Children

- As stated in EMSC: A Report to the Nation, published in 1991 by National Center for Education in Maternal and Child Health:

  "The lives of many infants, children, and young adults ... can be saved through implementation of emergency medical services for children. Outcomes for critically ill and injured children can be influenced by the provision of timely care by health care professionals who are well trained and equipped for pediatric emergency and critical care."

EMS for Children

- In 2005, EMS-C program celebrated its 20th anniversary
- As stated in the Institute of Medicine’s 2006 report, Future of Emergency Care, Emergency Care of Children-Growing Pains:

  "The program’s accomplishments are numerous... The program has broadly advanced the state of pediatric emergency care nationwide. It has improved the availability of child-size equipment in ambulances and EDs; initiated hundreds of programs to prevent injuries; and provided thousands of hours of training to EMTs, paramedics, and other emergency medical care providers...to help achieve the program’s goals..."
EMS for Children

• Children have unique anatomical, physiological, and psychological characteristics that change during their development

How comfortable are you with a “normal” well child?

Newborn (First Few Hours of Life)

• Method most commonly used to evaluate newborn is Apgar score
• Resuscitation of newborn (if needed) should follow recommendations established by AHA, including those found in curriculum for Neonatal Resuscitation Program
Newborn (First Few Hours of Life)

- Newborn’s heart rate during first 30 minutes of life is between 120 and 160 bpm
- Respirations at birth are usually between 40 and 60 breaths/min
  - 30 to 40 breaths/min within a few minutes after delivery
- Full-term newborn normally weighs 3 to 3.5 kg (about 6 to 8 lb)

Neonate (First 28 Days of Life)

- Total body weight in neonate may decrease 5 to 10 percent during first few days of life because of excretion of extracellular fluid
- Lost weight is regained by second week of life and generally exceeds newborn weight
- Most infants gain an average of 5 to 6 oz per week
Neonate (First 28 Days of Life)

- Neonates respond to their environment with a range of stereotypic reflexes
  - Protective and include those associated with
    - Breathing
    - Eating
    - Stress
    - Discomfort

Neonate (First 28 Days of Life)

- Neonates sleep an average of 16 to 18 hours/day, with sleep and wakefulness evenly distributed over 24 hours
- Infants are obligate nose breathers (breathing occurs mainly through nose) during first month of life
  - Horizontal position of ribs produces characteristic diaphragmatic breathing
- Crying gradually decreases throughout infancy
  - Persistent crying may indicate physiological distress

Neonate (First 28 Days of Life)

- Illnesses that may be encountered in this age group
  - Respiratory problems
  - Jaundice
  - Vomiting
  - Fever
  - Sepsis
  - Meningitis
  - Problems of prematurity
Infant (2 to 12 Months)

- Major advances in physical and mental skills occur as brain and nervous system gradually mature
- Response to environment evolves from reflexes of purposeful movements
- Musculature of the neck and back enables them to hold the head upright, sit, and babble
- Between 4 to 6 months of age, most infants have doubled birth weight, tripling within 9 to 12 months

Infant (2 to 12 Months)

- In first year of life, heart also doubles in size
  - Heart rate gradually slows
  - BP begin to increase
- By 12 months of age, development of mature nerves is nearly complete
  - Enables many infants to stand and walk with little or no assistance
  - Muscle weight in infants is about 25 percent of entire musculoskeletal system
Infant (2 to 12 Months)

• Common illnesses typically affect respiratory, GI system, and CNS
  – Respiratory distress
  – Nausea
  – Vomiting
  – Diarrhea
  – Dehydration
  – Seizures

Infant (2 to 12 Months)

• Other illnesses that may be encountered
  – Sepsis
  – Meningitis
  – SIDS

Infant (2 to 12 Months)

• Older infant (6 to 12 months of age) may experience
  – Bronchiolitis
  – Croup
  – Foreign body airway obstruction
  – Physical injury
    • Sexual abuse
    • Neglect
    • Falls
    • Motor vehicle crashes
Toddler (1 to 3 Years)

- Muscle mass and bone density increase during toddler years
- Most children gain an average of 2 kg (about 4 lb) each year
- By age 2, much of the nervous system is fully developed
  - Basic motor skills (e.g., balance and walking) and fine motor skills (e.g., stacking building blocks) become visible

Toddler (1 to 3 Years)

- Most are capable of controlling bladder and bowel function by 2 to 3 years
- By 2 years of age, toddlers have developed unique personality traits, moods, and specific likes and dislikes
Toddler (1 to 3 Years)

- Basic language skills are mastered by age 3
  - These skills continue to be refined through childhood
- By 3 years, toddlers and preschoolers also begin to recognize difference between sexes and start to model themselves after persons of their own gender

Toddler (1 to 3 Years)

- Illnesses
  - Respiratory distress (e.g., from asthma, bronchiolitis, foreign body aspiration, or croup)
  - Vomiting and diarrhea with dehydration
  - Febrile seizures
  - Sepsis
  - Meningitis

Toddler (1 to 3 Years)

- Toddlers learning to walk are prone to falls
  - May find themselves in dangerous environments without proper supervision or barriers (e.g., baby gates)
  - Physical injuries also occur from
    - Poisonings from accidental ingestions
    - Physical/sexual abuse
    - Drowning
    - Motor vehicle crashes
Preschooler (3 to 5 Years)

- Experience advances in gross and fine motor skills
  - Peer relationships begin to form with other children near same age and level of maturity
    - Often begin with play that involves acting out fantasies or using imagination for new situations
    - Can lead to problem-solving skills and cognitive development

- Illnesses and injuries include those mentioned for toddlers
  - More likely to experience injuries from
    - Thermal burns
    - Pedestrian accidents
    - Submersion incidents
    - Drowning

- Curious and have an urge to explore
  - Many have minimal concept of danger
School Age (6 to 12 Years)

- Growth is slower and steadier than during infancy, toddler, preschooler years
  - Most children gain about 3 kg (6.6 lb) per year
  - Average yearly gain in height of about 2 1/2 inches (6 cm)
  - Most bodily functions reach adult levels

School Age (6 to 12 Years)

- Two key areas of development
  - Increased ability to concentrate and learn quickly
  - Onset of puberty
- Psychosocial development varies by individual
  - Self-concept and moral traits and behavior begin to emerge during the school-age years
  - Children spend more time with others outside their immediate family
School Age (6 to 12 Years)

- Most illnesses are caused by viral infection
- Injuries become more common because of increased physical activity
  - Bicycle crashes
  - Fractures from falls
  - Sport-related injuries

Adolescent (13 to 18 Years)

- Final phase of change in growth and development occurs
  - Organs rapidly increase in size
  - Blood chemistry values become nearly equal to adult levels
  - Growth of bone and muscle mass becomes nearly complete
  - Reaches reproductive maturity
Adolescent (13 to 18 Years)

• With development of secondary sex characteristics in both sexes comes final period of rapid growth
  – Most boys gain average of 8 inches in height before age 21 when growth usually stops
  – Growth in girls is less dramatic, is usually complete by age 18

Adolescent (13 to 18 Years)

• Teenagers begin to experiment with different identities
  – Develop personality into that of adult
  – Make dramatic moves away from parents and family members toward peer groups
  – May experiment with alcohol and other drugs, sex, and extreme forms of behavior

Adolescent (13 to 18 Years)

• Paramedic may encounter
  – Behavioral emergencies associated with alcohol or other drugs use
  – Eating disorders
  – Depression
  – Suicide and suicide gestures
  – Sexually transmitted diseases
  – Pregnancy
  – Sexual assault
Head

- Up until age 8, child’s head is proportionally large
  - Accounts for about 25 percent of total body weight in newborns
  - Children also have larger occipital region and smaller face relative to adults
- High percentage of blunt trauma in children involves head and face

Head

- Prominent occiput of child predisposes neck to slight flexion when child is placed on flat surface
  - To prevent this, spine board with occipital well or blankets placed under child’s torso should be used to maintain neutral position of neck
### Head

- To accommodate for brain growth in infant, anterior fontanelle remains open 9 to 18 months after birth
  - Anterior fontanelle is usually level or slightly below surface of skull
  - Tight or bulging fontanelle suggests increased intracranial pressure as seen with meningitis or brain injury
  - Sunken fontanelle indicates possible dehydration

### Head

- Paramedic should assess anterior fontanelle in infants and young children who are ill or injured
  - Best assessed when child is upright and not crying

### Airway

- Airway structures of children
  - Narrower and less stable at all levels than those of adults
  - Airways of pediatric patients more easily blocked by secretions, obstructions, and injury or inflammation
  - Larynx is higher (at level of cervical vertebrae C3 to C4) and more anterior, extending into pharynx
  - Trachea is bifurcated at higher level
  - Tracheal cartilage is softer and smaller in length and diameter
Airway

- Airway structures of children
  - Cricoid ring is narrowest part of airway in young children
  - Jaw is proportionally small, and the tongue is proportionally large
    - Increases likelihood of airway obstruction by tongue in unconscious child
  - Epiglottis in infants is omega shaped and extends into airway at 45-degree angle
  - Epiglottic folds have softer cartilage and can become “floppy,” causing airway obstruction

Airway

- Management considerations
  - Placing padding under shoulders of small children to maintain neutral position of airway
  - Avoiding hyperflexion or hyperextension of neck, which can obstruct airway
  - Using suction to clear airway if secretions and particulate matter are present
  - Modifying tracheal intubation techniques by ensuring gentle touch to soft tissue of airway, which is easily injured and inflamed

Airway

- Management considerations
  - Using straight blade that lifts epiglottis
  - Choosing appropriately sized endotracheal tube and constantly monitoring airway for proper endotracheal tube placement with continuous capnography
Airway

• Infants breathe mainly through nose during first month of life
  – Obstruction of small nares by secretions can result easily in respiratory insufficiency
  – Assessment and suction of nares as needed is important especially important in infants under 6 months of age

Chest and Lungs

• In infants and young children, chief support for chest wall comes from muscles rather than bones
  – Chest muscles are immature
  – Can fatigue easily
  – Use of these muscles for breathing requires higher metabolic and oxygen consumption rates than in older children and adults
  – Increases pediatric patient’s susceptibility to accumulation of lactic acid in blood

Chest and Lungs

• Ribs of child are more pliable and are positioned horizontally
  – Mediastinum is more mobile
  – Chest wall offers less protection to internal organs
    • Allows for significant internal injury to occur without external signs of trauma
  – Rib fractures are less common in children
  – Can occur with child abuse and other forms of trauma
Chest and Lungs

- Lung tissue of pediatric patient is fragile
  - Pulmonary contusions from trauma and pneumothorax from barotrauma are common

Chest and Lungs

- When evaluating pediatric patient who has suffered major trauma, remember
  - Infants and children are diaphragmatic breathers and are prone to gastric distention
  - Mobile mediastinum may have greater shift with tension pneumothorax
  - Thin chest wall easily transmits breath sounds, which may complicate assessment of pneumothorax or endotracheal tube placement
  - Auscultation of breath sounds from axillary regions in addition to anterior and posterior thorax often is helpful

Abdomen

- Immature muscles of abdomen in child offer less protection to internal organs
  - Abdominal organs are closer together
  - Liver and spleen are proportionally larger and more vascular
  - Allow for multiple organ injuries to be more common following abdominal trauma
  - Liver and spleen are injured more often than in adult patient
Extremities

- Bones in children are softer and more porous until adolescence
  - As long bones mature, hormones act on cartilage in growing bones, replacing soft cartilage with hard bones
  - Epiphyseal plates (growth plates) are located at distal ends of long bones
    * Area where new cartilage is laid down and ossified, lengthening bones
    * Point of relative weakness
  - With age, long bones also thicken as additional layers of bone are laid down

Extremities

- All strains and sprains should be considered fracture
  - Manage with full immobilization of extremity
  - Be wary of injuries to the growth plate that may disrupt bone growth
    * Careful technique during intraosseous infusion procedures is critical
    * Improper insertion into the growth plate can affect future bone growth

Skin and Body Surface Area

- Skin is thinner and more elastic than skin of adults
  - Most children under 2 years have less subcutaneous fat
    * Child has larger body surface area-to-body mass ratio
  - Thinner skin of child allows for deeper injury to occur from heat or cold exposure
  - Lack of subcutaneous fat and larger body surface area-to-body mass ratio also increase child’s likelihood of hypothermia, hyperthermia, dehydration from fluid loss
Respiratory System

• Tidal volume of infants and young children is proportionally smaller than that of adolescents and adults
• Metabolic oxygen requirements for normal breathing are about double
• Pediatric patients have smaller functional residual capacity
  – Proportionally smaller oxygen reserves
  – Hypoxia can develop rapidly in infants and young children

Respiratory System

• Muscles are main support for chest wall
  – Can tire easily during respiratory distress
  – Can lead to respiratory failure and ultimately arrest

Respiratory System

• Anticipate respiratory failure if
  – Increased respiratory rate particularly with signs of distress
  • Nasal flaring
  • Retractions
  • Seesaw breathing
  • Grunting
  – Inadequate respiratory rate, effort, or chest excursion especially if mental status is depressed
  – Cyanosis with abnormal breathing despite supplementary oxygen
Cardiovascular System

- Cardiac output is rate dependent in infants and small children
  - Faster the heart rate, greater the cardiac output
  - Children are not as able as adults to increase contractility and stroke volume of heart
- Circulating blood volume in children is proportionally larger than in adults
  - Child’s absolute blood volume is smaller
- Ability of children to use vasoconstriction to decrease size of vessels allows them to maintain BP longer than adults
- Early intervention is required to prevent irreversible or decompensated shock

Cardiovascular System

- Special considerations in managing these patients
  - Cardiovascular reserve is vigorous, but limited
  - Loss of small volumes of fluid and blood can cause shock
  - Child may be in shock despite normal BP
  - Bradycardia is often response to hypoxia

Cardiovascular System

- Hypotension is late sign of shock in pediatric patient
  - Assessment of shock must be based on clinical signs of tissue perfusion
    - Level of consciousness
    - Skin color
    - Oxygen saturation
    - Capillary refill
  - Suspect shock in any ill or injured child who has tachycardia and evidence of decreased perfusion
Cardiovascular System

• Hypotension in infants and children can be defined as a systolic blood pressure
  – <60 mm Hg in term neonates (0 to 28 days)
  – <70 mm Hg in infants (1 to 12 months)
  – <70 mm Hg + (2 times age in years) in children 1 to 10 years
  – <90 mm Hg in children 10 years of age

Nervous System

• Nervous system develops throughout childhood
  – Developing neural tissue is fragile
  – Greater CSF space around neural tissues in children buffers blunt forces

Nervous System

• Spinal column also is more pliable
  – Children suffer spinal cord injury less frequently than adults (56 percent of spinal cord injuries in U.S. occur between ages of 16 and 30)
  – Children also may be free of injury, even after falls from great heights
• Anterior and posterior fontanelles in young children remain open 9 to 18 months after birth
  – Direct trauma to head can lead to brain injuries that are devastating in young children
Metabolic Differences

- How children and adults expend energy differs in many ways
  - Infants and children have limited glycogen and glucose stores
    - Blood glucose levels can drop in response to illness or injury
  - Pediatric patients can experience significant volume loss from vomiting and diarrhea
  - Children are also prone to hypothermia because of increased body surface area
    - Newborns and neonates do not have ability to shiver or sweat to maintain body temperature

Metabolic Differences

- Assess severely ill or injured child
  - For hypoglycemia or hypoperfusion
  - To minimize heat loss
  - To keep all children warm during treatment and transport

Why is it important to know what injuries and illnesses are commonly encountered in specific age groups?
General Principles of Pediatric Assessment

• General principles of assessment for pediatric patient similar to those for adults
• Approach strategies and medical equipment will differ some because of
  – Patient’s age
  – Maturity
  – Physical development

General Principles of Pediatric Assessment

• Brief overview of general principles of pediatric assessment
  – Evaluation of the scene (scene size-up)
  – Primary survey
  – Vital functions
  – Transition phase
  – Focused history
  – Secondary assessment
  – Reassessment

Evaluation of Scene (Scene Size-Up)

• Begin physical assessment of child with quick scene survey, noting any potential hazards
  – Note any visible mechanism of injury or illness
    • Presence of pills, medicine bottles, or household chemicals may indicate possibility of toxic ingestion
Evaluation of Scene (Scene Size-Up)

- Injury and history that does not coincide with stated mechanism of injury may indicate child abuse
  - Observe relationship between parent, guardian, or caregiver and child to determine appropriateness of interaction
  - Does interaction demonstrate concern, anger, or indifference?

Evaluation of Scene (Scene Size-Up)

- Other important assessments during scene size-up
  - Orderliness, cleanliness, and safety of home
  - General appearance of other children in family

Would you want to make a comment to the parents about an unsafe situation on the scene before transport? Why or why not?
Primary Survey

- Begins with forming general impression
  - Focus on details most valuable for determining whether life-threatening conditions exist
- Pediatric assessment triangle used to quickly assess
  - Appearance (mental status and muscle tone)
  - Work of breathing (respiratory rate and effort)
  - Circulation (skin signs and skin color)

Primary Survey

- If child’s condition is urgent, care should proceed with
  - Rapid assessment of airway, breathing, and circulation
  - Management
  - Rapid transport
- If child’s condition is not urgent, care can proceed with focused history and detailed physical examination

Think about one abnormal finding in each area of the assessment triangle. Would that single finding influence your triage decision?
Vital Functions

- AVPU scale
  - Alert
  - Responds to verbal stimuli
  - Responds to painful stimuli
  - Unresponsive
- Modified Glasgow Coma Scale
  - Can be used to determine child’s level of consciousness and to assess for signs of inadequate oxygenation

Airway and Breathing

- Child’s airway should be patent, and breathing should proceed with adequate chest rise and fall
- Signs of respiratory distress
  - Abnormal breath sounds
  - Absent breath sounds
  - Apnea or bradypnea
  - Grunting
  - Head bobbing
  - Irregular breathing pattern
  - Nasal flaring
  - Tachypnea
  - Use of accessory muscles
Circulation

• Assess circulation by comparing strength and quality of central and peripheral pulses
  – BP should be measured in children over 3 years of age with appropriately sized cuff
  – In all children who are seriously ill or injured

Circulation

• Skin should be evaluated for
  – Color
  – Temperature
  – Moisture
  – Turgor
  – Capillary refill
• Any signs of visible hemorrhage should be noted and managed appropriately

Transition Phase

• Integrated throughout assessment
  – Used to allow child to become more familiar with paramedic crew and medical equipment
• Use of this phase depends on seriousness of patient’s condition and is only appropriate for conscious child who is not acutely ill
  – If patient is unconscious or acutely ill, management should proceed quickly to emergency care and transport
Transition Phase

- When obtaining focused history for an infant, a toddler, or a preschooler, paramedic often must elicit information from parent, guardian, or caregiver
  - School-age and adolescent patients can provide most information by themselves

Transition Phase

- Paramedic should question them in private (away from parents or family members) about
  - Sexual activity
  - Pregnancy
  - Alcohol or other drug use
  - Suspicion of child abuse (if appropriate for the complaint)
- Focused history can be obtained using SAMPLE and OPQRST methods
  - Use methods as appropriate for patient’s age

Transition Phase

- Important elements of focused history
  - Chief complaint
  - Nature of illness or injury
  - Length (duration) of illness or injury
  - Last meal
  - Presence of fever
  - Effects on behavior
  - Vomiting or diarrhea
  - Frequency of urination
  - Medications and allergies
  - Medical history
  - Physician care
  - Chronic illnesses
Secondary Assessment
• Perform detailed secondary assessment
  – Proceed from head to toe in older children
  – Proceed from toe to head in younger children

Secondary Assessment
• Depending on patient’s condition, some or all of the following assessments may be appropriate
  – Pupils
    • Are they equal and reactive to light?
  – Capillary refill (most accurate in patients under 6 years)
    • Is it less than 2 seconds (normal) or delayed?
  – Hydration
    • Does skin show normal resiliency (skin turgor)?
    • Are there tears and saliva?
    • Are fontanelles in infant sunken or flat?

Secondary Assessment
• If time allows and patient’s condition warrants, noninvasive monitoring of vital signs can provide more information
  – Pulse oximetry to measure perfusion and oxygen saturation
  – BP assessment
  – Measurement of body temperature
Secondary Assessment

- All seriously ill or injured children should receive continuous ECG monitoring
  - Measurement tools (e.g., blood pressure cuffs and electrodes) should be appropriate for size of child

Reassessment

- Reassessment should be ongoing and is appropriate for all patients
- Purpose is to monitor patient for changes
  - Respiratory effort
  - Skin color and temperature
  - Mental status
  - Vital signs (including pulse oximetry measurements)
Reassessment

• Child's condition can change rapidly
  – Vital signs assessed every 15 minutes in child not critical
  – Vital signs assessed every 5 minutes in child who is seriously ill or injured

Why is ongoing assessment critical when caring for the young child?

General Principles of Patient Management

• Principles of patient management depend on patient’s condition
  – Basic airway management
  – Advanced airway management
  – Circulatory support
  – Pharmacological therapy
  – Nonpharmacological therapy
  – Transport considerations
  – Psychological support
  – Comfort measures
  – Communication strategies
• General principles of patient management for children are similar to those of adult patients
Basic Airway Management

• Basic and advanced airway management procedures
  – Manual positioning of the airway
  – Removal of foreign body airway obstruction with chest or abdominal thrusts
  – Suctioning secretions from the airway
  – Providing supplemental oxygen
  – Using oral or nasal airway adjuncts
  – Assisting ventilation with a bag-valve device

Advanced Airway Management

• May be needed when caring for child who is acutely ill or seriously injured when other methods to maintain patent airway have failed
  – Removing foreign body airway obstruction under direct visualization with Magill forceps
  – Endotracheal intubation (including drug-assisted intubation)
  – Cricothyroidotomy (per medical direction)

Circulatory Support

• May be required in an ill or injured child
  – Basic life support with CPR
  – Vascular access may be required for drug therapy and fluid resuscitation
    • Peripheral venous cannulation
    • Intraosseous infusion
Pharmacological Therapy

- At times, drug therapy will be required when caring for pediatric patient
  - Therapy for pain management
  - Drug-assisted intubation
  - Patients with respiratory, cardiac, endocrinological, or neurological conditions

Additional Therapy

- Additional therapies may be indicated depending on type of illness or injury
  - Spinal immobilization for trauma patients
  - Hemorrhage control and bandaging and splinting
  - Electrical therapy
  - Lowering body temperature with cooling methods or maintaining body temperature with blankets and warm clothing

Transport Considerations

- Some pediatric patients will need transport to specialty care medical facility
  - Pediatric trauma centers
  - High-risk newborn care facilities
  - Pediatric burn centers
- Paramedic crew must consider proper mode of caring for these patients
  - Decisions to provide rapid transport versus providing on-scene care
  - Use of ground or air ambulance
Psychological Support

- Important for paramedic to provide psychological support to pediatric patient and to patient’s family or caregivers

Specific Pathophysiology, Assessment, and Management

- Conditions are specific to major body systems and associated illness or injury
  - Respiratory
  - Cardiac
  - Endocrine
  - Hematologic
  - Neurologic
  - Immune
  - Gastrointestinal
  - Shock
  - Toxicology
  - Abuse
  - Neglect
  - Sudden infant death syndrome

Respiratory Compromise

- Respiratory distress can be caused by many conditions that affect upper and lower airways
  - Upper and lower foreign body airway obstruction
  - Upper airway disease (croup, epiglottitis, and bacterial tracheitis)
  - Lower airway disease (asthma, bronchiolitis)
  - Pneumonia
  - Pertussis
  - Cystic fibrosis
  - Bronchopulmonary dysplasia
Respiratory Compromise

- Most cases of cardiac arrest in children occur because of respiratory insufficiency (asphyxial arrest)
- Respiratory emergencies call for rapid assessment and management
  - Severity of respiratory compromise may be classified as
    - Respiratory distress
    - Respiratory failure
    - Respiratory arrest

Respiratory Compromise

- If left untreated, respiratory distress may lead to respiratory failure
- Respiratory failure results from poor ventilation or lack of oxygenation
  - Occurs when heart and lungs do not exchange enough oxygen and carbon dioxide
  - Causes decrease in Po2 and increase in Pco2 (leading to respiratory acidosis)
Respiratory Compromise

- Signs and symptoms of respiratory failure
  - Irritability deteriorating to lethargy
  - Marked tachypnea deteriorating to bradypnea
  - Marked retractions deteriorating to agonal respirations
  - Marked tachycardia deteriorating to bradycardia
  - Central cyanosis

Respiratory Compromise

- Respiratory distress is mildest form of respiratory compromise
  - Respiratory distress is evident by increase in rate and depth of breathing and by use of accessory muscles to assist ventilation
  - Changes cause slight decrease in arterial carbon dioxide levels in blood as respiratory rate increases
  - As respiratory distress increases, patient becomes exhausted
  - Pco2 gradually increases as patient’s condition worsens

Respiratory Compromise

- Signs and symptoms of respiratory distress
  - Change in mental status from normal to irritable or anxious
  - Tachypnea
  - Retractions (accessory muscle use)
  - Nasal flaring
  - Poor muscle tone
  - Tachycardia
  - Head bobbing
  - Grunting
  - Cyanosis that improves with supplemental oxygen
Respiratory Compromise

• Respiratory failure in any patient is ominous sign
  – Without immediate help, respiratory arrest can occur
  – Respiratory arrest is cessation of breathing
  – Good outcomes can be expected with early treatment that protects airway and provides adequate ventilation and oxygenation
  – Failure to treat respiratory arrest can lead to cardiopulmonary arrest

Respiratory Compromise

• Signs and symptoms of respiratory arrest
  – Unresponsiveness
  – Apnea
  – Absent chest wall movement
  – Limp muscle tone
  – Bradycardia deteriorating to asystole
  – Profound cyanosis

Respiratory Compromise

• Providing aggressive ventilatory and circulatory support for patients in respiratory distress is critical
• Airway interventions
  – Bag-valve-mask ventilation
  – Endotracheal intubation
  – Gastric decompression (if abdominal distention is impeding ventilation)
  – Needle decompression for pneumothorax
  – Cricothyrotomy for complete upper airway obstruction that cannot be relieved by other means
Respiratory Compromise

- Success of emergency care is indicated by
  - Improvement in patient’s color and oxygen saturation
  - Improvement in pulse rate
  - Improved level of consciousness

Upper and Lower Foreign Body Airway Obstruction

- Obstruction of upper or lower airway by foreign body may cause partial or full obstruction
  - Usually occurs in toddlers and preschoolers (1 to 4 years of age)
  - Children develop molars around age 3, but do not chew well
  - Obstruction often is caused by food such as hot dogs (most common food to cause obstruction), peanut butter, hard candy, popcorn, grapes, nuts, and seeds
  - Other causes of upper airway obstruction include small objects such as coins and balloons

Upper and Lower Foreign Body Airway Obstruction

- Signs and symptoms of airway obstruction
  - Anxiety
  - Inspiratory stridor
  - Muffled or hoarse voice
  - Drooling
  - Pain in the throat
  - Decreased breath sounds
  - Crackles
  - Rhonchi
  - Wheezing
Upper and Lower Foreign Body Airway Obstruction

- Child may have history of choking (observed by an adult)
  - If full obstruction cannot be relieved with basic and advanced methods of clearing, tracheal intubation may be indicated
  - Full obstruction calls for immediate intervention to relieve obstruction

Upper and Lower Foreign Body Airway Obstruction

- If child with partial obstruction is conscious and has adequate movement of air, paramedic should not agitate child
- Provide continuous respiratory monitoring
- Child should be transported immediately to hospital
  - Agitation or attempts to relieve partial obstruction may cause foreign body to move
  - May lead to full obstruction

Croup

- Croup (laryngotracheobronchitis) is common, viral infection of upper airway
  - Usually occurs in children between ages of 6 months and 4 years
  - Often occurs during late fall and early winter months
  - Causes
    - Parainfluenza virus
    - Respiratory syncytial virus
    - Rubeola
    - Adenovirus
Croup

• May involve entire respiratory tract
  – Caused by inflammation in subglottic region (at level of larynx extending to cricoid cartilage)
  – Prehospital management of croup includes airway maintenance
  – Administration of cool mist or humidified or nebulized oxygen (per protocol)
  – Transportation in position of comfort

Croup

• Symptoms may improve dramatically in patients with croup after child is exposed to cool, humidified air
• Make all efforts to keep child comfortable and at ease
Epiglottitis

- Inflammation of epiglottis caused by bacterial infection of upper airway
  - Can progress rapidly and become life threatening
  - Most often affects children between 3 and 7 years of age
    - Can occur at any age

Epiglottitis

- Disease usually is associated with *Haemophilus influenzae* type B, but *Streptococcus*, *Pneumococcus*, and *Staphylococcus* organisms also have been implicated
  - Bacterial infection causes edema and occlusion from swelling of epiglottis and supraglottic structures (pharynx, aryepiglottic folds, and arytenoid cartilage)
- True emergency
  - Requires prompt, expert airway management

Epiglottitis

- Usually begins suddenly
  - Child goes to bed without any symptoms and wakes up complaining of sore throat and pain on swallowing
  - May have fever, muffled voice (from edema of mucosal covering of vocal cords), and drooling from pooled saliva that occurs because of difficult and painful swallowing (ominous sign of impending airway obstruction)
  - Differentiating epiglottitis from croup in prehospital setting may be difficult
Epiglottitis

- On arrival, usually find child sitting upright
  - Leaning forward with head hyperextended
  - Position aids breathing (tripod position)
  - Tongue may be protruding
  - May have inspiratory stridor
  - Usually do not cry or struggle because all attention and energy being used to maximize air exchange
  - Inspiratory stridor with characteristic rattle often is present
  - Child also may be gasping or gulping for air
  - Classic signs of respiratory distress usually are present
  - Preferred and definitive care for epiglottitis is in-hospital intubation and parenteral antibiotic therapy

What other childhood respiratory problems (traumatic and nontraumatic) can manifest with stridor?
Epiglottitis

• Children with acute epiglottitis are in danger of full airway obstruction and respiratory arrest
  – Occlusion of airway can occur suddenly
    • May be caused by minor irritation of throat, stress, anxiety
  – Gentle handling is essential

Epiglottitis

• Prehospital management
  – Do not attempt to lay child down or to change position of comfort
  – Do not attempt to visualize airway if child is still ventilating adequately
  – Advise medical direction of suspicion of epiglottitis so that appropriate personnel and resources can be made available

Epiglottitis

• Prehospital management
  – Administer 100 percent humidified oxygen by mask unless it provokes agitation
  – Do not attempt vascular access
  – Have correct-sized emergency airway equipment selected and ready
  – Transport child to hospital in position of comfort
Epiglottitis

• If respiratory arrest occurs before arrival at emergency department, attempt intubation
  – Child's lungs should be hyperventilated and preoxygenated with bag-valve device before intubation
  – After airway established, obtain intravenous (IV) access if time allows
  – Intubation may be difficult because vocal cords are likely to be hidden by swollen tissues
    • Uncuffed endotracheal tube one to two sizes smaller than normal may be recommended by some medical direction physicians

Epiglottitis

• Locate laryngeal opening to larynx by looking for mucus bubbles in cleft between edematous aryepiglottic folds and swollen epiglottis
  – Chest compressions during glottic visualization may produce bubble at tracheal opening
  – In rare instance that intubation cannot be achieved and child cannot be ventilated adequately by bag-valve device, medical direction may advise needle cricothyroidotomy

Epiglottitis

• Often child can be ventilated through occlusive crisis of epiglottitis by bag-valve-mask ventilation using tight facial seal
  – May call for two persons: one to maintain seal and other to ventilate
Bacterial Tracheitis

• Bacterial tracheitis is uncommon infection (often caused by *Staphylococcus*) of upper airway and subglottic trachea that may occur after viral illness
  – Generally occurs in infants and toddlers (1 to 5 years), but also can occur in older children
  – Can lead to airway obstruction severe enough to cause respiratory arrest

Bacterial Tracheitis

• Signs and symptoms of bacterial tracheitis are those of respiratory distress or failure (depending on severity)
  – Agitation
  – Cough that produces pus or mucus
  – High-grade fever
  – Hoarseness
  – Inspiratory and expiratory stridor
  – Throat pain

Bacterial Tracheitis

• Emergency care
  – Airway, ventilatory, and circulatory support
  – Rapid transport
  – If airway obstruction, respiratory failure, or respiratory arrest develops, tracheal intubation required with tracheal suction to remove mucus or pus
  – Bag-valve-mask ventilation may require high pressures

• In-hospital care
  – IV antibiotics specific for causative organism
  – Will be given after child’s airway stabilized
**Asthma**

- Chronic inflammatory disorder of airways that may cause recurrent episodes of
  - Wheezing
  - Breathlessness
  - Chest tightness and cough
  - Characterized by
    - Inflammation
    - Bronchoconstriction
    - Mucus production that obstructs lower airways

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**Asthma**

- Results from autonomic dysfunction or exposure to sensitizing agents
- Hallmarks of acute exacerbation
  - Anxiety
  - Dyspnea
  - Tachypnea

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**Asthma**

- Audible expiratory (when severe, inspiratory) wheezes with prolonged expiratory phase
  - Silent chest indicates impending respiratory failure
- Common among children over 2 years of age, can be difficult to diagnose
  - Other respiratory conditions in children can cause similar signs and symptoms
  - Affects about 10 percent of those under 10 years of age
  - In 2008, there were estimated 7 million children with asthma in United States
Asthma

• Acute exacerbation may be triggered by
  – Infection
  – Changes in temperature
  – Physical exercise
  – Emotional response
  – Exposure to allergens

What other signs or symptoms would lead you to believe that a child with asthma is decompensating?

Asthma

• Goals of prehospital management
  – Ventilatory assistance (as needed)
  – Administration of humidified oxygen
  – Reversal of the bronchospasm
  – Rapid transport for evaluation and treatment
Asthma

- Severe asthma may be life threatening and can progress rapidly to respiratory failure
- Be ready to initiate aggressive airway management along with ventilatory and circulatory support

Asthma

- Depending on local protocol, prior medication use, and recommendations of medical direction, drug therapy may include
  - Aerosolized bronchodilators (albuterol, ipratropium, or levalbuterol)
  - Subcutaneously administered epinephrine or terbutaline with severe respiratory distress or failure
  - Corticosteroids (e.g., methylprednisolone) during prolonged transports
  - If patient requires tracheal intubation, medical direction may advise administration of magnesium sulfate and low tidal volumes (5 to 8 mL/kg) to reduce potential for barotrauma

Bronchiolitis

- Manifests with tachypnea and wheezing
  - Caused by viral infections that can cause inflammation of lower airway
    - Example is respiratory syncytial virus (RSV)
  - Bronchiolitis usually affects children under 2 years of age
  - Often occurs in winter months and generally is associated with upper respiratory infection
  - Bronchiolitis sometimes is unresponsive to therapy aimed at relieving bronchospasm
Bronchiolitis
• Generally is not serious and recovery is uneventful
  – May become life threatening
  – Infants are at greater risk of developing respiratory failure
    from this condition because of small diameter of bronchioles
  – Prehospital care is aimed at providing ventilatory support
    with humidified oxygen
  – Patient should be transported rapidly for evaluation by a
    physician
  – Therapeutic trial of albuterol via nebulizer may be used as
    temporary measure to reduce respiratory distress

Pneumonia
• Acute infection of lower airway and lungs that involves alveolar walls or alveoli
  – Commonly caused by bacterial or viral infection
  – Children with pneumonia may have history of recent airway infection

Pneumonia
• Acute infection of lower airway and lungs that involves alveolar walls or alveoli
  – May have respiratory distress or failure (depending on severity) and
    • Decreased breath sounds in affected area
    • Fever
    • Pain in the chest
    • Rales localized to the affected area
    • Rhonchi (localized or diffuse)
    • Tachypnea
Pneumonia

- Most children with pneumonia have only mild signs and symptoms and require no immediate treatment or airway support
  - When respiratory distress is present, stabilization of airway and oxygenation is highest priority
  - In severe cases, bronchodilators may be indicated
  - Assisted ventilations via bag-valve device or intubation of trachea also may be required

Pertussis

- Primarily affects infants and young children
  - Infectious disease caused by bacterium *Bordetella pertussis*
  - Spread by direct contact with discharges from mucous membranes contained in airborne droplets
  - Causes inflammation of entire respiratory tract

Pertussis

- Major complications in infants
  - Pneumonia (less than 6 months of age)
  - Apnea (less than 2 months of age)
- Other possible complications
  - Weight loss
  - Sleep disturbance
  - Seizures
Pertussis

- Incidence of complications is highest in children under 1 year of age
- Commonly associated with episodes of violent and productive coughing with inspiratory “whoop” or gasp
  - High coughing pressure may cause pneumothorax, epistaxis, subconjunctival hemorrhage, and rib fracture
  - Episodes can last 1 to 2 months

Pertussis

- Most children are vaccinated through series of pertussis vaccines given in combination with diphtheria and tetanus (DPT)
- Respiratory protection for both patient and EMS crew is required

Bronchopulmonary Dysplasia

- Formerly known as chronic lung disease of infancy is rare, chronic lung disease affecting about 12,000 babies in U.S. each year
  - Usually occurs in premature infants who receive lung damage from oxygen toxicity and barotrauma from mechanical ventilation early in life
Bronchopulmonary Dysplasia

• Use of supplemental oxygen can lead to overproduction of oxygen radicals (agents of oxygen toxicity)
  – Superoxide
  – Hydrogen peroxide
  – Perhydroxyl radicals
  – Preterm infants are particularly susceptible to oxygen radicals
    • Antioxidant systems are developed in last trimester of pregnancy

Bronchopulmonary Dysplasia

• Use of supplemental oxygen can lead to overproduction of oxygen radicals (agents of oxygen toxicity)
  – Prolonged hyperoxia begins sequence of lung injury that leads to
    • Inflammation
    • Diffuse alveolar damage
    • Pulmonary dysfunction
    • Death

Bronchopulmonary Dysplasia

• Classic diagnosis of BPD may be assigned at 28 days of life if following criteria are met
  – Positive pressure ventilation during first 2 weeks of life for minimum of 3 days
  – Clinical signs of abnormal respiratory function
  – Requirements for supplemental oxygen >28 days of age to maintain PaO2 > 50 mm Hg
  – Chest radiograph with diffuse abnormal findings characteristic of BPD
Bronchopulmonary Dysplasia

- Often suffer from recurrent respiratory infections and exercise-induced bronchospasm
  - Primary goal for infants is to promote growth and development
- Treatment
  - Pulmonary support to maintain optimal oxygen saturation
  - Prevent complications
- Nutritional support needed to promote growth
- As infants grow, lung function improves and risk of severe cardiopulmonary complications and morbidity and mortality due to respiratory infection decline

Bronchopulmonary Dysplasia

- Treatment therapies for children
  - Dietary and vitamin supplements
  - Fluid restriction
  - Diuretics
  - Inhaled bronchodilators
  - Corticosteroids
  - Oxygen therapy through CPAP and BiPAP to maintain oxygen saturation at or above 92 percent during eating, sleeping, periods of crying recommended

Bronchopulmonary Dysplasia

- Treatment therapies for children
  - Continuous pulse oximetry often prescribed to monitor oxygen saturation levels
  - While providing emergency care, airway management may include
    - Positioning of airway
    - Oral or nasal adjuncts
    - Suction
    - Assisted ventilations
  - In severe cases, endotracheal intubation may be required
Bronchopulmonary Dysplasia

- Following stabilization, treatment of infants with BPD involves steps to minimize additional lung damage and prevent pulmonary hypertension and cor pulmonale
  - May be dependent on supplemental oxygen or mechanical ventilation for months
  - Some will have symptoms of airway obstruction for years
  - Therapy usually is supportive throughout course of disease

Shock

- Abnormal condition characterized by inadequate delivery of oxygen to meet metabolic demands of tissues
  - Condition may occur with increased, normal, or decreased BP
- Categorized as
  - Compensated (shock without hypotension)
  - Decompensated (shock with hypotension)

Shock

- Further categorized as cardiogenic and noncardiogenic
  - Cardiogenic shock characterized by adequate intravascular volume, but myocardial dysfunction limits stroke volume and cardiac output
  - Noncardiogenic shock can be hypovolemic shock from loss of loss of volume
  - May also be distributive shock (septic, neurogenic, or anaphylactic)
Shock

- Take into account number of special considerations when caring for child in shock
  - Circulating blood volume
  - Body surface area and hypothermia
  - Cardiac reserve
  - Respiratory fatigue
  - Vital signs
  - Assessment

Circulating Blood Volume

- In adults, blood volume accounts for 5 to 6 percent of total body weight, or 50 to 60 mL/kg of body weight
- In children, blood volume accounts for 7 to 8 percent of total body weight, or 70 to 80 mL/kg of body weight
  - Although percentage of circulating blood volume in child is greater than adult, child's actual blood volume is considerably lower than adult's
  - Relatively small loss of blood may be devastating
  - Example: a blood loss of 100 mL in an adult is a 2 percent loss; a 100 mL loss in an infant is a 15 to 20 percent loss, resulting in shock

Circulating Blood Volume

- Child with blood or fluid deficit will maintain stable hemodynamics until all compensatory mechanisms fail
  - At that point, shock progresses rapidly, with serious deterioration
Circulating Blood Volume

- Compensatory mechanisms can mask potentially life-threatening condition
  - Maintain high degree of suspicion, based on patient’s complaint or clinical presentation
  - Early recognition, stabilization (airway control, fluid replacement), rapid transport are critical
  - Treatment must be focused on
    • Ventilation
    • Fluid administration
    • Improvement of pumping action of heart

How comfortable are you with starting an intravenous infusion on an infant or young child?

Body Surface Area and Hypothermia

- Young children have large body surface area in proportion to body weight
  - Compensatory mechanisms (e.g., shivering and sweating) not well developed
  - Can develop hypothermia from
    • Exposure and concurrent metabolic acidosis
    • Increased vascular resistance
    • Respiratory depression
    • Myocardial dysfunction
Body Surface Area and Hypothermia

- Young children have large body surface area in proportion to body weight
  - Hypothermia makes resuscitation and drug therapy less effective
  - Maintain patient’s body temperature by
    - Using blankets
    - Covering the child’s head with towels
    - Using warming devices for IV fluids

Cardiac Reserve

- Infants and children already have high metabolic needs
- As result, have less cardiac reserve than adults for stressful situations such as shock
  - Important step is to reduce energy and oxygen requirements of child in shock as much as possible
    - Providing ventilatory support
    - Reducing anxiety
    - Maintaining moderate ambient temperatures

Respiratory Fatigue

- Respiratory muscle fatigue may lead to
  - Hypoventilation
  - Hypoxemia
  - Respiratory failure or arrest
- Respiratory compensation generally is at maximum until depleted
  - Deterioration can be sudden
  - Airway control and supplemental oxygen are essential in all children who are seriously ill or injured
Vital Signs and Assessment

- Consider many factors when evaluating child’s vital signs
  - Example BP and pulse rate vary greatly with age, body temperature, degree of agitation
  - Measure vital signs as baseline assessments, even though they may be of limited value in assessing circulation of child in shock
  - Most effective assessment is constant monitoring of child’s mental and physical status and response to therapy

Vital Signs and Assessment

- Evaluation components noted when assessing child in shock
  - Level of consciousness
    - Ability to make eye contact
    - Ability to recognize family members
    - Agitation
    - Anxiety

Vital Signs and Assessment

- Evaluation components noted when assessing child in shock
  - Skin
    - Capillary refill (in children under 6 years of age)
    - Color
    - Moisture
    - Temperature
    - Turgor
  - Mucous membranes
    - Color
    - Moisture
Vital Signs and Assessment

• Evaluation components noted when assessing child in shock
  – Nail beds
    • Capillary refill (in children younger than 6 years of age)
    • Color
  – Peripheral circulation
    • Collapse
    • Distention

Vital Signs and Assessment

• Evaluation components noted when assessing child in shock
  – Cardiac
    • Electrocardiogram findings
    • Location of pulses
    • Quality of pulses
    • Rate
    • Rhythm

Vital Signs and Assessment

• Evaluation components noted when assessing child in shock
  – Respiration
    • Depth
    • Rate
  – BP (in children over 3 years of age) with appropriate sized cuff
  – Body temperature
Hypovolemia

- Common causes of hypovolemia in children
  - Dehydration resulting from vomiting and diarrhea
  - Blood loss resulting from trauma or internal bleeding
- Children also at risk of intravascular volume depletion as result of burns

Dehydration

- Profound fluid and electrolyte imbalances can occur in children as result of
  - Vomiting
  - Diarrhea
  - Poor fluid intake
  - Fever
  - Burns

Dehydration

- Dehydration compromises cardiac output and systemic perfusion
  - Occurs if child loses fluid equivalent of 5 percent or more of total body weight
  - For adolescent, losses of 5 to 7 percent of total body weight can compromise perfusion
Dehydration

• If allowed to progress, dehydration can result in
  – Renal failure
  – Shock
  – Death
• Severity of dehydration and fluid loss can be estimated from history of child’s weight loss and physical examination
Dehydration

- Airway and ventilatory support (if needed) are initial steps in treatment for dehydrated child.
- Treatment directed at replacing and maintaining blood volume and perfusion
  - IV therapy should be initiated with isotonic crystalloids such as lactated Ringer’s solution or normal saline
  - A fluid bolus of 20 mL/kg (administered in less than 20 minutes) should be administered even if BP is normal
  - Fluid boluses may be repeated if patient’s systemic perfusion fails to improve

Dehydration

- After physician evaluation and initial shock resuscitation, fluid administration rate and type of fluid replacement are determined by
  - Volume and type of fluid deficit (isotonic, hypotonic, hypertonic)
  - Patient’s response to therapy

What are some ways to determine the child’s weight for fluid and drug dosing?
Blood Loss

• Even small amount of blood loss can be serious for pediatric patient
• After paramedic achieves control of external hemorrhage (if present), secures patient’s airway, and provides high-concentration oxygen, child’s circulatory status may require support with IV therapy

Blood Loss

• As with other causes of hypovolemia, volume replacement is needed
  – Isotonic crystalloid solutions such as normal saline or lactated Ringer’s solution should be used
  – First bolus should be 20 mL/kg
  – If volume loss is in 20 percent range, vital signs should improve after infusion

Blood Loss

• As with other causes of hypovolemia, volume replacement is needed
  – If improvement occurs, IV therapy should be continued at maintenance rate during patient transport
    • Child may show little response to first bolus
    • Slight improvement in color and capillary refill and decreased heart rate may be evident
  – If no response to initial infusion, give second bolus of 20 mL/kg
Distributive Shock

- Used to refer to septic shock, neurogenic shock, and anaphylactic shock
- Results in peripheral pooling because of loss of vasomotor tone
  - Vasodilation that occurs causes BP to fall
  - Vasodilation also allows plasma to leak from vascular space
- Fairly uncommon in children

Distributive Shock

- Septic shock
  - Usually caused by systemic bacterial infection
  - Sometimes associated with illnesses such as meningitis and pneumonia
  - Toxins released by pathogen affect arterioles, capillaries, and venules, altering microcirculatory pressure and capillary permeability
**Distributive Shock**

- Septic shock
  - Children usually appear very ill
    - May have signs and symptoms that include those of decompensated shock
  - Characteristic findings
    - Skin that is warm in early stages
    - Skin that is cool in late stages

- Neurogenic shock
  - Results from sudden peripheral vasodilation caused by traumatic injury
  - Most often to spinal cord
  - Loss of sympathetic impulses and resultant vasodilation increase size of vascular compartment
  - Normal intravascular volume is not enough to fill vascular compartment and to perfuse tissues
  - Characteristic findings
    - Warm skin
    - Bradycardia
    - Impaired neurological function

- Anaphylactic shock
  - Occurs when exposed to substance that produces severe allergic reaction
  - Common causes of allergic reactions
    - Antibiotic agents
    - Foods
    - Insect stings
Distributive Shock

- **Anaphylactic shock**
  - Bodily response to antigen causes release of histamine
    - Results in peripheral vasodilation and leak of intravascular fluid into interstitial space, resulting in decrease in intravascular volume
  - Characteristic findings
    - Rapid onset of skin signs (hives, allergic rash, and erythema)
    - Upper airway obstruction
    - Dyspnea
    - Signs of shock
    - Gastrointestinal distress

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Distributive Shock

- **Emergency care**
  - Ensure patient’s vital functions through airway, ventilatory, and circulatory support
  - Rapid transport
  - Medical direction may advise IV fluid therapy and drugs to manage specific forms of distributive
  - Aids often used to calculate drug and fluid doses for pediatric patients include Pedia-Wheel and Broselow tape
Congestive Heart Failure

• May result from
  – Myocarditis
    • Inflammation of heart
  – Cardiomyopathy
    • Degeneration of heart muscle that causes reduction in force of heart contractions
  – Both conditions decrease force of contractions and amount of blood circulated to lungs and to rest of body

Congestive Heart Failure

• Usually results from viral infection or congenital abnormalities that affect both ventricles of heart
  – Symptoms
    • Fatigue
    • Chest pain
    • Dysrhythmias

Congestive Heart Failure

• Usually results from viral infection or congenital abnormalities that affect both ventricles of heart
  – In severe cases, include signs of heart failure and cardiogenic shock, such as
    • Crackles
    • Hypotension
    • Jugular vein distention (difficult to determine in young children)
    • Peripheral edema
    • Tachycardia
    • Tachypnea
Congestive Heart Failure

• Patients in stable condition are managed with
  — Supportive care
  — Oxygen administration
  — Transport

Congestive Heart Failure

• Hypotensive children showing other signs and symptoms of decompensation
  — May require vascular access for administration of drugs
    • Antidysrhythmics
    • Diuretics
    • Vasopressors
  — IV fluid therapy should be given to children in shock with signs of CHF in small boluses of 5 to 10 mL/kg
    • Will help to avoid volume overload

Rhythm Disturbances

• Most children are born with healthy hearts
  — When rhythm disturbances occur, usually result of
    • Hypoxia
    • Acidosis
    • Hypotension
    • Structural heart disease
Rhythm Disturbances

- Most children are born with healthy hearts
  - Most common dysrhythmias in pediatric patients
    - Sinus tachycardia
    - Supraventricular tachycardia
    - Bradycardia
    - Asystole
  - Ventricular tachycardia and ventricular fibrillation are not common but do occur

Bradydysrhythmias

- Clinically significant bradycardia
  - Heart rate less than 60 beats/min (or rapidly dropping heart rate) associated with poor systemic perfusion
  - Occurs despite adequate oxygenation and ventilation

- May be caused by
  - Hypoxemia
  - Acidosis
  - Hypotension
  - Hypoglycemia
  - CNS injury
  - Excessive vagal stimulation
  - Drug-induced (digitalis toxicity)
  - Myocarditis
  - Bradycardia
Bradydysrhythmias

• Most common preterminal rhythms in infants/children
  – Sinus bradycardia
  – Sinus node arrest with slow junctional or idioventricular rhythm
  – AV block

Bradydysrhythmias

• Possible causes
  – Hypoxemia
  – Acidosis
  – Hypotension
  – Hypoglycemia
  – CNS injury
  – Excessive vagal stimulation

Bradydysrhythmias

• Infants and children with history of heart surgery may have injury at atrioventricular node or conduction system
  – Would produce sick sinus syndrome or heart block
• All symptomatic bradycardias require treatment
Bradydysrhythmias

- Important ECG findings
  - Heart rate less than 60 beats/min
  - P waves may or may not be visible
  - QRS complex duration may be normal or prolonged
  - P wave and QRS complex often unrelated

Treatment

- Initial treatment
  - Ensure adequate breathing
  - Supplemental oxygen
    - Mechanical problems with oxygen delivery should be assessed prior to drug administration

Treatment

- If pulses, perfusion, respirations are adequate, no emergency treatment necessary
  - Monitor and proceed with evaluation
- If drug therapy required, epinephrine
- Bradycardia caused by heart block or increased vagal tone
  - Both rare in pediatric patients
  - Manage with atropine
Treatment

- Bradycardia caused by dysfunction in sinus node
  - External cardiac pacing may be lifesaving
- Asystole or bradycardia due to postarrest hypoxic/ischemic myocardial insult or respiratory failure
  - Pacing not useful
- External cardiac pacing is uncomfortable
  - Use in children reserved for profound symptomatic bradycardia that does not respond to advanced life support and basic life support treatments

Pulseless Electrical Activity

- Often precedes asystole
- Usually caused by prolonged periods of hypoxia, ischemia, or hypercarbia
Pulseless Electrical Activity

• Reversible causes of pulseless electrical activity include H’s and T’s
  – H’s
    • Hypovolemia
    • Hypoxemia
    • Hypothermia
    • Hyper/hypokalemia
    • Hydrogen ion excess (acidosis)
    • Hypoglycemia

– T’s
  • Tension pneumothorax
  • Pericardial tamponade
  • Toxins
  • Thromboembolus

Pulseless Electrical Activity

• Important ECG findings
  – Slow, wide-complex rhythm
  – Presence of some electrical activity (other than ventricular tachycardia/ventricular fibrillation)
  – Absence of detectable pulse
Treatment

- Managed in same way as asystole with drug therapy (epinephrine) and CPR
  - Defibrillation not effective in treatment of PEA and asystolic arrest
  - Reversible causes of condition should be considered and corrected if possible
  - Identification and treatment of underlying cause is only true means of reversal of pulseless electrical activity

Supraventricular Tachycardia

- Most common nonarrest dysrhythmia during childhood
- Most common dysrhythmia that produces cardiovascular instability during infancy
Supraventricular Tachycardia

- Two factors can help distinguish SVT from sinus tachycardia caused by shock
  - Patient history (e.g., dehydration or hemorrhage associated with shock)
  - Heart rate
  - Sinus tachycardia usually less than 220 beats/min in infants, less than 180 beats/min in children, and greater than those rates with SVT

Supraventricular Tachycardia

- Important ECG findings
  - Heart rate greater than 220 beats/min in infants and greater than 180 beats/min in children
  - Rhythm usually is regular because associated atrioventricular block is rare
  - P waves may not be identifiable, especially when ventricular rate is high
  - If present, P waves usually are negative in leads II, III, and aVF
  - QRS complex duration is normal in most children (less than 0.09 second)

Treatment

- Signs and symptoms are affected by
  - Child’s age
  - Duration of supraventricular tachycardia
  - Prior ventricular function
  - Ventricular rate
Treatment

• If child is hemodynamically stable and cooperative
  – Vagal maneuvers may terminate rhythm
    • Ice water applied to child’s face
    • Blowing through straw
    • Carotid sinus massage
• Unstable SVT is best managed with synchronized cardioversion or drug therapy
  – Adenosine is drug of choice

Treatment

• Wide-complex tachycardias with signs of compromised tissue perfusion and impaired level of consciousness require immediate care
  – Treat as if ventricular tachycardia
• Urgent treatment includes
  – Synchronized cardioversion if pulses are present
  – Defibrillation if pulses are absent
Ventricular Tachycardia and Ventricular Fibrillation

- Uncommon in children
- Possible causes
  - Congenital heart disease
  - Cardiomyopathies
  - Myocarditis
  - Reversible causes (e.g., drug toxicity)
  - Metabolic causes (e.g., hypoglycemia)
  - Hypothermia

Ventricular Tachycardia and Ventricular Fibrillation

- Important ECG findings
  - Ventricular tachycardia
    - Ventricular rate at least 120 beats/min and regular
    - Wide QRS complex
    - P waves often not identifiable
  - Ventricular fibrillation
    - No identifiable P wave, QRS complex, or T wave
    - Ventricular fibrillation waves that may be coarse or fine

Ventricular Tachycardia with a Pulse

- Hemodynamically stable ventricular tachycardia should be managed under advice of medical direction and with caution
  - Initial efforts aimed at determining origin of tachycardia
  - Obtain thorough history
  - Drug therapy usually delayed in stable patient until arrival in emergency department
  - In-hospital, administration of amiodarone or procainamide (these drugs should not routinely be administered together)
  - Ventricular tachycardia that produces a palpable pulse and signs of shock (low cardiac output, poor perfusion) requires immediate synchronized cardioversion
Pulseless Ventricular Tachycardia and Ventricular Fibrillation

• Management
  – Immediate defibrillation
  – CPR
  – Intubation with ventilatory support
  – Drug therapy
    • Epinephrine and vasopressin
    • Amiodarone
    • Lidocaine

Pulseless Ventricular Tachycardia and Ventricular Fibrillation

• Management
  – Infant patches (4.5 cm) generally should be used during defibrillation for infants up to about 1 year of age or 10 kg
  – Adult patches (8 to 10 cm) generally should be used for patients over 1 year of age or over 10 kg

Postresuscitation Stabilization

• Postresuscitation phase
  – Begins after initial stabilization of patient with shock or respiratory failure
  – Can begin after return of spontaneous circulation in patient who was in cardiac arrest
Postresuscitation Stabilization

• Goals of postresuscitation stabilization
  – Preserve brain function
  – Maintain oxygen saturation to at least 94 percent
  – Avoid secondary organ injury
  – Seek and correct causes of illness
  – Manage pain with analgesics (e.g., morphine) or sedatives (lorazepam, midazolam) as ordered by medical direction
  – Enable patient to arrive at appropriate care facility in best possible physiological state

Postresuscitation Stabilization

• Focuses on preserving neurological function and avoiding multisystem organ failure
• Requires knowledge and experience in evaluation of all organ systems
  – Stabilizing airway and supporting oxygenation, ventilation, perfusion
  – Performing thorough secondary assessment
  – Obtaining medical history

Postresuscitation Stabilization

• Inform family members of what has been done and how patient is responding to care
  – Provide frequent reports to receiving hospital
Meningitis

- Inflammation of fluid-containing membranes (meninges) that surround brain and spinal cord
  - Normally occurs as complication of bacterial or viral infection
  - Can be life threatening
  - 10 to 15 percent of cases of bacterial meningitis are fatal

Meningitis

- Inflammation of fluid-containing membranes (meninges) that surround brain and spinal cord
  - Can rapidly progress to
    - Permanent brain damage
    - Impaired vision or hearing
    - Neurologic dysfunction
    - Death

Meningitis

- Inflammation of fluid-containing membranes (meninges) that surround brain and spinal cord
  - Highest incidence of meningitis is 6 months to 2 years of age
  - Greatest time for risk is immediately after birth and again at 3 to 8 months of age
  - Most commonly, meningitis develops over 1 to 4 days
    - In severe cases, child who looks healthy can rapidly become seriously ill within 1 day
Meningitis

- Signs and symptoms of meningitis depend on child's age, not always obvious
  - Classic symptoms in infants under 3 months
    - Decreased liquid intake
    - Vomiting
    - Irritability
    - Lethargy
    - Fever
    - Bulging fontanelle
    - Seizures

Meningitis

- Signs and symptoms of meningitis depend on child's age, not always obvious
  - Signs and symptoms for older children and adults
    - Nausea and vomiting
    - Headache
    - Photophobia
    - Fever
    - Altered mental status
    - Lethargy
    - Seizures
    - Neck stiffness (nuchal rigidity) or pain

Meningitis

- Signs and symptoms of meningitis depend on child's age, not always obvious
  - Other classic presentations that may aid in diagnosis
    - Brudzinski sign: Knees automatically brought up toward body when neck is bent forward or pain in legs when bent
    - Kernig sign: Inability to straighten lower legs when thigh is flexed on abdomen
    - Rash: Petechial or purpuric rash may appear if meningococcus is causative agent
Meningitis

• Prehospital care is primarily supportive
  – Universal precautions
  – Surgical mask should be applied to patient while providing care and during transport
  – In some cases, seizure control or IV fluid replacement will be necessary
• In-hospital care based on causative agent

Seizure

• Episode of sudden abnormal electrical activity in brain
  – Results in abnormalities in motor, sensory, or autonomic function usually associated with
    • Abnormal behavior
    • Changes in level of consciousness
    • Both

Seizure

• Common causes of seizure in adults and children
  – Noncompliance with drug regimen for treatment of epilepsy
  – Head trauma
  – Intracranial infection
  – Brain tumor
  – Metabolic disturbance
  – Poisoning
• Most common cause of new onset of seizure in children is fever
Are you comfortable using the pediatric paddles on the defibrillators you will be using in clinicals and on the ambulance?

Febrile Seizures

- Seizure associated with fever but without evidence of intracranial infection or other definable cause
  - Usually occur between ages of 6 months and 5 years
  - About 2 to 5 percent of children under 7 years experience
  - About 30 percent of those who have a seizure experience recurrence
  - More than half occur in children age 9 to 20 months
  - In 60 percent of cases, family history is factor

Febrile Seizures

- Usually associated with
  - Underlying viral infection (most often of upper respiratory tract)
  - Gastroenteritis
  - Roseola
  - Otitis media
  - Another febrile illness
  - Usually occur in vulnerable patients during rapid rise in body temperature
    - Intensity of seizure is not related to severity of fever
Febrile Seizures

- Febrile seizures may manifest with generalized tonic-clonic activity, or they may have a more subtle presentation.
- As a rule, classic febrile seizures are of short duration (usually last less than 5 minutes).
- They also have an uncomplicated and short postictal period.

Febrile Seizures

- Seizures that last longer than 20 minutes call for extensive investigation.
  - These should never be considered benign.
- Regardless of suspected cause, all children who have suffered a seizure should be transported for evaluation by a physician per protocol.

Assessment and Management

- In most cases, seizure has stopped before EMS arrives.
  - Child may be in postictal state.
Assessment and Management

• Management
  – Airway management
  – Ventilatory and circulatory support
  – Airway positioning
  – Suctioning of airway
  – Oxygen administration
  – Repeatedly assess adequacy of ventilation
    • Special emphasis should be placed on respiratory rate and depth

• Important elements of history
  – Previous seizures
  – Number of seizures in this episode
  – Duration of seizure activity
  – Tonic-clonic
    • From onset of symptoms until clonic activity stops
  – Absence
  – Time from loss of consciousness to return of consciousness
  – Complex partial
    • From loss of consciousness or start of motor activity, automatism until child is responsive
Assessment and Management

• Important elements of history
  – Previous seizures
  – Number of seizures in this episode
  – Duration of seizure activity
  – Tonic-clonic
    • From onset of symptoms until clonic activity stops
  – Absence
    • Time from loss of consciousness to return of consciousness
  – Complex partial
    • From loss of consciousness or start of motor activity, automatism until child is responsive

Assessment and Management

• Important elements of history
  – Description of seizure activity
  – Areas of body involved
  – What area of body seizure activity started in (foot, mouth, generalized)
  – Positional change
  – Length of tonic and clonic phases
  – Absence of movement or muscle tone in selected body areas

Assessment and Management

• Important elements of history
  – Presence of vomiting during seizure (aspiration risk)
  – Color change during seizure
  – Appearance of face during seizure
  – Appearance of eyes during seizure
  – Pupils
  – Gaze
  – Condition of child when first found
Assessment and Management

• Important elements of history
  – Recent illness
  – Potential for toxic ingestion
  – Potential head injury (as primary cause or secondary complication)
  – Significant medical problems
  – Recent headache or stiff neck (which may suggest meningitis)
  – Medication use and compliance with anticonvulsant medication

• During transport to emergency department, continuously monitor child and be alert for recurrent seizures
  – Characteristics of postictal period should be noted
    • Level of consciousness
    • Movement
    • Speech
    • Sensory or motor impairment

• Medical direction may advise that febrile patient be given antipyretic if patient is alert
  – Antipyretic will reduce fever en route to receiving hospital
  – Do not apply ice or submerge patient in cool bath in effort to reduce fever
**Status Epilepticus**

- Continuous seizure activity that lasts more than 30 minutes or recurrent seizure without an intervening period of consciousness
  - True emergency, can lead to
    - Hypotension
    - Cardiovascular, respiratory, and renal failure
    - Permanent brain damage

**Status Epilepticus**

- Management
  - Provide adequate airway, ventilatory, and circulatory support
    - Intubation for airway protection or mechanical ventilation seldom needed
    - Intubation should be withheld unless child fails to respond to initial management
  - Per protocol, obtain vascular access through IV or intraosseous route

**Status Epilepticus**

- Management
  - Measure blood glucose level to screen for hypoglycemia
    - If value less than 60 mg/dL (40 mg/dL in an infant), administer dextrose 10 percent, or 25 percent (per medical direction)
    - Can be treated with intramuscular injection of glucagon if IV or intraosseous access cannot be established
    - If seizures do not stop, consult medical direction regarding IV, intraosseous, or rectal administration of anticonvulsants diazepam or lorazepam
    - Lorazepam may also be given IM
Status Epilepticus

• Management
  – Attach cardiac monitor
    • Observe for rhythm or conduction abnormalities that may suggest hypoxia

Diazepam

• Breaks active seizures in 70 percent of cases
  – Drug has short duration of action (15 minutes)
  – It may require repeat administration to a maximum of three doses
  – Be ready for sudden respiratory depression or hypotension when using this drug
  – If IV or intraosseous access cannot be obtained, may be administered rectally and may be given intramuscular
  – Transport should not be delayed to attempt vascular access

Lorazepam

• Alternative to IV or intraosseous administration of diazepam
  – Has long duration of action (6 to 8 hours), is preferred by some physicians
  – May be injected intramuscularly
  – May be given intravenously, intraosseously, or rectally
  – Side effects are similar to those of diazepam in terms of cardiorespiratory and central nervous system depression
Hypoglycemia

- Abnormally low concentration of glucose in blood
  - Result of
    - Excessive response to glucose absorption
    - Illness
    - Physical exertion
    - Decreased dietary intake
  - In diabetic children, usually caused by
    - Too large of insulin dose
    - Delayed or missed meal
    - Vigorous physical activity

Hypoglycemia

- Most commonly occurs in prehospital setting in infants and children with type 1 diabetes
  - Affects about 0.2 percent of all school-age children
  - About 15,000 children in U.S. under age 20 are diagnosed with type 1 diabetes each year

Hypoglycemia

- Signs and symptoms can be classified as mild, moderate, and severe
  - Mild symptoms
    - Hunger
    - Weakness
    - Tachypnea
    - Tachycardia
Hypoglycemia

• Signs and symptoms can be classified as mild, moderate, and severe
  – Moderate symptoms
    • Sweating
    • Tremors
    • Irritability
    • Vomiting
    • Mood disorders
    • Blurred vision
    • Stomachache
    • Headache
    • Dizziness

• Severe symptoms
  • Decreased level of consciousness
  • Seizure activity

• True emergency that calls for prompt treatment with dextrose to prevent brain damage

Hypoglycemia

• Prehospital care
  – Ensure adequate airway
  – Ventilatory and circulatory support
  – Obtain blood glucose measurement in any child with altered level of consciousness that has no explainable cause
  – Conscious children should receive an oral glucose solution or paste
Hypoglycemia

- Prehospital care
  - Unconscious children or those with moderate or severe hypoglycemia require IV/intraosseous dextrose or intramuscular glucagon administration
  - Followed with repeat blood glucose measurement in 10 to 15 minutes
  - Transport

Hyperglycemia

- Abnormally high concentration of glucose in blood
  - Results from absence or resistance to insulin
  - Low insulin level prevents glucose from entering the cells
    - Causes glucose to build up in blood
  - Can lead to
    - Dehydration
    - Diabetic ketoacidosis
    - Coma

Hyperglycemia

- Abnormally high concentration of glucose in blood
  - In children with type 1 diabetes, often result of
    - Too small insulin dose in relation to food intake
    - Failure to take insulin
    - Illness
    - Malfunctioning insulin-delivery system (e.g., insulin pump)
Hyperglycemia

• Signs and symptoms are classified as early or late
  – Early signs and symptoms
    • Increased thirst (polydipsia)
    • Increased hunger (polyphagia)
    • Increased urination (polyuria)
    • Weight loss also is considered an early sign of the illness

Hyperglycemia

• Signs and symptoms are classified as early or late
  – Late signs and symptoms associated with dehydration and early ketoacidosis
    • Weakness
    • Abdominal pain
    • Generalized aches
    • Loss of appetite
    • Nausea
    • Vomiting
    • Signs of dehydration (with the exception of urinary output)

Hyperglycemia

• Signs and symptoms are classified as early or late
  – Late signs and symptoms associated with dehydration and early ketoacidosis
    • Altered mental status (lethargy)
    • Fruity breath odor
    • Tachypnea
    • Hyperventilation
    • Tachycardia
    • If untreated, Kussmaul’s respirations and coma may occur
Hyperglycemia

- Prehospital care
  - Airway, ventilatory, and circulatory support
  - Followed by glucose testing
  - IV fluid therapy if signs of dehydration are present
  - Insulin administration usually reserved as in-hospital procedure

Why do you think type 1 diabetes may go undetected until a child is seriously ill?
Blood Disorders

- Number of conditions and diseases can cause blood disorders in children and adults
  - Disorders may affect
    - Oxygen-carrying capacity of hemoglobin
    - Blood clotting mechanisms
    - Immune function
    - Infection risk

Blood Disorders

- Number of conditions and diseases can cause blood disorders in children and adults
  - Common blood disorders presenting in children
    - Sickle cell disease (presenting as acute chest syndrome, splenic sequestration, vasoocclusive crisis, and priapism)
    - Bleeding disorders (e.g., thrombocytopenia, hemophilia, Von Willebrand’s disease)
    - Leukemia
    - Leukopenia
    - Lymphoma
    - Others

Blood Disorders

- After obtaining through patient history (often provided by parent or caregiver), important assessment findings include
  - History of chest pain
  - Weakness
  - Abdominal pain
  - Extremity pain
  - Trauma
  - Bleeding
  - Swollen joints
  - Swollen glands
  - Fever
  - Bruising
Blood Disorders

• Depending on condition of patient and nature of illness, prehospital care may include
  – IV hydration
  – Fluid resuscitation
  – Bleeding control
  – Pain control
  – Transport
• In children who have high risk of infection, routine IV access should be avoided in prehospital setting

Gastrointestinal Disorders

• Abnormalities in GI tract can lead to illnesses in pediatric patient that can cause vomiting and bleeding
  – May be result of GI embryology (formation of GI tract during fetal development)
  – May result from illness and infection

Gastrointestinal Disorders

• Important components of patient’s history for children with GI disorders
  – Blood or bile in emesis
  – Epistaxis
  – Diarrhea
  – Constipation
  – Fever
  – Medications
  – Prematurity
  – ABO incompatibility
  – Liver disease
Gastrointestinal Disorders

- Depending on cause of child’s illness, physical findings may include
  - Elevation or decrease in heart rate and BP
  - Signs of dehydration (dry mucous membranes, delayed capillary refill)
  - Icterus (jaundice)
  - Abdominal distention or abdominal mass
  - Hepatomegaly (enlarged liver)
  - Pallor

GI Disorders that Cause Vomiting

- Vomiting is protective mechanism that removes toxic materials from GI tract before absorbed
  - Controlled by emetic center, located in reticular formation of brain stem
  - Can be stimulated by
    - Chemoreceptors
    - Cranial nerves
    - Vagal and enteric input
    - CNS

GI Disorders that Cause Vomiting

- Three disorders can cause vomiting in pediatric patient
  - Gastroenteritis
    - Inflammation of stomach and intestines
    - Can accompany many conditions of GI tract
    - Most often due to viral infections that can cause diarrhea, with or without vomiting
    - Can cause life-threatening dehydration, which may require volume replacement
  - Intestinal malrotation
  - Pyloric stenosis
**GI Disorders that Cause Vomiting**

- Bleeding can occur from upper and lower GI tract in children of all ages
  - Upper GI bleeding can occur in newborns who swallow maternal blood
  - Lower GI bleeding can occur in adolescents from inflammatory bowel disease

**GI Disorders that Cause Vomiting**

- Child’s condition, signs, and symptoms will be related to site and cause of bleeding
- Prehospital care
  - Supportive care
  - Transportation
  - May need to provide advanced life support to manage shock and hypovolemia
  - Following stabilization, managed with bowel rest, antibiotics (if needed), volume replacement

**Infection**

- May have a variety of signs and symptoms
  - Depend on source and extent of infection and length of time since patient was exposed
- Parent or caregiver provides history of recent illness
  - When caring for any patient who may have infectious disease, strictly adhere to body substance isolation because of unknown cause of infection
Infection

• Prehospital care
  – Most need only supportive care while being transported
  – In very sick children, support of airway, ventilation, and circulation
  – If signs of decompensated shock are present, IV therapy
  – Active seizure activity may require use of anticonvulsant agents
  – When possible, child in stable condition should be transported in child’s position of comfort
    • Should be transported in company of parent or caregiver

Poisoning and Toxic Exposure

• Most poisoning in U.S. involves children and is major cause of preventable death in children under 5 years of age

• Common sources of poisoning (unintentional and intentional)
  – Acetaminophen
  – Alcohol
  – Anticholinergics
  – Aspirin
  – Barbiturates
  – Cold medicines
  – Corrosives
  – Digitalis, beta-blocker agents
  – Hydrocarbons
  – Narcotics
  – Organic solvents (inhaled)
  – Organophosphates
  – Sedatives
  – Vitamins (especially iron)

Poisoning and Toxic Exposure

• Signs and symptoms vary, depending on toxic substance and length of time since child was exposed
  – Signs and symptoms may include
    • Cardiac and respiratory depression
    • Central nervous system stimulation or depression
    • Gastrointestinal irritation
    • Behavioral changes
Poisoning and Toxic Exposure

• Emergency care
  – Ensure adequate airway, ventilatory, and circulatory support
  – Contact medical direction and poison control center for specific treatments
  – All pills, substances, and containers associated with poisoning should be transported with child to receiving hospital
  – No efforts should be made in prehospital setting to induce vomiting
  – Gastric lavage also is contraindicated unless ingestion of poison has been less than 1 hour prior to EMS arrival

For what critical signs or symptoms of poisoning should you be alert?

Pediatric Trauma

• Blunt and penetrating trauma are major causes of injury and death in children
• Other significant injuries in children often result from
  – Falls
  – Motor vehicle crashes
  – Pedestrian-vehicle collisions
  – Drowning/submersion
  – Penetrating injuries
  – Burns
  – Abuse
Why are children at risk for injuries related to falls?

Pediatric Trauma

• Following common injuries highlight value of injury prevention program
  – Falls
    • Single most common cause of injuries in children
    • Serious injury or death from truly unintentional falls is uncommon, unless from significant height
  – Motor vehicle crashes
    • Leading cause of permanent brain injury, serious injury, death in children
    • Among infants under 1 year old, second only to mechanical suffocation

Pediatric Trauma

• Following common injuries highlight value of injury prevention program
  – Pedestrian-vehicle collisions
    • Can result in serious injury or death in children
    • Initial injury is caused by impact with vehicle
    • Often thrown from force of first impact, causes additional injury
Pediatric Trauma

• Following common injuries highlight value of injury prevention program
  – Drowning/submersion
    • Third leading cause of death in children from birth until 4 years of age
    • Each year, about 1,000 children die from drowning
    • 5 to 20 percent of children hospitalized for submersion suffer severe, permanent brain damage

Pediatric Trauma

• Following common injuries highlight value of injury prevention program
  – Penetrating injuries
    • Occur especially during adolescence
    • Penetrating injuries that are intentional (e.g., from violent crime) are more common in inner cities
    • Unintentional penetrating injuries in rural areas occur often
    • Stab wounds and firearm injuries make up about 10 to 15 percent of all pediatric trauma admissions
    • Risk of death increases with age of patient
    • Appearance of the external wounds cannot be used to determine extent of internal injury in children

Pediatric Trauma

• Following common injuries highlight value of injury prevention program
  – Burns
    • Children under 4 years of age and children with disabilities are at greatest risk of burn-related death and disability
    • Survival is determined by
      – Size and depth of burn
      – Presence of inhalation injury
      – Nature of other injuries that may have occurred during event
What types of situations cause burn injuries to children in the home?

Pediatric Trauma

- Following common injuries highlight value of injury prevention program
  - Child abuse
    - Injuries to children may result from physical abuse, sexual abuse, emotional abuse, and child neglect
    - Physical abuse often is associated with lower socioeconomic status, domestic disturbances, younger-aged parents, substance abuse, and community violence
    - Abuse of children occurs in all levels of society
    - Thorough documentation of pertinent findings, treatment, and interventions are critical for legal purposes

Special Considerations for Specific Injuries

- Head and neck injury
  - Larger relative mass of head and lack of neck muscle strength provide increased momentum in acceleration-deceleration injuries
  - Fulcrum of cervical mobility in younger child is at C2 to C3 level (70 percent of fractures in children under 8 years of age occur in C1 or C2)
  - Head injury is most common cause of death in pediatric trauma victims
  - Diffuse head injuries are common in children, focal injuries are rare
Special Considerations for Specific Injuries

- Head and neck injury
  - Soft tissues, skull, brain are more compliant in children than in adults
  - Because of open fontanelles and sutures, infants up to 12 to 18 months of age may be more tolerant to increased ICP and can have delayed signs
  - Subdural bleeding in infant can produce hypotension (rare)
  - Significant blood loss can occur through scalp lacerations, and such bleeding should be controlled immediately
  - Modified Glasgow Coma Scale (GCS) should be used for assessing infants and young children

Special Considerations for Specific Injuries

- Traumatic brain injury
  - Early recognition and aggressive management can reduce mortality and morbidity
  - Modified Glasgow Coma Scale (GCS) should be used for assessing infants and young children
  - Signs of increased ICP
    - Elevated BP
    - Bradycardia
    - Irregular respirations progressing to Cheyne-Stokes respirations
    - Bulging fontanelle in infants
  - Signs of herniation include asymmetrical pupils and abnormal posturing

Special Considerations for Specific Injuries

- Traumatic brain injury
  - Management
    - Administer high-concentration oxygen for mild to moderate head injury (GCS score of 9 to 15)
    - Monitor pulse oximetry
    - Intubate and ventilate at normal breathing rate with 100 percent oxygen for severe head injury (GCS score less than 8)
    - Hyperventilate only with signs of increased ICP
    - Some authorities recommend the use of lidocaine before intubation to blunt rise in ICP
      - Controversial, should be guided by medical direction
What are some early signs of increasing intracranial pressure in a child?

Special Considerations for Specific Injuries

- Chest injury
  - Chest injuries in children under 14 years of age usually are result of blunt trauma
  - Because of flexibility of chest wall, severe intrathoracic injury (such as severe pulmonary contusion) can be present without signs of external injury such as rib fractures

Special Considerations for Specific Injuries

- Chest injury
  - Tension pneumothorax is poorly tolerated and is immediate threat to life
  - Flail segment is uncommon injury in children; when noted without a significant mechanism of injury, child abuse should be suspected
  - Many children with cardiac tamponade have no physical signs other than hypotension
Special Considerations for Specific Injuries

• Abdominal injury
  – Musculature is minimal and poorly protects viscera
  – Organs most commonly injured are liver, kidneys, spleen
  – Onset of symptoms may be rapid or gradual
  – Because of small size of abdomen, palpation should be performed in one quadrant at a time
  – Any child who is hemodynamically unstable without obvious source of blood loss should be considered to have abdominal injury until it is proved otherwise
  – Majority of children with abdominal injury have abdominal bruising or ecchymosis

Special Considerations for Specific Injuries

• Extremity injury
  – Extremity injury is relatively more common in children than adults
  – Growth plate injuries are common
  – Compartment syndrome is emergency in children
  – Management
    • Control any sites of active bleeding
    • Perform splinting to prevent further injury and blood loss
    • Pneumatic antishock garment or pelvic binding with sheet may be useful for unstable pelvic fracture with hypotension (per protocol)

Special Considerations for Specific Injuries

• Extremity injury
  – Most femur fractures result from falls or other unintentional injuries
    • Child abuse should be considered
Special Considerations for Specific Injuries

• Burns
  – Burns may be thermal, chemical, or electrical
  – Management priorities
    • Prompt management of airway is required because swelling can develop rapidly
    • If intubation is indicated, endotracheal tube 1/2 size smaller than expected may be required
    • Suspect musculoskeletal injuries in electrical burn patients, and perform spine immobilization
    • Spinal cord injury can be present in children without vertebral abnormality

Trauma Management Considerations for Pediatric Patients

• Injured children require special consideration for
  – Airway control
  – Immobilization techniques
  – Fluid management
  – Pain relief

Airway Control

• Management
  – Airway of injured child should be maintained in in-line or neutral position
  – Sniffing position is appropriate for older children and adults
  – Padding may need to be placed under shoulders in some children, will help to maintain neutral airway position
  – High-concentration oxygen should be given to all patients
  – Jaw-thrust positioning and suctioning used to keep airway open
Airway Control

- Management
  - Endotracheal intubation (followed by insertion of gastric tube) should be performed when airway and ventilation remain inadequate
  - Cricothyroidotomy rarely is indicated for traumatic upper airway obstruction
  - Must be able to provide effective oxygenation and ventilation using bag-mask technique

Immobilization

- Spinal immobilization devices must be right size for infants and children
  - Equipment that may be used
    - Child safety seat
    - Long spine board
    - Padding
    - Pediatric immobilization device
    - Rigid cervical collar
    - Straps, cravats
    - Tape
    - Towel/blanket roll/sandbags
    - Vest-type/short spine board
Immobilization

- Place supine (unless positioned in infant carrier) and immobilized in neutral in-line position
  - Use backboard with recess for head or by using padding under back from shoulders to buttocks

Fluid Management

- Management of child’s airway and breathing takes priority over management of circulation
  - Circulatory compromise is less common in children than adults
  - When vascular access is indicated, consider
    - Large-bore IV catheters inserted into large peripheral veins
    - Transport should not be delayed to obtain vascular access
    - Intraosseous access in children can be used if IV access fails
    - Initial fluid bolus of 20 mL/kg of lactated Ringer’s solution or normal saline should be given
    - Will help to manage volume depletion

Fluid Management

- Management of child’s airway and breathing takes priority over management of circulation
  - Vital signs should be reassessed and bolus (20 mL/kg) repeated if needed
    - Vital signs that do not improve after second bolus indicate need for rapid surgical intervention
Fluid Management

- Injuries are often painful
  - Relief from pain should be priority when providing care to injured child
  - Drugs that may be used to manage some forms of pain and to alter emotional response in pediatric patients include
    - Fentanyl
    - Ketamine
    - Ketorolac
    - Morphine
    - Nitrous oxide (in absence of hemorrhage)

- Other indications for pain relief or sedation in pediatric patients
  - Some airway management procedures
  - Entrapment requiring extended extrication time
  - Cardioversion or other uncomfortable procedures
Sudden Infant Death Syndrome

• Leading cause of death in American infants under 1 year of age
  – Defined as sudden death of seemingly healthy infant that remains unexplained by history and autopsy
  – Affects about 0.57 per 1,000 live births each year in U.S.
  – Cannot be predicted or prevented
    • Positioning during sleep appears to be factor

Sudden Infant Death Syndrome

• Leading cause of death in American infants under 1 year of age
  – Usually occurs between midnight and 6 AM
  – Seasonal distribution for SIDS is October to March (in northern hemisphere)
  – Infant often has history of minor illness, such as cold, within 2 weeks before death

Sudden Infant Death Syndrome

• Signs that may be present
  – Lividity
  – Frothy, blood-tinged drainage from nose and mouth
  – Rigor mortis
  – With most SIDS cases, no external signs of injury are found
  – Often evidence indicates that baby was active just before death
    • Rumpled bed clothes
    • Unusual position or location in bed
SIDS Pathophysiology

• Cause unknown
  – Studies have failed to confirm physiological, environmental, genetic, and social factors as causes
  – Studies have confirmed it is not caused by
    • External suffocation
    • Regurgitation or aspiration of vomitus
    • Hereditary factors
    • Allergies
  – Small percentage of SIDS deaths are thought to be abuse related

SIDS Pathophysiology

• Various physiological aspects suggested to explain SIDS include immaturity of CNS following prenatal event
  – Idiopathic apnea
  – Brainstem abnormalities
  – Upper airway obstruction
  – Hyperactive upper airway reflexes
  – Cardiac conduction disorders
  – Abnormal responses to hypoxia and hypercarbia
  – Abnormal responses to hyperthermia
  – Alterations in fat metabolism

SIDS Pathophysiology

• Risk factors
  – Maternal smoking
  – Young maternal age (under age 20)
  – Infants of mothers who received poor or no prenatal care
  – Infants born with low level serotonin
  – Social deprivation
  – Premature births and low-birth-weight infants
  – Infants of mothers who used cocaine, methadone, or heroin during pregnancy
SIDS Pathophysiology

• Confirmed by excluding other causes of death
  – Autopsy findings include smooth muscle thickening in small pulmonary arteries and right ventricular hypertrophy
    • Thought to occur following hypoxia and constriction of pulmonary vasculature

SIDS Pathophysiology

• Confirmed by excluding other causes of death
  – Other findings
    • Brainstem tumors
    • Low serotonin levels, which may be associated with respiratory center dysfunction
    • Neuroepithelial bodies in tracheobronchial tree
    • Distal atelectasis
  – About 80 percent of SIDS victims also have intrathoracic petechiae, especially on thymus, pleura, pericardium

Management

• EMS providers can do little to help SIDS infant
  – Offer emotional support for parents or other caregivers and loved ones
  – If infant possibly could be viable, resuscitation should proceed
    • Important for parents or other caregivers to see that everything possible is being done for their child
    • Follow pediatric resuscitation protocols and consult with medical direction on decisions to initiate or continue efforts
Management

• Grief reactions should be expected from those who witness event
  – May vary from shock and disbelief to anger, rage, self-blame
• Arrangements should be made for relative or neighbor to stay with family or accompany them to hospital so that they are not left alone
• Many areas have SIDS resource services
  – Provide immediate counseling and support for family of infant who dies of SIDS

Management

• Victims may appear to have been abused or neglected
  – Classic signs such as postmortem lividity and frothy fluid in infant’s nose and mouth give such appearance
  – Avoid comments or questions that may imply suspicion of improper child care

Management

• Determining cause of death is not duty of EMS crew
  – Careful scene observation is crucial
  – Document all findings objectively, accurately, completely
  – Medical direction and other authorities (per protocol) should be advised if inappropriate child care is suspected
Management

• Death of infant has powerful effect on all involved
  – Rescuers commonly have range of emotional reactions after SIDS death
  – Some EMS provide counseling and formal debriefing programs
  – Discuss event openly with others involved in response
    • May help relieve normal feelings of anxiety and stress

What factors do you think influence the reactions of each crew member to a SIDS death?

Child Abuse and Neglect

• More than 3 million cases reported each year in U.S.
  – In 2007, about 5.8 million children were involved in estimated 3.8 million reports and allegations
  – In U.S., child abuse and neglect results in about 5 deaths/day
    • Majority are children under 4 years of age
Child Abuse and Neglect

• Follow local protocol in reporting suspected abuse
  – Discuss any suspicions with medical direction
  – Agencies that may be involved
    • State, regional, and local child protection services
    • Hospital-based social service departments and child protection programs

Child Abuse and Neglect

• Child abuse and neglect is crime that must be reported by law in all 50 states
  – In some states, persons have legal duty to report child abuse or neglect (mandated reporter)
  – Failure to report may result in criminal prosecution and may be punishable by fine or imprisonment or both
  – Reporting in good faith provides immunity from legal liability as consequence of reporting, which may be raised as defense if one is sued for negligent reporting

Elements of Child Abuse

• Child abuse and neglect is maltreatment of children by their parents, guardians, or other caregivers
• Forms of maltreatment
  – Infliction of physical injury (battered child syndrome, shaken baby syndrome)
  – Sexual exploitation
  – Infliction of emotional pain
  – Neglect (medical neglect, safety neglect, nutritional and social deprivation)
Elements of Child Abuse

• Factors
  – Caregiver with potential to abuse
  – Child with particular characteristics that place him or her at risk for abuse
  – Element of crisis

Characteristics of Abusers

• Child abuse usually reflects pattern of unstable behavior
  – Typically not single act of violence
  – In many cases, abuser is child’s parent
    • Other caregivers may be responsible

Characteristics of Abusers

• Child abuse usually reflects pattern of unstable behavior
  – In case of physical abuse, most abusers tend to be unhappy, angry adults
    • Often under extreme stress
    • Usually isolated
    • Often incapable of using support agencies or extended family in times of crisis
    • Often were victim of physical or emotional abuse as children
    • Come from all ethnic, geographical, religious, educational, occupational, and socioeconomic groups
Characteristics of Abusers

- Child abuse usually reflects pattern of unstable behavior
  - Other factors
    - Poverty
    - Alcohol
    - Other drug dependence

Can you make a determination that someone is not an abuser if they don’t fit this profile based on your prehospital assessment?

Characteristics of the Abused Child

- Abused children often have certain characteristics that increase their risk for abuse
  - Demanding and difficult behavior
  - Decreased level of functioning (e.g., a handicapped child or preterm infant requiring extra parenting)
  - Hyperactivity
  - Precociousness with intellectual ability equal to or superior to parent
  - Often parent sees abused child as “special” or “different” from other siblings
Characteristics of the Abused Child

- Other factors
  - Age (child is usually under 5 years old)
  - Gender (boys are involved more often than girls)
  - Illegitimacy

Crisis that May Precipitate Abuse

- Can occur constantly during child’s life
  - More often are intermittent and unpredictable
  - Often brought on by stressors in adult caregiver’s life, especially when caregiver expects child to fill emotional needs created by stress
    - Failure of child to respond in ideal way to caregiver’s needs may lead to abuse

Crises that May Precipitate Abuse

- Common crises associated with episode of child abuse
  - Financial stress
  - Loss of employment
  - Eviction from housing
  - Marital or relationship stress
  - Physical illness in child that leads to intractable crying
  - Death of family member
  - Diagnosis of unwanted pregnancy
  - Birth of sibling
History of Injuries Suspicious for Abuse

• Physical abuse or neglect often is hard to determine
  – Ultimate diagnosis usually begins with suspicions based on
    • Unexplained injuries
    • Discrepant history
    • Delays in seeking medical care
    • Repeated episodes of suspicious injuries

• If injured child indicates that an adult caused him or her physical harm
  – Take seriously and advise medical direction
  – Contact proper authorities

• 15 indicators of possible abuse
  – Any obvious or suspected fractures in child under 2 years of age
  – Injuries in various stages of healing, especially burns and bruises
  – More injuries than usually seen in other children of same age
  – Injuries scattered on many areas of body
  – Bruises or burns in patterns that suggest intentional infliction
History of Injuries Suspicious for Abuse

- 15 indicators of possible abuse
  - Suspected increased intracranial pressure in infant
  - Suspected intra-abdominal trauma in young child
  - Any injury that does not fit description of cause
  - Accusation child injured himself or herself intentionally
  - Long-standing skin infections

History of Injuries Suspicious for Abuse

- 15 indicators of possible abuse
  - Extreme malnutrition
  - Extreme lack of cleanliness
  - Inappropriate clothing for the situation
  - Child who withdraws from parent
  - Child who responds inappropriately to situation (e.g., quiet, distant, withdrawn)
Physical Findings Suggestive of Abuse

• Physical findings
  – Multiple, widely dispersed bruises
  – Welts
  – Burns
    • Such physical findings, along with vague history or delays in seeking medical care for child, should alert to possibility of abuse or neglect

Physical Findings Suggestive of Abuse

• Bruises
  – Predominate on buttocks or lower back
    • Almost always related to punishment
  – Genital area or inner thigh
    • May be inflicted for toileting mishaps
  – Facial or number of petechiae on ear lobe
    • May be caused by slapping
  – Upper lip and labial frenulum
    • May be caused by forced feedings
    • Forcing pacifier into mouth of screaming infant

Physical Findings Suggestive of Abuse

• Bruises
  – Human hand marks
    • From squeezing in shapes resembling fingertips, fingers, or entire hand of abuser
  – Human bite marks
    • Result in paired, crescent-shaped bruises
    • Often contain individual teeth marks
    • Size of arc distinguishes adult bites from child bites
Consider an infant under 3 months of age. Based on the physical capabilities of this age group, where would you expect to see “normal bruises”?

Physical Findings Suggestive of Abuse

- **Welts**
  - Strap marks 1 to 2 inches wide are almost always caused by belt
  - Bizarre-shaped welts or bruises usually inflicted by blunt object that resembles its shape (e.g., a toy or shoe)
  - Choke marks may be seen on neck with or without associated petechiae of face
  - Circumferential bruising or abrasions on ankles or wrists may be caused by rope, cord, or dog leash

- **Burns**
  - Cigarette burns often are found on palms, soles, or abdomen
  - Lighted cigarette, a hot match, or burning incense sometimes is applied to hand to stop child from sucking thumb or to genital area to discourage masturbation
  - Burns may be inflicted with lighters or other sources of open flame (e.g., a gas stove) to teach child not to play with fire
  - Dry contact burns may result from forcibly holding child against heating device (e.g., a radiator, hot iron, or electric hot plate)
Physical Findings Suggestive of Abuse

• Burns
  – Most common abusive hot-water burns or scalds occur from forcible immersion of hands, feet, or buttocks in scalding water
  • These injuries often involve both arms or both legs, or they may be circular burns restricted to buttocks
  • Incompatible with falling or stepping into tub of hot water

Physical Findings Suggestive of Abuse

• Bites
  – Human bites have different characteristics than animal bites
  – Usually more superficial injuries
  – Human bite appears as two joined “c” shapes; dog’s bite has more of an oval or “u” shape
  – May be seen with sexual assault

Physical Findings Suggestive of Abuse

• Other less visible injuries may indicate child abuse
  – Brain injury
  – Abdominal visceral injury
  – Bone fractures
Subdural Hematoma

- Brain injury is leading cause of death in battered children
  - Various pathological lesions
    - Cerebral contusions
    - Intraparenchymal hemorrhage
    - Subdural or even epidural hematomata

Subdural Hematoma

- Subdural hematomata are among most common injuries associated with intentionally inflicted head injury in children
  - Should be suspected in any young child who is in coma or having convulsions
    - Particularly if child has no history of seizure disorder
  - Bleeding into brain tissue can occur as result of skull fractures or scalp bruises
    - Commonly result from direct blow from hand or by being thrown against wall or door

Subdural Hematoma

- Subdural hematomata are among most common injuries associated with intentionally inflicted head injury in children
  - Can result from vigorous shaking of child (shaken baby syndrome)
    - Acceleration and deceleration forces on brain associated with shaking cause tearing of bridging cerebral veins
    - Leads to bleeding into subdural space
Subdural Hematoma

- Subdural hematomata are among most common injuries associated with intentionally inflicted head injury in children
  - Signs and symptoms of shaken baby syndrome
    - Retinal hemorrhages
    - Irritability
    - Altered level of consciousness
    - Vomiting
    - Full fontanelle

Why is it critical that your documentation be clear, objective, and complete in cases of suspected abuse?

Abdominal Visceral Injury

- Intra-abdominal injuries are second most common cause of death in battered children
  - Usually produced by blunt force such as punch or blow to abdomen
Abdominal Visceral Injury

- Children with an abdominal injury often have
  - Recurrent vomiting
  - Abdominal distention
  - Absent bowel sounds
  - Localized tenderness with or without abdominal bruising
- Caregivers routinely deny history of trauma to child’s abdomen in these cases

Bone Injury

- More than 20 percent of physically abused children have positive result on radiological bone survey from previous abusive episodes
  - Injuries that may be obvious only through radiography
    - Fractures of ribs
    - Lateral portion of clavicle, scapula, sternum
    - Extremities
  - Multiple fractures in various stages of healing are highly suspicious for physical abuse

Injuries from Sexual Abuse

- Sexual abuse is symptom of seriously disturbed family relationship
  - Usually associated with physical or emotional neglect or abuse
  - Often sexually abusive adult received similar abuse as child
  - Adult may justify behavior in his or her mind
  - Family relationships are complex, silent complicity by at least one parent often involved
Injuries from Sexual Abuse

- Injuries from sexual abuse may be physical and psychological
- Sexual abuse may include
  - Vaginal intercourse
  - Sodomy (anal intercourse)
  - Oral-genital contact
  - Molestation (fondling, masturbation, exposure)
Injuries from Sexual Abuse

• Emergency care
  – Limited to managing injuries that pose threat to life
  – Give emotional support during transport
  – Undergo extensive interviews and examination by emergency department physician and others

Injuries from Sexual Abuse

• Carefully document any statements made by patient, family member, or caregiver
  – Any findings should be reported to medical direction

• Children require compassionate support
  – Should never be made to feel that he or she is responsible for any of abuse
  – Should not be given impression that discussion of event is inappropriate
  – If possible, paramedic of same sex should interview and care for child

Injuries from Sexual Abuse

• All patients who report sexual assault should be transported
  – Most regions coordinate intensive interview by social worker and physical examination by physician
  – Provided at hospital-based programs that have specialized training in assessment and care of sexually abused children
  – Ideally, contact medical direction to identify child protection center where these services can be provided
  – Fewer number of interviews and exams performed, better for children who have been victimized
Infants and Children with Special Needs

- Some infants and children are born with or develop conditions that pose special needs
  - May require special medical equipment to sustain life
    - Infants born prematurely
    - Those who have altered functions from birth
    - Those who have chronic or acute disease of lung, heart, or CNS
  - Often cared for at home by family and home health services

Infants and Children with Special Needs

- Some infants and children are born with or develop conditions that pose special needs
  - Many are dependent on special medical equipment such as
    - Tracheostomy tubes
    - Home artificial ventilators
    - Central venous lines
    - Gastrostomy tubes
    - Shunts

Infants and Children with Special Needs

- Some infants and children are born with or develop conditions that pose special needs
  - Parents and other family members of a child with special medical needs often are "experts" in caring for child and maintaining required medical equipment
    - Their knowledge, skills, and experience are valuable
    - Use skills and expertise of these parents when managing these emergencies
How can an emergency medical services agency prepare crews to care for these special needs children before a call is even received?

**Tracheostomy Tubes**

- Patient with complete tracheostomy has had airway surgically bypass larynx at level of trachea
  - Larynx is no longer connected to trachea
  - Modern tracheostomy tubes are flexible and relatively comfortable for patient
  - Have few associated risks

**Tracheostomy Tubes**

- Patient with complete tracheostomy has had airway surgically bypass larynx at level of trachea
  - Complications
    - Obstruction
    - Air leak
    - Bleeding
    - Dislodgment
    - Infection
Tracheostomy Tubes

• Patient with complete tracheostomy has had airway surgically bypass larynx at level of trachea
  – All of these may lead to inadequate ventilation
    • Bleeding around tracheostomy usually occurs within 24 hours of surgery and is not commonly seen in prehospital setting
    – Aseptic technique and respiratory support are always high priorities

Management

• Tracheostomy tube may become blocked or dislodged
  – Clear tube with sterile water or saline or remove and reinsert
    • Medical direction may advise that tracheostomy tube be replaced with endotracheal tube as temporary measure
  – Tracheal succioning (using sterile technique) may be required to remove secretions and mucus
  – If tracheal intubation becomes necessary in these patients, must be performed via stoma
Home Artificial Ventilators

• When patient needs help breathing, child may be put on mechanical ventilator
  – Can simulate normal movement of diaphragm and thoracic cage
  – Type of home ventilator used depends on patient’s specific needs
    • Ventilators are classified by function
    • Based on amount of air and pressure they are set to deliver during certain phases of respiratory cycle

Home Artificial Ventilators

• When patient needs help breathing, child may be put on mechanical ventilator
  – Complications can occur from
    • Malfunction of machine and alarms
    • Airway obstruction
    • Respiratory distress
Management

- Due to variety of artificial ventilators, never try to troubleshoot ventilator problem
- Do not try to adjust settings of ventilator
- EMS crew should always treat patient and not try to correct malfunction of machine

Central Venous Lines

- Some patients with chronic illnesses need prolonged and frequent access to venous circulation for drug or fluid therapy
  - Made possible through vascular access devices
    - Surgically implanted medication delivery devices (e.g., Port-a-cath)
    - Peripheral vascular access devices (e.g., peripherally inserted central catheters, Intracath)
    - Central venous access devices (e.g., Broviac, Groshong, Hickman)

Central Venous Lines

- Some patients with chronic illnesses need prolonged and frequent access to venous circulation for drug or fluid therapy
  - Complications
    - Cracked line
    - Air embolism
    - Bleeding
    - Obstruction
    - Local infection
Central Venous Lines

- Patients with vascular access devices often have a serious illness such as cancer or AIDS
  - Effects of these illnesses may complicate assessment and management of emergencies associated with central venous lines

Management

- Torn or leaking catheter (cracked line) may allow fluids or drugs to infiltrate into surrounding tissues
  - Can lead to air embolism
  - Evidenced by
    - Leaking fluid
    - Complaint of burning sensation
    - Swollen and tender skin near insertion site
  - If torn catheter is suspected, stop infusion immediately and clamp catheter between tear and patient
Management

- Patient who develops altered level of consciousness (indicating possible air embolism) should be positioned on left side
  - Patient’s head should be slightly lowered to help prevent embolism from traveling to brain
  - High-concentration oxygen, IV access, and rapid transport for evaluation by physician are indicated
  - Any bleeding at site should be controlled with direct pressure

Management

- Occasionally, lumen port becomes obstructed by blood clot that disrupts flow of fluids or drugs
  - Signs and symptoms of obstruction include sluggish flow and swelling and tenderness at site
  - When this occurs, transport so catheter can be cleared with thrombolytics or replaced
  - Attempts to clear vascular access device require special training and authorization from medical direction

Gastric Tubes and Gastrostomy Tubes

- Gastric tubes used as temporary measure to provide liquid feeding to patient who cannot swallow or absorb nutrients (often used for feeding premature infants)
  - Tubes are inserted through nose or mouth into stomach and can cause irritation to nasal and mucous membranes
  - Designed for short-term use
Gastric Tubes and Gastrostomy Tubes

• Gastrostomy tube provides permanent route for gastric feeding in patients who usually cannot be fed by mouth (e.g., a patient with facial burns or paralysis)
  – Tube is surgically placed into stomach
  – Tube can be visualized in upper left quadrant of abdomen
  – Opening (stoma) has flexible, silicone “button” (covered with protective cap)
  – Stoma allows for regular feedings
Management

• Serious complications with gastric or gastrostomy tubes are rare
  — Seldom require emergency care
• Potential complications
  — Obstruction
  — Pulmonary aspiration
  — Gastrointestinal disturbances (vomiting and diarrhea)
  — Irritation to the mucous membrane
  — Electrolyte imbalances
    • All can result in inadequate nutrition and fluid needs

Management

• Emergency care mainly is supportive
  — May include transport for evaluation by physician
• If not contraindicated, patient will be most comfortable lying on right side with head elevated

Shunts

• Tube or device implanted surgically in body
  — Redirects body fluid from one cavity or vessel to another
    • Example: used to relieve abnormal fluid pressures from excess cerebrospinal fluid around brain in children with hydrocephalus
    • Consists of two catheters, reservoir, and valve to prevent backflow
      • First catheter is inserted through skull, drains fluid from ventricles of brain
      • Second catheter is passed into another body cavity (usually abdomen or right atrium of heart through jugular vein), where excess fluid is absorbed
      • Two catheters are connected by reservoir and valve, which is placed under scalp
      • Reservoir usually can be palpated over mastoid area, just behind ear
Management

- Complications
  - Need for catheter replacement as child grows (requiring several surgeries in first 10 years of life)
  - Obstruction from clotted blood or fluid
  - Catheter displacement
  - Infection may occur, but most common with first 6 months after surgical placement
Management

• Signs and symptoms of obstruction or displacement are those of increased ICP
  – Headache
  – Nausea and vomiting
  – Visual disturbances, in particular limitation in extraocular movements
  – Cushing’s triad (elevated systolic pressure, irregular respirations, bradycardia), which are signs of impending brain stem herniation

Management

• Children with complications from ventricular shunt need emergency surgery to prevent brainstem herniation
  – Ensure adequate airway, ventilatory, and circulatory support
  – Medical direction may recommend endotracheal intubation and hyperventilation to lower ICP, and IV access
  – Patients are prone to respiratory arrest
  – Need immediate transport
  – If possible, patient’s head should be elevated during transport

Summary

• Paramedics must continually maintain their knowledge of pediatric emergency care
• Emergency Medical Services for Children program was designed to enhance and expand emergency medical services for acutely ill and injured children
  – Has defined 12 basic components of an effective Emergency Medical Services for Children system
Summary

- Children have unique anatomical, physiological, and psychological characteristics, which change during their development
- Airway structures are narrower and less stable than those of adults
  - Increases the risk of upper and lower airway obstruction related to injury or illness

Summary

- Principles of assessment are similar to adults, but pediatric-sized equipment and specific adaptations to examination should be made
- Some childhood diseases and disabilities can be predicted by age group

Summary

- Many elements of initial evaluation can be done by observing the child
  - Parent or guardian also should be involved in initial evaluation
  - Three components of the pediatric assessment triangle are appearance, work of breathing, and circulation
- Paramedics must recognize and distinguish between respiratory distress, respiratory failure, and respiratory arrest
Summary

• Obstruction of the upper or lower airway by a foreign body usually occurs in toddlers or preschoolers
  – Obstruction may be partial or complete
• Croup is a common inflammatory respiratory illness
  – Usually is seen in children between the ages of 6 months and 4 years
  – Symptoms are caused by inflammation in the subglottic region

Summary

• Epiglottitis is a rapidly progressive, life-threatening bacterial infection
  – Causes edema and swelling of the epiglottis and supraglottic structures
  – Often affects children between 3 and 7 years of age
• Bacterial tracheitis is an infection of the upper airway and subglottic trachea usually seen in infants and toddlers; it often occurs with or after croup

Summary

• Asthma is common in children over 2 years of age
  – Characterized by bronchoconstriction that results from autonomic dysfunction or sensitizing agents
• Bronchiolitis is a viral disease frequently caused by respiratory syncytial virus infection of the lower airway; it usually affects children 6 to 18 months of age
Summary

- Pneumonia is an acute infection of the lower airways and lungs involving the alveolar walls and the alveoli
- Pertussis is a bacterial respiratory infection associated with a long course of illness, a violent cough with a characteristic “whoop,” and a risk of pneumonia and death, especially in infants

Summary

- Bronchopulmonary dysplasia is a chronic lung disease resulting from intervention with oxygen and ventilation as a neonate
  - Causes alveolar damage and chronic pulmonary dysfunction that can lead to death

Summary

- Several special differences must be remembered when caring for a child in shock
  - Include circulating blood volume, body surface area and hypothermia, cardiac reserve, and vital signs and assessment
  - Child in shock may appear normal and stable until all compensatory mechanisms fail
    - At that point, pediatric shock progresses rapidly, with serious deterioration
Summary

- When dysrhythmias occur in children, they usually result from hypoxia or structural heart disease
- Goals of post-resuscitation stabilization in children include preserving brain function, avoiding secondary injury, identifying causes of illness, managing pain, and providing transport to an appropriate facility

Summary

- Meningitis is inflammation of the meninges
  - Can lead to neurologic damage, hearing or vision impairment, and death
- Most common causes of seizure are noncompliance with a drug regimen for the treatment of epilepsy, in addition to head trauma, intracranial infection, metabolic disturbance, and poisoning
  - Most common cause of new onset of seizure in children is fever

Summary

- Hypoglycemia and hyperglycemia should be suspected whenever a child has an altered level of consciousness with no explainable cause
  - Consider diabetes as a possible cause in children even in absence of a history of diabetes
- Blood disorders that may affect children include sickle cell disease, leukemia, clotting disorders, and others
Summary

• GI disorders in children can lead to serious illness, including life-threatening dehydration and death
• Children with infection may have a variety of signs and symptoms
  – Depend on the source and extent of infection and length of time since the patient was exposed

Summary

• Most poisoning events in U.S. involve children
  – Signs and symptoms of accidental poisoning vary, depending on the toxic substance and the length of time since the child was exposed

Summary

• Blunt and penetrating trauma is a chief cause of injury and death in children
  – Head injury is the most common cause of death in pediatric trauma patients
  – Early recognition and aggressive management can reduce morbidity and mortality caused by traumatic brain injury in children
Summary

• Because of the pliability of the chest wall, severe intrathoracic injury can be present without signs of external injury
  – Liver, kidneys, and spleen are the most frequently injured abdominal organs
  – Extremity injuries are more common in children than adults

Summary

• Sudden infant death syndrome is the leading cause of death in American infants under 1 year of age
  – Defined as the sudden death of a seemingly healthy infant that cannot be explained by history and autopsy
• Child abuse and neglect is maltreatment of children by their parents, guardians, or other caregivers
  – Forms of maltreatment include infliction of physical injury, sexual exploitation, and infliction of emotional pain and neglect

Summary

• Some infants and children are born with or develop conditions that pose special needs
  – May require special medical equipment to sustain life
  – Often are cared for at home
  – Many are dependent on specialized medical equipment such as tracheostomy tubes, home artificial ventilators, central venous lines, gastrostomy tubes, and shunts
  – May have emergencies associated with airway obstruction, impaired ventilation, infection, or increased intracranial pressure