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PEDIATRIC ASSESSMENT

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OBJECTIVES

Upon completion of this topic, the Provider will be able to tailor basic principles of assessment, treatment and transport to the unique needs of the pediatric patient. Specifically, the provider will:

1. Understand the psychological dynamics between child, parent, and provider in pediatric emergencies.

2. Review basic assessment procedures and learn to adjust approach to children of different ages according to development.

3. Recognize physical and developmental differences of children of different ages.

4. Know that history-taking in pediatric emergencies differs from adult emergencies in that it depends upon the age of the child.

5. Know that the history should be brief and relevant but SAMPLE (including Symptoms, Allergies, Medications, Past medical history, Last oral intake, Events).

6. Know that the physical exam of a child should be preceded by careful observation and always followed by initial assessment and vital signs.

7. Know that transport should not be delayed for a detailed assessment which can be done en route.

8. Know general treatment and transport techniques which are specific to pediatric patients and their parents.

PEDIATRIC ASSESSMENT

I. Course Philosophy

A. Out of hospital care should be minimized and transport should be carried out as expeditiously as possible, if this is consistent with patient safety. Under the right circumstances, minimizing field intervention reflects not lack of skill, but a sensible understanding of benefits in early definitive care.

B. Geographic constraints and time factors must be considered in deciding degree of field care: a procedure which is elective in the vicinity of a major hospital may be essential when distance or transportation difficulties mandate a 45 minute transport.

C. Factors to consider before undertaking transport

1. Are the patient's oxygenation and ventilation adequate to preserve life and CNS function?
2. Is the child's cardiac output sufficient to sustain life and CNS viability?
3. Are oxygenation, ventilation, or cardiac output likely to deteriorate before a hospital can be reached? If so, have preparations been made to recognize and deal with such an event in transport?
4. Has the child's C-spine been protected from possible further injury? Are major fractures adequately immobilized?
5. If an invasive procedure is contemplated, do the potential benefits outweigh its costs?
6. If a parent is not to accompany child, is enough history known to allow ER personnel to begin treatment?

II. Psychological Aspects of Pediatric Emergencies

A. All individuals present are under significant stress.

1. Child's viewpoint
   a. In pain, feels terrible.
   b. Usually terrified (fear of permanent injury or loss of body parts, fear of strangers, fear of separation from parents, fear of the unknown).
   c. May feel guilty, even if the problem is not of their making ("I must have done something wrong or this wouldn't have happened to me!")
2. Parent's viewpoint
   a. Frightened.
   b. Often feel guilty ("Why didn't I call a doctor sooner?"; "Why didn't I watch him more closely?")
   c. May be exhausted (may have been up all night with an ill child).
3. Provider's viewpoint
   a. Scared ("I've never treated a baby before!")
   b. May over-empathize ("She looks just like my child!")

B. Awareness of high stress levels should help providers to defuse the situation. Additional training and careful advanced preparation for pediatric emergencies should lessen the psychological toll on provider care givers.

III. The Pediatric History

A. Historian depends on age of the child.

1. Infants and small children cannot give a reliable verbal history. They may not even be able (or willing) to tell what happened, or where it hurts.
2. Parents or other care givers remain major sources of history for most patients and are the only ones for pre-verbal or unconscious children
3. Any child capable of speaking may contribute valuable information.
4. Questioning the patient alone may at times be the only way to learn the truth. e.g., adolescents who are sexually active, pregnant, or using illicit drugs, children of any age who have been abused. Independent interviews of children are time consuming and may arouse parental hostility. This sort of questioning is generally best left to hospital personnel.

B. History should be brief and relevant but should be **SAMPLE**:

1. **S**ample
2. **A**llergies.
3. **M**edications.
4. **P**ast medical history of importance (e.g., asthma, diabetes).
5. **L**ast oral intake (relevant if child is likely to need intubation or urgent surgery).
6. **E**vents leading to call - specifics of present illness.

C. On-the-scene observations may provide valuable information.

1. Hospital personnel will never see the site where a battered child supposedly fell and sustained his injuries; a history which does not fit physical findings may be much more obvious to the Provider.
2. If ingestion is suspected, look for bottles of medicine or household chemicals and bring them to the hospital.
3. Close observation of the scene of an accident may be invaluable in understanding the mechanism of injury.

D. Never be judgmental or accusatory, even if there is obvious battering and neglect.

E. History-taking should never delay transport. Historical data can often be gathered en route if parent is allowed to accompany child.

IV. Vital Signs and Monitoring

A. There are two elements necessary in monitoring vital signs and treating derangements - appropriate equipment and knowledge of normal values.

1. Normal vital signs vary with age and are rarely recalled in an emergency. Carrying a reminder chart is a prudent means of assuring accuracy.

Age	Heart Rate	Blood Pressure (systolic)	Respirations	Weight (kg)
Newborn	100-160	50-70	30-60	3
1 - 6 wks	100-160	70-95	30-60	4
6 months	90-120	80-100	25-40	7
1 year	90-120	80-100	20-30	10
3 years	80-120	80-110	20-30	15
6 years	70-100	80-110	18-25	20
10 years	60-90	90-120	15-22	30

(From Seidel,J.S. and Henderson,D.P. Prehospital Care of Pediatric Emergencies, 1987)

2. Knowledge of these values are of significance in treatment decisions.
   a. A newborn with a heart rate of 70 is profoundly bradycardic. After tactile stimulation oxygenation, and ventilation, chest compressions would be initiated.
   b. A 2 year old with a respiratory rate of 12 is in respiratory failure and needs assisted ventilation.

B. Weight
   1. Critical measurement in children because it is used when calculating drug dosages and fluid replacement. To estimate child's weight:
      a. Ask parents
      b. length, weight and/or age based resuscitation device
      c. (age in years x 2) + 8 = weight in kilograms.

C. Heart Rate
   1. May be assessed by direct apical auscultation or palpation of central pulses.
      a. Brachial in the infant.
      b. Carotid in the older child.
      c. Femoral in the undressed child of any age.
      d. Umbilical cord in the neonate.

2. Tachycardia may result from a variety of causes, some of which are unrelated to cardiovascular pathology:
   a. Fear.
   b. Pain.
   c. Fever.
   d. Diminished cardiac output from any cause.
3. In the quiet or unconscious, non-febrile child, tachycardia is a useful indicator of decreased cardiac output; heart rate rises long before blood pressure falls.
4. Bradycardia in an ill child indicates extreme distress. A heart rate of 60-70/minute in an infant is considered bradycardia.

D. Blood Pressure
1. The most critical variable in obtaining blood pressure is the size of the cuff.
   a. Cuff width should approximate 2/3 of the length of the upper arm; the air bladder should encircle the arm without overlapping
   b. Usual sizes

Age	Cuff Width (inches)	Cuff Length (inches)
Newborn	1-1.5	2-4
Infant	2-3	3-5
Child	3-4	6-8

   c. Too large a cuff will give a falsely low reading.
      Too small a cuff will give a falsely high reading.
2. Blood pressure cannot be measured in conventional fashion in some small infants.
   a. Doppler assistance may be required to hear the pulse.
   b. Palpable blood pressure may be more easily obtained in small infants; this more closely approximates mean blood pressure (normally > 40 torr in prematures, > 50 torr in term neonates).
3. Range of normal blood pressure varies widely and emotional upset will cause an increase in systolic pressure.
4. Normal blood pressure for children over 1 year of age can be estimated:
   (age in years x 2) + 80 = systolic BP.
5. Children will maintain "normal" blood pressure by means of vasoconstriction and increased heart rate despite loss of significant (up to 20%) intravascular volume - never wait for hypotension to initiate volume resuscitation.

6. Transport should not be delayed by attempts to measure blood pressure. Clinical signs such as capillary refill time, extremity warmth, degree of tachycardia, and level of consciousness may be more useful for assessing cardiac output and peripheral perfusion in the field.

E. Assessment of peripheral perfusion via capillary filling time (CFT) is a useful tool for monitoring adequacy of cardiac output in the prehospital setting.
   1. Changes in capillary refill time occur long before BP drops.
   2. Assessed by pressing on skin of finger or toe pad, with extremity above the level of the heart, then releasing and timing interval until return of blood flow; normal refill should occur within 2 seconds.
   3. Capillary refill time may be falsely elevated in the cold child due to vasoconstriction.

F. Respirations
   1. Infants and small children have relatively weak chest walls and use their diaphragm as well as their intercostal muscles to breath causing the abdomen rise and fall with each breath.
   2. Ask the mother to expose the child's chest and abdomen and count the respirations before touching the child - once crying, the respiratory rate cannot be accurately assessed. It is best to count respirations for one full minute

G. Temperature measurement
   1. Normal body temperature is 37^{o} Celsius (98.6^{o} Fahrenheit) for patients of all ages.
   2. Clinical estimate may suffice in most cases. If temperature measurement is undertaken, it may be performed in the course of detailed assessment during transport.
   3. Tempa-dots are acceptably accurate for temperature measurement in non-hypothermic children. Hypothermia thermometers are required for measurement of low temperatures in near-drowning or exposure victims.
   4. Means of measurement
      a. Axillary temperature
         1. Tempa-dot strip or thermometer is held in skin fold for at least 2-3 minutes.
         2. Measurement tends to be lower than a true rectal temperature but is usually $>97.5^{o.}$
         3. Result may be very inaccurate in the patient with significant vasoconstriction; rectal measurement should be considered in the child with very low peripheral temperature.

b. Oral temperature
    1. May be measured, if indicated, with Tempa-dot strip; use of glass thermometers in the mouth is inadvisable in the prehospital setting.
c. Rectal temperature
    1. The most accurate assessment of core temperature available to field personnel.
    2. Should not be measured in the uncooperative, struggling child, or in a child less than 2 months old.
    3. Should be measured with a lubricated thermometer inserted at least 4cm into the rectum and held in place for at least 1-2 minutes

V. The Physical Exam

A. Conscious children often hate to be examined even more than providers hate to examine them; limit the exam to essentials!

B. Observation should precede touching the conscious child, the exam may change if they become agitated with handling.
Such assessment should include:
    1. Color.
    2. Presence or absence of respiratory distress (retractions, stridor, audible wheezing, etc.).
    3. Respiratory rate.
    4. Preferred position.
    5. Obvious bleeding, deformity, stiff neck, limp.
    6. Gross assessment of behavior - is the child too quiet or too wild? Does the child look ill?

C. The exam of all children must include:
    1. Initial assessment
        a. Appearance.
        b. Airway and C-spine.
        c. Breathing.
        d. Circulation - CFT/pulse, with evaluation of hemorrhage in trauma.
        e. Disability.
        f. Level of consciousness.
        g. Exposure of the affected body part.
    2. Vital signs
    3. Relevant features suggested by history of the illness or injury.

D. Transport should not be delayed for a full detailed assessment. Additional examination can be performed en route if tolerated by the child. Many problems, especially respiratory distress, are made worse by agitation.
   1. A `head-to-toe' approach may not yield best results in examining an infant or small child - go 'toe-to-head.'
      a. When possible, examining the child in a parent's lap may give improved cooperation.
      b. Examine the area of greatest interest first, e.g. the abdomen, breath sounds - before the child starts to cry.
      c. Be opportunistic, e.g. take advantage of a child's crying to look in the mouth.
   2. Physical exam findings unique to children include:
      a. Head - The anterior fontanel or `soft spot' will be open until the age of 12-18 months. It is best assessed in the upright position, and may be bulging in the face of increased intracranial pressure (head trauma, meningitis), or sunken with dehydration.
      b. Chest - Infants have small chest size and thin chest walls, leading to transmission of breath sounds throughout the chest. It is often difficult to distinguish upper airway noise from true lung sounds. Listen over the midaxillary line to detect bilateral breath sounds. If `wheezes' or `rhonchi' are loudest over the central airway (trachea or nose), they are likely upper airway in origin.
      c. Neurologic - Glasgow Coma Score is hard to interpret in pre-verbal infants and children. Level of consciousness better assessed by alertness, eye contact, recognition of parents, reaching for objects, playing with exam instruments, withdrawal from pain, spontaneous movement of extremities.

VI. Development Approach to Pediatric Patients
   A. Differences in physical, immunologic, and intellectual maturity among children of different ages leads to susceptibility to different medical and surgical emergencies.
      1. Newborn
         a. Tiny, completely dependent.
         b. Radical transition from fetal to neonatal physiology in dangerous first few minutes of life.
         c. Vulnerability to environmental stress, heat loss, glucose, dehydration.
         d. Immunologically immature, poorly prepared to fight infectious disease.
         e. 5% of all newborns have some congenital malformation which may be trivial (e.g., extra digits) to lethal (e.g., hypoplastic left heart).

f. Practical difficulties in field evaluation of newborn: difficult to localize site of illness difficult to localize site of illness (limited clues -history of poor feeding, lethargy, irritability, fever or hypothermia); IV access, airway maintenance, heat conservation.

2. Toddler
   a. New set of vulnerabilities due to high physical mobility and little common sense.
   b. Dependent on parents for food, shelter, protection, but move about freely, manipulate environment.
   c. Major cause of morbidity is injuries - poisonings, falls, burns, strangulation.
3. Children
   a. Better defended against serious infectious disease.
   b. Venture further out into world, therefore increased incidence trauma. Most trauma is blunt.
      1. Unintentional injuries are responsible for 1/2 of all deaths between 1-14 years in U.S. (23,000 deaths/year). Greater than 1/2 of unintentional deaths due to motor vehicle trauma - passenger, car vs. pedestrian, car vs. bike, car vs. skateboard, etc.
4. Adolescence
   a. Like toddlers, lots of mobility but little sense.
   b. Major morbidity - trauma with teen as driver of car.
   c. Recreational drug abuse, suicide, and homicide are problems in this age group.

B. Clinical importance of developmental approach
1. Grasp of age-related risk factors leads to better field triage and treatment decisions, i.e., differential diagnosis of unresponsive patient:
   2 day old - neonatal sepsis vs. congenital heart disease.
   2 month old - SIDS, meningitis, child abuse.
   2 year old - still at risk for non-accidental trauma, infection. New risks of ingestion of non-food substances/medications, accidental closed head injury, febrile seizure.
   14 year old - CNS infection, seizure disorder, closed head injury are still possible, but drug overdose, suicide attempt must be considered.
2. Age-related cognitive development impacts interaction with patient.
   a. <6 months - unafraid of strangers; may permit exam if not in pain, examiner is gentle, and hands are warm.
   b. 6 months-1 year - afraid of strangers, separation anxiety; best examined while being held by parent.

c. 1-3 years - "terrible two's," any exam may be difficult; patience and persistence needed.
d. 3-6 years - able to understand explanations and cooperate; likely to be very frightened and in need of reassurance.
e. 6-12 years - usually cooperative; needs reassurance and explanation; modest.
f. Adolescents - expects to be treated like an adult, but shares many of the fears of younger children; modest.

3. Approach to the frightened child
   a. Be calm and gentle.
      1. Remember frightened children can't cooperate, can't gauge degree of illness or probable outcome.
      2. Young children perceive stethoscope as invasive, IV as overwhelming.
      3. Poorly developed sense of time and contingency, e.g., to 14 month old, mom who has left room is gone, period.
   b. Talk to patients in simple, but honest terms.
   c. Make non-painful, non-threatening physical contact first.
   d. Explain what you're doing and where they're going; children's receptive language skills may exceed their ability to express themselves verbally.
   e. Never lie, i.e., don't say painful procedure won't hurt, or that you are "all done" unless you really are. On the other hand, don't give a 3 or 4 year old much advance warning - they are not capable of preparing psychologically for a painful procedure or separation from parents. A 5-10 minute wait may lead to increased anxiety.
   f. Don't bargain
      1. Tell them what you are going to do - don't ask, since the child doesn't have a choice.
      2. Physical restraint is essential if too young or too frightened to cooperate.
   g. A favorite toy or security blanket may comfort the child in transport. Allow parent to accompany child, if possible.
   h. Hospital personnel should be notified of impending arrival as soon as possible.

VII. Age-Related Intervention

A. In addition to monitoring, other interventions which are age/size dependent include 1) choice of tubes/lines, 2) administration of drugs/defibrillation, 3) heat conservation measures.

1. IV's - caliber and placement site depends on age.
   a. 20G catheter in newborn is a large bore central line.

1. Infants 22-24 g
2. Children 20-22 g
3. Adolescents 16-18 g (as for adult trauma victims).

b. Peripheral IV sites:
1. Babies and toddlers - dorsal veins of hands, feet; greater saphenous vein at ankle, antecubital, scalp veins.
2. Children - as for adults.

c. Central line sites:
1. Newborn - umbilical vein.
2. Infants, toddlers, children < 8 years - femoral vein, external jugular vein.
a. Subclavian line placement has a high complication rate in young children (pneumothorax) and may interfere with CPR and airway management.

d. Intraosseous infusion - provides rapid, reliable access to systemic circulation in critically ill or injured children < 6 years old.

2. Airway adjuncts (masks, bags, oral airways, blades, endotracheal tubes), NG tubes are chosen based on the estimated weight/age of child. See Appendix for Table of Equipment Guidelines According to Age and Weight.

3. Drugs
a. Drug administration in children is more exacting than in adults, e.g., Can't give an "amp of epi" to an asystolic infant.
b. Dosage calculated per kg of body weight. Need estimated weight for age.

4. Defibrillation
a. Because of small chest size of infants, need to choose paddle size (4.5 cm vs 8 cm) and paddle placement (apex-base vs anterior-posterior) to avoid electrical bridging and maximize skin contact.
b. Defibrillation and cardioversion doses calculated on watt-seconds/kg basis.

5. Heat conservation
a. Infants have high surface to volume ratio, thin skin, little subcutaneous tissue for insulation. High risk for environmental heat loss and hypothermia during field resuscitation and transport.
b. Hypothermia may lead to metabolic acidosis and hypoglycemia resulting in cardiovascular compromise arrhythmias and peripheral vascular collapse.
c. Field precautions to minimize heat loss critical in newborn resuscitation and transport of all infants.

VIII. Summary

A. Rapid growth and development of children is a special challenge to the emergency medical practitioner.
    1. Available history, adequacy of physical exam, techniques of stabilization are all conditioned by where child sits in continuum from infancy to adulthood
    2. Diagnosis to be considered variable with age.

B. Success and satisfaction in dealing with ill and injured children will be promoted by sensitivity to age-related issues in pediatric care.

AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS

AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS

OBJECTIVES

Upon completion of this lesson, the Provider will:

1. Know that appropriate airway management is the key to success in pediatric resuscitation.

2. Know the clinical signs of respiratory failure.

3. Know the unique features of the pediatric airway and their implications for airway management.

4. List three common causes of upper airway emergencies in children and the clinical features of upper airway obstruction.

5. Know clinical presentation of lower airway obstruction.

6. List four signs of respiratory distress.

7. Describe appropriate field management of the child in respiratory distress based on level of consciousness.

8. Know that adequate oxygenation and ventilation must be ensured before transport is initiated.

AIRWAY MANAGEMENT AND RESPIRATORY DISTRESS

I. Etiology/Epidemiology
- A. Anatomic features of the immature airway, age-related developmental issues, and infectious disease susceptibilities lead to increased risk for severe respiratory compromise in pediatric patients
- B. The majority of cardiopulmonary arrests in the pediatric age group are precipitated by a primary respiratory cause.
  1. Primary cardiac arrest is rare in children
     a. Hypoxemia and acidosis due to respiratory failure are the precursors of full arrest.
  2. The leading cause of preventable death in pediatric emergencies - both medical and trauma - is failure to adequately manage the airway.
  3. <u>The airway is the key to success in pediatric resuscitation</u> Pediatric bradycardia/arrest can often be treated with oxygenation and ventilation alone.
- D. Respiratory Failure
  1. Clinical state characterized by inadequate elimination of carbon dioxide and/or inadequate oxygenation of the blood.
  2. Seen as the end stage of respiratory distress of any cause or with inadequate respiratory drive (e.g., the patient with shallow respirations or apnea due to a head injury, seizure, or meningitis).
  3. Respiratory failure is often preceded by a `compensated' state characterized by respiratory distress: use of accessory muscles, retractions, tachypnea and tachycardia .
  4. Clinical signs of respiratory failure reflect inadequate oxygen delivery to the tissues and organs: decreased level of consciousness, tachycardia/ bradycardia, weak proximal pulses, and poor skin perfusion.
- C. Unique features of the pediatric airway
  1. Tongue relatively large in proportion to oral cavity.
     a. Most common cause of airway obstruction is loss of muscle tone with tongue falling back against posterior pharynx.
  2. Infants < 2 months of age are obligate nose breathers.
     a. Nasal obstruction, as with mucous or blood, may result in severe respiratory distress.
  3. Trachea is smaller and shorter than that of adults.
     a. Smaller radius results in marked increase in resistance to air flow when edema or foreign body present.
     b. Trachea of newborn ~5cm in length; 18 month old ~7cm.
        1. Right mainstem intubation and accidental extubation common.

4. Larynx is relatively anterior and high: C2 in neonate, C3-4 in child, C5-6 in adult
    a. Cords may be difficult to visualize during laryngoscopy.
5. Smallest diameter of trachea is at the cricoid ring, below the cords, rather than at the vocal cords themselves.
    a. Endotracheal tube size dictated by caliber of subglottic trachea
    b. Cuffed ET tubes not used in children< 8 years-narrow subglottic region produces functional seal.
    6. Chest wall of infants relatively weak and unstable
    a. Use of diaphragm leads to characteristic `see-saw' or abdominal breathing pattern.
    b. Intercostal, subcostal and suprasternal retractions are prominent as work of breathing increases with airway obstruction or lung disease.
    c. Fatigue of respiratory muscles may lead to decreased respiratory effort as respiratory failure progresses.
7. Immunologic immaturity leads to increased susceptibility to respiratory infections.
    a. Croup, epiglottitis, and bronchiolitis seen almost exclusively in young children.
8. Developmental immaturity leads to increased susceptibility to foreign body aspiration.

D. Common Pediatric Upper Airway Emergencies
1. The upper airway includes the oral and nasal cavities, pharynx, and trachea to the sternal notch.
2. Croup
    a. Viral infection causing edema of vocal cords and adjacent trachea. Results in partial upper airway obstruction.
    b. Accounts for ~90% of infectious upper airway problems in children.
    c. Occurs more commonly in winter.
    d. Children 6 months-3 years most commonly affected.
    e. Clinical syndrome consists of cold symptoms and fever for several days, followed by respiratory distress, stridor, and barking cough.
    f. Symptoms often worse at night.
    g. Course is subacute, and respiratory failure rare.
3. Epiglottitis
    a. Life-threatening bacterial infection causing inflammation and edema of the epiglottis and adjacent structures above the larynx.
    b. Relatively uncommon - accounts for only 5-10% of pediatric upper airway infections.
    c. More common in winter, but occurs year round.

d. Children 3-7 years old most commonly affected.
e. Onset is abrupt, with progression to severe airway obstruction over hours.
1) Fever, often up to 40 degrees C, is generally the first sign and is present in almost every case.
2) Sore throat is complaint in 50% of cases.
3) As disease progresses, difficulty swallowing may lead to drooling and refusal to take fluids.
4) Late in course, children may exhibit postural preference, assuming a seated position with jaw thrust forward - to maximize air entry, the 'sniff position'.
5) Stridor may be a prominent sign, but cough is not characteristic of epiglottitis.
6) Children tend to be very quiet and anxious.
f. Complete obstruction and respiratory arrest will occur if definitive therapy not undertaken expeditiously. May be precipitated by agitation.

4. Foreign body aspiration
a. Ages at highest risk: 6 months-5 years.
1) >90% of pediatric deaths due to foreign body aspiration occur in children <5 years old; 65% in infants.
b. Diagnosis suspected in <u>any</u> previously well, afebrile child with sudden onset respiratory distress and associated coughing, choking, stridor or wheezing.
1) <50% of children will have history of witnessed or suspected foreign body aspiration.
c. Severity and nature of symptoms varies with location of foreign body in respiratory tract.

D. Common lower airway/pulmonary emergencies
1. Asthma
a. Disease characterized by hyper-reactive small airways and reversible obstruction of those airways.
1) Three components of obstruction: bronchoconstriction, mucosal edema, and increased secretions.
b. Most common pediatric chronic disease.
c. Attacks precipitated by variety of causes - infections, allergies, cold, exercise, stress.
d. Characterized by wheezing, cough and increased work of breathing.
e. Children in severe distress may assume `tripod' position, leaning forward on hands to facilitate use of accessory muscles of respiration.

f. With severe obstruction air entry may be so compromised that wheezing disappears, so called 'quiet chest' signaling impending respiratory failure.
g. Severity of symptoms varies widely from mild distress to respiratory arrest.

2. Bronchiolitis
   a. Viral infection causing obstruction of lower airways and symptom complex similar to asthma.
   b. Most common in children < 2 years old.
   c. Epidemics occur in winter months.
   d. Characterized by diffuse crackles, wheezing, and increased work of breathing.
   e. Apnea is a complication seen primarily in young infants.
   f. Unlike asthma, obstruction is poorly responsive to bronchodilator medications

3. Bronchopulmonary Dysplasia (BPD)
   a. Chronic lung disease as a complication of the infant respiratory distress syndrome. Seen in infants who were born prematurely.
   b. Of most significance in urban areas where former premmies are discharged home from intensive care, frequently on home oxygen and multiple medications.
   c. Characterized by chronic respiratory distress. May have retractions, crackles, wheezing and supplemental oxygen requirement at baseline.
   d. Medically fragile children who may decompensate quickly.

II. Field Assessment

A. Agitation tends to make respiratory distress worse. Young children are often frightened of strangers and dislike being examined. Physical exam of the conscious child in respiratory distress should be limited to the essentials. As much information as possible should be obtained by observation. Always look before touching!

B. Respiratory distress may result from abnormalities anywhere in the tracheobronchial tree, lungs, pleura, or chest wall. Symptoms and signs of respiratory distress, regardless of etiology, may include:

1. Abnormal respiratory rate.
   a. Normal respiratory rate varies with age and activity.

Age	Normal Rate
Newborn	30-60
6 months	25-40
1-3 years	20-30
6 years	18-25
10 years	15-20

b. Rate is best assessed by observation - have parent expose child's chest while seated on their lap. Watch rise and fall of chest and abdomen.
c. Rate >60 is abnormal in child of any age.
d. Abnormally slow rate is more worrisome than tachypnea and signals respiratory failure.

2. Increased work of breathing
   a. Retractions
      1. Prominent sign in infants and young children due to thin, unstable chest wall.
      2. Intercostal, subcostal, and suprasternal retractions increase with progressive respiratory distress.
      3. Decreasing respiratory rate and diminished retractions in a child with history of distress signal severe fatigue and respiratory failure.
   b. Nasal flaring
   c. Grunting
      1. Expiratory noise made to generate end expiratory pressure (PEEP), ominous sign.
3. Altered mental status
   a. Agitation and irritability may indicate hypoxemia.
   b. Lethargy and decreased responsiveness may signal severe hypoxemia and/or carbon dioxide retention.
4. Color
   a. Cyanosis is an unreliable sign of hypoxemia in children.
      1. Cyanosis reflects presence of critical level of deoxygenated hemoglobin. Children are relatively anemic, and may not look blue until blood oxygen is dangerously low.
5. Position
   a. `Sniff' position - child seated with jaw thrust forward to maximally open airway
      1. Seen with critical upper airway obstruction.
      2. Characteristic of epiglottitis.
   b. `Tripod' position - child seated and leaning forward supported on outstretched arms to maximally utilize accessory muscles of respiration
      1. Seen with severe distress and increased work of breathing.
6. Cardiovascular status
   a. Tachycardia commonly seen in child with respiratory distress.
   b. Bradycardia seen with severe hypoxemia and acidosis due to respiratory failure.

1. Bradycardia in child with respiratory distress signals imminent cardiopulmonary arrest.

C. Localizing site of illness to upper or lower airway may assist in field treatment decisions.
   1. History
      a. Has the child had fever? For how long?
         1. Acute onset of respiratory distress in absence of fever suggests foreign body aspiration.
         2. Pneumonia, croup, and epiglottitis all have associated fever.
            a. Croup often has history of several days of low-grade fever (38-39 degrees C.).
            b. In epiglottitis, onset of respiratory distress occurs within 12 hours of appearance of fever.
            c. Temperature in epiglottitis often >40 degrees C.
      b. Has the child had acute episode of coughing or choking suggestive of foreign body aspiration?
      c. Will child drink? Has he/she been drooling?
         1. Difficulty swallowing suggests upper airway obstruction.
         2. Fever and drooling points to epiglottitis
      d. Has the child's voice changed?
         1. Hoarse voice suggests croup
         2. Muffled voice or refusal to talk suggests epiglottitis
      e. Has child had similar problems in past?
         1. Infants born prematurely often have chronic lung disease
         2. May have history of wheezing with colds and undiagnosed asthma
      f. Is the child a known asthmatic? On what medications? Last dose?
   2. Physical Exam
      a. Abnormal lung sounds may be difficult to appreciate under noisy conditions in the field. If adequate auscultation is possible, the following sounds may help localize site of illness:
         1. Snoring
            a. Due to very proximal upper airway obstruction (tongue falling back against posterior pharynx).
         2. Stridor
            a. High pitched noise heard on inspiration.
            b. Due to upper airway obstruction (croup, epiglottitis or foreign body).
         3. Wheezing
            a. Heard most commonly on expiration.

b. Indicates lower airway obstruction (asthma, bronchiolitis).

4. Crackles
   a. Inspiratory noises; heard with parenchymal lung disease (pneumonia, bronchiolitis).

III. Field Management

A. Early recognition of the need for life support in the child with respiratory distress is the goal of field assessment. Regardless of the underlying cause of respiratory distress, early intervention to correct inadequate oxygenation and/or ventilation is the key to a good outcome.

1. Cardiopulmonary failure is the final common pathway of inadequate tissue oxygen delivery, whatever the initial problem .
   a. Prognosis following resuscitation from witnessed respiratory arrest is excellent.
   b. Prognosis following resuscitation from full cardiopulmonary arrest is grim, even if a perfusing rhythm is restored.
      1. Irreversible central nervous system damage has occurred when hypoxemia is sufficiently severe to precipitate cardiovascular collapse.

B. Level of consciousness should dictate aggressiveness of field resuscitation.

1. Agitation may precipitate worsening respiratory distress in the conscious child
   a. Offer supplemental oxygen as tolerated.
      1. Infants and young children may not tolerate mask or nasal prongs. Allow parent to administer blowby O_2.
   b. Allow child to remain with parent.
   c. Allow child to remain in position of comfort.
      1. Do not force child to lie down for exam or transport.
   d. IV placement should not be undertaken unless clearly indicated.
2. Impending respiratory failure should be suspected in child with decreased level of consciousness.
   a. Hypoxemia will initially cause agitation.
   b. As hypoxemia worsens or severe CO_2 retention develops, child becomes less responsive and will ultimately lose consciousness.
   c. For the child that does not respond to supplemental O^2 eg: continued respiratory distress, cyanosis, gasping or apnea. Positive pressure ventilation technique should be initiated.
      1. Open airway, using jaw thrust if C-spine injury suspected.
      2. Suction to clear the airway of blood, vomitus or visible secretions.
      3. Ventilate with pediatric bag-valve-mask device and 100% O_2.
         a. If spontaneous respiratory effort present, attempt to coordinate assisted ventilations with child's own breaths.
         b. Appropriate rate will vary with age.

c. Pop-off valve should be overridden (taped down) to allow delivery of adequate tidal volume when airway or lung disease present.
d. Monitor chest rise to assess adequacy of tidal volume.
e. Nasogastric tube should be placed to avoid gastric distention, vomiting and spiration if prolonged BVM ventilation is needed.

4. Child who does not respond to BVM ventilation with improved responsiveness, color, and pulse is not being adequately oxygenated and ventilated. Endotracheal intubation should be undertaken if clinical response is not rapidly seen. If patient > 16 y/o or > 5ft consider a blindly inserted esophageal/tracheal double lumen airway.
   a. If transport time will be prolonged ALS intercept should be initiated
5. Cardiac monitor for transport.

C. Diagnosis-specific therapies
1. Croup
   a. Cool, humidified air tends to alleviate obstruction associated with croup
   b. Aerosol Saline
      1. Dose: 3cc NS as aerosol
   c. Racemic Epinepherine
      1. Dose: 0.5cc in 3cc NS as in aerosol
      2. Administration of racemic epinephrine in the field commits the child to hospitalization due to the rebound effect.
      3. This is given under the discretion of Medical Control.
      4. Cardiac monitoring required due to the tachycardia effect and potential for arrhythmias.
      5. Always administered with supplemental O
2. Epiglottitis
   a. Minimize interventions if child is conscious and maintaining own airway
      1. Instrumentation of oral cavity with tongue blade or suction catheter may precipitate complete obstruction and <u>should not be done unless the child arrests</u>.
      2. Administer 100% O_2 only as tolerated
      3. Invasive procedures, such as IV placement, should <u>not</u> be performed.
      4. <u>Rapid transport with parent .</u>
   b. If child loses consciousness, becomes apneic, or develops persistent central cyanosis despite administration of 100% O_2, positive pressure ventilation is required.
      1. Most children with epiglottitis and `complete' obstruction can be bagged with bag-valve-mask.

a. Excellent mask seal and high inspiratory pressures required - use two person technique; override pop-off valve.

2. If BVM ventilation unsuccessful, attempt intubation using endotracheal tube 1-2 sizes smaller than anticipated for age.
   a. Chest compression by second rescuer may force bubble of air through glottis and assist in identifying cords.
3. If patient cannot be intubated, needle cricothyroidotomy should be attempted if in EMS System policy.

3. Foreign body aspiration
   a. Minimize field interventions if child is conscious and maintaining own airway
   b. Administer 100% O_2 as tolerated.
   c. Mouth sweeps should not be attempted unless foreign body is visible and child's cooperation can be ensured.
      1. Blind sweeps may lead to impaction of foreign body in glottis and complete obstruction.
   d. If wheezing present, foreign body is in a small airway and attempts to dislodge should <u>not</u> be undertaken in field.
   e. Tracheal foreign body causing complete obstruction, loss of consciousness, central cyanosis unresponsive to 100% O_2, or gasping respirations must be removed.
      1. <1 year old - back blows/chest compressions.
      2. >1 year old - Heimlich maneuver.
      3. If foreign body not expelled by above, perform laryngoscopy and remove visible foreign body with Magill forceps.
      4. If foreign body not visualized, attempt to intubate and/or blindly inserted airway and push foreign body into lower airway.
      5. If child cannot be intubated, needle cricothyroidotomy should be attempted if allowed per medical director .

4. Asthma
   a. Administer supplemental O_2
   b. A severe asthma attack can be treated with bronchodilator drugs
      1. Epinephrine - 0.01cc/kg
         1:1000 Solution SQ
         Maximum dose is 0.3cc; may repeat every 20-30 minutes twice.
      2. Aerosol therapy
         a. May be better tolerated than SQ epi, especially by older children.
         b. May be administered by blow-by to infants too young to accept mouthpiece.

c. Sympathetic side effects (tachycardia, tremor, nausea) less pronounced than seen with epinephrine.
d. Metaproterenol (Alupent), albuterol (Proventil), and isoetharine (Bronkosol) can each be given in dose of 0.2 cc in 3cc NS as aerosol. May repeat q20-30 minutes x2.

2. Theophylline/aminophylline
   a. Use in the field should be discouraged due to potential toxicity and late onset of action.
3. All bronchodilator drugs may cause tachycardia and arrhythmias, although children tolerate this tachycardia well.
   a. Consult Medical Control prior to administration if heart rate >180.
   b. Continuous cardiac monitoring required when bronchodilators administered in field.

D. Transport
1. Transport should be undertaken expeditiously, however a stable airway and adequate oxygenation and ventilation should always be ensured before transport is initiated. `Scoop and run' has no place in the management of a child in respiratory failure.
2. Frequent reassessment for signs of deterioration must be performed and appropriate action taken as problems are identified.
3. Early notification of the receiving hospital should be performed.
4. BLS units should consider ALS intercept if child unstable.

PEDIATRIC SHOCK AND SHOCK MANAGEMENT

* This is an optional chapter for the BLS course.

PEDIATRIC SHOCK AND SHOCK MANAGEMENT

OBJECTIVES

Upon completion of this lesson the provider will be able to:

1. Know that cardiac arrest in children is almost always a complication of respiratory failure, not primary cardiac disease.

2. Know that bradycardia in the ill pediatric patient is a response to hypoxemia, and is treated with oxygenation and ventilation.

3. Know that hypovolemia is the most common cause of shock in children.

4. Recognize the early signs and symptoms of shock in the pediatric patient.

5. Know that hypotension is a late sign of shock.

6. Describe the basic treatment of a child in shock of any cause.

7. Describe the ALS techniques for the primary treatment of shock, and the medications which may be used in the field.

8. Describe the symptoms and signs of congenital heart disease and congestive heart failure in pediatric patients.

PEDIATRIC SHOCK AND SHOCK MANAGEMENT

I. Cardiac Arrest/Arrhythmias
   A. Incidence/Etiology
      1. Cardiac arrest in children is almost always a complication of respiratory failure, not primary cardiac disease.
         a. Hypoxemia and acidosis result in multiple organ system failure, including cardiovascular collapse.
         b. Bradycardia in children is almost always a sign of profound hypoxemia, and is generally the only arrhythmia seen prior to full arrest and asystole.
         c. When a hypoxemic insult has progressed to the point of full arrest, the extent of CNS injury may be so great that brain death will ensue, even if the heart itself is restored to a perfusing rhythm.
         d. Early recognition of the need for respiratory support is the key to avoiding cardiac arrest, and to a successful resuscitation.
      2. Arrhythmias
         a. Tachycardia in children is common, and is most frequently a physiologic response to a non-cardiac derangement -- hypovolemia, fear, pain, fever.
         b. Bradycardia in children is almost always a response to hypoxemia, rather than to a primary cardiac problem.
            1) Bradycardia is a pre-arrest rhythm in the ill pediatric patient and must be treated immediately.
            2) Treatment of bradycardia is oxygenation and ventilation.
         c. Ventricular arrhythmias are exceedingly rare in children, except in hypothermic near-drowning victims.

II. Shock
   A. Incidence/Etiology
      1. Shock is circulatory failure characterized by inadequate delivery of oxygen at the tissue level, and inadequate clearance of metabolic waste products.
      2. Shock in children has the same spectrum of etiologies as shock in adults. However, the frequency of causes is different.
         a. Hypovolemia is the most common cause of shock in children, and may be due to hemorrhage or fluid loss.
            1) Children are at increased risk for hypovolemic shock due to their relatively small blood volume (80 cc/kg), e.g., a 10 kg one-year-old has a blood volume of only 800 cc. Loss of 200 cc due to a femur fracture represents 25% of his blood volume!
            2) Vomiting and diarrhea due to viral illness can lead rapidly to significant hypovolemia in young infants.

         b. Septic shock results from overwhelming bacterial infection, to

which young children are especially prone due to the immaturity of their immune system. This is the second most common cause of shock in the pediatric age group.

c. Cardiogenic shock is far less common in children than in adults. 1) Primary pump failure is unusual, except in children with congenital heart disease.
   2) Cardiac function may be secondarily depressed due to metabolic changes from hypoxemia associated with respiratory failure. Hypoglycemia, acidosis, hypothermia, and some drugs and toxins may also precipitate cardiogenic shock.

d. Neurogenic shock is unusual, and generally seen only with spinal cord injury.
   1) Shock in the head injured trauma victim is almost always due to hemorrhage elsewhere, <u>not</u> to the head injury itself.

e. Hypoglycemia can present as shock.
   1) Small or chronically ill children have limited sugar stores. Poor perfusion, sweating, tachycardia and hypotension from hypoglycemia mimic shock.

B. Field Assessment of Shock

1. Regardless of the specific etiology, shock in the pediatric patient presents with a similar clinical picture. Cardiovascular collapse is the final common pathway of inadequate tissue oxygen delivery, whether it is due to blood loss, loss of vascular tone, pump failure, or respiratory compromise.
2. Early signs and symptoms of shock may be subtle in the previously healthy child. Such children have the ability to markedly increase heart rate and vascular tone to compensate for falling cardiac output. <u>Hypotension is a late sign of shock in the pediatric patient and signals a pre-arrest state. Never wait for blood pressure to fall to make the diagnosis of shock</u>.

   a. Early signs/symptoms
      1) Tachycardia (fast heart rate)
         a) Progressive tachycardia may be the <u>only</u> objective finding in early shock.
         b) Recognition of an abnormally fast rate requires familiarity with normal values -- <u>carry a chart of normal vital signs by age</u>.
         c) Tachycardia may also be due to pain, fear, fever -- history and the clinical setting will help to make this distinction.
      2) Delayed capillary refill time (>2 seconds). Pale or mottled skin, cool extremities, weak thready or absent peripheral pulses.
         a) Indicate peripheral vasoconstriction and decreased peripheral perfusion in an attempt to shunt blood to vital organs.
      3) Tachypnea (hyperventilation)

a) An attempt to compensate for poor oxygenation and metabolic acidosis at the tissue level by blowing off carbon dioxide.

b. Late signs/symptoms

1) Weak or absent peripheral pulses.

2) Decreased level of consciousness.

a) Due to decreased brain perfusion, acidosis.

3)Hypotension

a) Blood pressure tends to be maintained at "normal" values until late in the course of shock. A child may lose up to 20-25% of their blood volume acutely before the blood pressure falls.

b) Hypotension signals a truly critical situation, with cardiac arrest imminent.

3. History

a. Though scene time should not be prolonged to obtain a detailed history, several questions may help to clarify the etiology of shock and assist hospital providers in instituting definitive care.

1) Has the child had a fever? How long?

2) Has the child had vomiting? Diarrhea? How much?

3) Does the child have a cardiac history? Supraventricular tachycardia? Cardiac surgery? (Look for a sternal scar!)

4) Is the child diabetic? (May be hypoglycemic based on too much insulin, or hypovolemic due to hyperglycemia and excessive urine output.)

5) Is there a history of trauma or source of blood loss?

6) When did the child last void?

4. Continual reassessment of the ABC's is imperative -- the initially "compensated" child may rapidly deteriorate in transport.

C. Field Treatment of Shock

1. Initial assessment should allow the diagnosis of shock, though etiology may be unclear. The vast majority of cases of shock in pediatric patients will be due to hypovolemia. <u>When in doubt as to etiology, treat for hypovolemic shock</u>.

2. Airway

a. Decreased level of consciousness in the child in shock may lead to impaired airway reflexes and the need for noninvasive (chin-lift, jaw-thrust) airway or invasive (oropharengeal, nasophrengeal or endotracheal intubation**)** management.

b. Potential C-spine injury must be considered in undertaking any airway maneuvers in the trauma victim with shock.

3. Breathing

a. <u>All patients with shock should receive 100% oxygen</u>.

b. Ventilatory assistance may be necessary. Hyperventilation will help to compensate for the metabolic acidosis associated with poor perfusion by blowing off carbon dioxide.

1) Attempt to coordinate assisted ventilation with the patient's own respiratory efforts. The patient who fights and becomes more agitated, even with well coordinated breaths, should be allowed to breathe 100% oxygen without assistance.
2) As the initially uncooperative patient tires, he may become more tolerant of assisted ventilation. Continued reassessment is imperative.

4. Circulation
   a. Apply cardiac monitor.
   b. Cardiac compressions should be performed if the child is pulseless regardless of whether a rhythm is detected on the monitor**.** Compressions are indicated in an infant with a rate of <80 and a child with a rate <60. Shock is a common cause for no detectable pulse (PEA).
   c. Control any obvious source of hemorrhage.
   d. Elevate the lower extremities in children above the age of 12.
   e. Consider the use of pediatric anti-shock garment (MAST) in the child with hemorrhagic shock.
      1) Do <u>not</u> inflate the abdominal compartment in children under 10 years of age, as this may lead to respiratory compromise.
   f. Fluid resuscitation
      1) Definitive therapy for shock involves fluid administration.
      2) Establishment of intravenous access is difficult in young children, especially in the face of dehydration or shock.
         a) The risks of prolonged scene time must be weighed against transport time to the receiving facility, patient's condition, and anticipated benefits of fluid administration in transport.
         b) Consider intraosseous infusion.
            (1) Tibial bone marrow represents a "noncollapsible vein," and may provide rapid, reliable access in the infant in shock.
      3) <u>Only</u> isotonic fluids (Normal Saline/Lactated Ringers) should be used for volume resuscitation. D5W has no role in the acute resuscitation of shock.
         a) Bolus with 20 cc/kg over 5 minutes.
         b) <u>Repeat 20 cc/kg boluses LR/NS</u> as indicated by reassessing adequacy of perfusion: heart rate, quality of pulses, capillary refill time, extremity warmth, level of consciousness, blood pressure.
         c) <u>The most common error in fluid resuscitation is reluctance to give adequate volume</u>. A child with hypovolemic shock may require 60 cc/kg in the first hour. The child with septic shock may require

80 cc/kg, or more.

d) Children receiving fluid bolus should be monitored for symptoms of respiratory distress which may suggest pulmonary edema.

g. Chemstrip determination should be performed and 2-4 cc/kg D25W administered IV if blood sugar is <40-60 mg%, except in neonates.

h. Pressors

1) Catecholamines (e.g., Epinephrine, Dopamine) are seldom indicated in the prehospital treatment of shock in children and should be used only after consultation with a physician advisor.

2) Possible indications for field use of sympathetic drugs include persistent shock despite administration of 60 cc/kg of Crystalloid, or persistent shock despite fluid infusion to the point of inducing respiratory distress.

3) The treatment of hypovolemia is <u>volume</u>. Never give pressors with an "empty tank."

5. If only BLS consider intercept with a paramedic unit or helicopter airlift if the child is very sick and transport time is longer than 20 minutes.

6. Rapid transport, with early notification of the receiving facility should be undertaken in any child with shock.

III. Congenital Heart Disease

A. Incidence/Etiology

1. Children may be born with a structurally abnormal heart which results in cardiovascular compromise early in infancy. Some will have continued problems with congestive heart failure (CHF) throughout childhood, and may be on multiple medications.

2. There will be a disproportionate number of such children in cities with a children's hospital supporting an active cardiac surgery service. Many of these patients will return to small communities either before or after corrective surgery.

3. Many hospitals will notify EMS providers when such a medically fragile child is discharged to their service area. Sometimes the diagnosis will not have been made prior to discharge from the newborn nursery.

B. Field Assessment

1. In the previously diagnosed infant or child, parental history will be very helpful.

a. What is the child's baseline respiratory status? -- Some will be in chronic CHF with baseline retractions and crackles.

b. Is the child <u>always</u> cyanotic? Does he/she "pink up" on supplemental oxygen?

c. Is the child on cardiac medications -- Digoxin? Diuretics? Home oxygen?

d. Has the child undergone corrective surgery?

2. In the previously undiagnosed infant, congenital heart disease should be considered in the newborn with signs of inadequate perfusion, poor color, poor feeding, or respiratory distress.
3. Signs and symptoms of congestive heart failure include:
    a. Respiratory distress
        1) Tachypnea, with or without increased work of breathing (retractions, nasal flaring, grunting).
        2) Crackles or wheezing on auscultation.
    b. Decreased oral intake
        1) Parents may note increased respiratory rate or distress during feeds, inability to finish usual bottle due to fatigue, sweating during feedings.
    c. Cardiac exam
        1) Tachycardia
        2) Heart murmur may be present
        3) Gallop rhythms very difficult to detect at fast infant rates.
        4) Poor peripheral perfusion -- delayed capillary refill, mottled or cool extremities, weak peripheral pulses.
        5) Cyanosis may or may not be present, depending on the type of heart problem.
    d. Peripheral edema is not a prominent sign in infants.
4. Cardiac monitoring may reveal ventricular ectopy and conduction problems.
    a. Seen most commonly in children who have undergone cardiac surgery.
    b. May also be due to Digoxin toxicity or to electrolyte derangements due to diuretic therapy.

C. Field Treatment
1. Airway /Breathing
    a. One hundred percent (100%) oxygen should be administered, but may not relieve cyanosis in children with certain types of heart defects who are always "blue."
    b. Assisted ventilation may be needed if respiratory distress and pulmonary edema are severe. Reassess frequently, as increased work of breathing may lead to respiratory fatigue and progressive respiratory failure during transport.
2. Circulation
    a. Evaluate pulse quality and capillary refill.
    b. Cardiac monitor.
    c. Aggressive fluid therapy may make both perfusion and respiratory distress worse. Contact medical control to determine if IV access is indicated. Hang LR at a "to-keep-open (TKO)" rate (2 cc/hour) if IV access is indicated.
    d. Arrhythmias treated as per PALS protocols -- drugs and electricity are administered on a mg/kg basis. (Carry a precalculated dose card!)
3. Notify receiving hospital and transport expeditiously. Consider ALS intercept in seriously compromised or cardiovascularly unstable child.

PEDIATRIC TRAUMA

PEDIATRIC TRAUMA

OBJECTIVES

Upon completion of this lesson, the Provider will:

1. Know that head injury is the most common type of trauma in children.

2. Identify the correct sequence of priorities to be used in assessing and managing the multiple injured patient.

3. Recognize that priorities for the pediatric trauma patient are basically the same as for adults, but that critical differences exist in:
   a. Airway management
   b. Recognition of shock
   c. Fluid management
   d. Dosage of medications
   e. Psychological support

4. Outline the initial and detailed assessment.

5. Know the assessment and management priorities for the near-drowning victim.

6. Determine when ALS backup or alternative modes of transport are needed.

PEDIATRIC TRAUMA

I. Etiology/Epidemiology

A. Trauma is the most common cause of death in children between 1-14 years of age.

1. Head injury is the leading cause of pediatric trauma death.
2. Failure to manage the pediatric airway is the leading cause of preventable trauma death in children.
3. Causes of unintentional injury death:

Motor vehicle accidents	36%
Auto-Pedestrian/Bicycle	20%
Drowning	10%
Choking/Suffocation	10%
Motorcycle Accidents	06%

B. Risk Factors for Injury

1. Two out of three injuries occur in males.
2. Higher incidence in children who live in poverty, in single parent households, and in infants born to teenage mothers.
3. Frequently alcohol and drug related in teenagers.

C. Types of Injuries:

1. Pediatrics -- 80-90% blunt trauma, 10-20% penetrating trauma
   vs. Adults -- 10% penetrating, 90% blunt
2. Anatomic distribution of injuries:

Neurologic	75%
Chest	40%
Extremities/pelvic girdle	30%
Face and neck	30%
Abdomen	25%

3. Nationwide, approximately 3% of injured children die from traumatic unintentional injuries.
4. Mechanism of injury is a critical observation in field triage of trauma.
   a. Early notification of base hospital is imperative if mechanism is suggestive of serious injury, even if child 'looks ok' (e.g., ejection from motor vehicle, vehicular intrusion, fall from significant height).

II. Field Assessment and Management

A. Principles of evaluation and stabilization for trauma are the same for patients of any age. Pediatric trauma care differs from that of adults because:

1. Children sustain different types of injuries.
2. Children have smaller total blood volume (70-80 cc/kg).
3. Pulse, respiratory rate, blood pressure and drug dosages vary with age.
4. Most care providers have less experience in dealing with children.

B. The goals of prehospital management of the critically injured child include rapid assessment and treatment of life-threatening conditions and immediate transport to a hospital. Early notification of the hospital is important so that maximal resources are available upon arrival.

C. During the initial assessment, life-threatening conditions are identified and simultaneous management is begun. Resuscitation of vital functions proceeds concurrently with the initial assessment.

A--Airway management with C-spine immobilization
B--Breathing (oxygenation and ventilation)
C--Circulation, with control of ongoing hemorrhage
D--Disability (level of consciousness)
E--Expose and examine and keep warm

D. Airway Management with Spinal Immobilization

1. The first priority in caring for the injured child is to establish a patent airway while simultaneously taking steps to protect the cervical spine.
2. Assume a cervical spine injury in any trauma patient with an altered level of consciousness, obvious injuries of the head or neck, or a suggestive mechanism of injury.
3. Airway evaluation
   a. If patent -- no intervention needed.
   b. If intervention needed
      1) BLS -- positioning, suction, oral/nasopharyngeal airway, foreign body removal via log roll while maintaining c-spine control.
      2) ALS -- endotracheal intubation, cricothyrotomy, foreign body removal with Magill forceps.
4. Establishing an Airway
   a. Maintain gentle in-line immobilization and a neutral position of the head and neck while establishing a patent airway. Avoid the use of traction.
   b. Use jaw-thrust maneuver only.
   c. Remove any foreign matter from the mouth.
   d. If an adequate natural airway cannot be maintained an oral or nasopharyngeal airway may be placed.
      1) An oral airway will produce gagging/vomiting in a conscious child.
      2) Nasal airways may be better tolerated in the awake child with intact gag reflex. Caution should be used in the their placement to avoid trauma to nasal passages.
   e. Endotracheal intubation should be considered if a stable airway cannot be maintained or if manual ventilation is necessary.
5. Techniques of Spinal Immobilization
   a. The cervical spine is immobilized using a rigid cervical collar and two-inch tape across the forehead to secure the head to a backboard.
   b. Do not attempt to use a collar if you do not have the appropriate size available. Adequate immobilization can be achieved using towel/blanket rolls and two-inch tape.
   c. The child's body must be secured to a backboard. The childs head should be last body part secured to the back board. Blanket rolls may be necessary to ensure adequate immobilization using an adult backboard and straps.

d. A frightened or preverbal child cannot cooperate -- anticipate this in your efforts to restrain the child.

6. Before applying the cervical collar check for neck vein distension, carotid pulses, tracheal deviation, and subcutaneous emphysema.

E. Breathing and Ventilation

1. Look, listen, and feel for air movement.
2. If the child does not start breathing after opening the airway, assisted ventilation should be initiated with 100% bag-valve-mask. Proper mask fit is imperative to obtain an adequate seal and adequate air entry.
3. If adequate tidal volume cannot be delivered via bag-valve-mask, or prolonged assisted ventilation is anticipated, endotracheal intubation may be necessary.
4. An orogastric or nasogastric tube should be inserted if the child is being ventilated with positive pressure technique. Positive pressure ventilation in children leads to gastric distention with impairment of diaphragmatic excursion and decreased ability to ventilate, as well as increased risk of vomiting and aspiration. An NG tube is contraindicated in patients with facial trauma or suspected basilar skull fracture. However an OG tube is appropriate for this patient.
5. If the child is spontaneously breathing, the adequacy of ventilation must be assessed
   a. Look:
      1) Expose the chest.
      2) Determine if there is symmetrical chest rise and estimate rate of respirations.
      3) Inspect for signs of respiratory distress: substernal, intercostal or suprasternal retractions; expiratory grunt; nasal flaring.
      4) Note bruises, open wounds which may reflect underlying contusion or hemo/pneumothorax.
   b. Listen:
      1) Over midaxillary line bilaterally for equal breath sounds.
   c. Feel:
      1) Palpate trachea and neck noting tenderness, subcutaneous emphysema or deviation of the trachea.
   d. Re-evaluate airway.
6. <u>Supplemental oxygen as high as possible should be administered to all trauma patients</u>.

F. Circulation

1. The possibility of shock must be considered in all trauma patients.
   a. Shock is present when circulation is inadequate to meet tissue metabolic needs.
   b. In trauma, shock is most often caused by blood loss, but may be caused by spinal cord injury, cardiac tamponade, or tension pneumothorax. Since the majority of pediatric trauma is blunt, blood loss may not be obvious.

2. Shock is characterized by:

a. Tachycardia
b. Cool clammy skin
c. Delayed capillary refill (>2 seconds)
d. Anxiety, agitation, or decreased level of consciousness
e. Weak, thready, or absent peripheral pulses
f. Increased respiratory rate
g. Decreased blood pressure

3. Hypotension is a late indication of shock in children.
   a. Blood pressure will be maintained at 'normal' values via compensatory mechanisms such as increased heart rate and vasoconstriction despite acute loss of 20-30% of blood volume. Never wait for hypotension to initiate shock therapy.

4. In children, total blood volume = 80 ml/kg of body weight.
   a. Small volumes of blood loss are significant in a child. For example, a 10 kg 1-year-old has a total blood volume of 800 ml. He/she will be in shock with a loss of only 160 ml of blood (20% of total blood volume).

5. Field treatment of shock
   a. As in adults, the therapy of shock in children includes control of ongoing hemorrhage, raising the lower extremities, preventing heat loss, and volume resuscitation with Crystalloid.
      1) Volume resuscitation -- 20 cc/kg bolus of Ringer's Lactate or Normal Saline. Repeat as necessary based on clinical response (heart rate, capillary refill time, extremity warmth, level of consciousness).
      2) Vascular access -- advantage of field IV placement must be weighed against prolonged scene time. Consider intraosseous infusion if peripheral venous line cannot be rapidly established in children under the age of 6.
   b. Pneumatic antishock garments
      1) The use of pneumatic antishock garments in children is debatable. Good evidence for their efficacy in treating pediatric shock is lacking.
      2) Inflation of the abdominal compartment will lead to compromise of respiratory status. Avoid its use in children under ten.
      3) May be useful to splint lower extremity or pelvic fractures.
      4) Pediatric garment fits children and adolescents. Garments are not available for infants and toddlers, so antishock garments are not recommended in these age groups.

G. Disability
   1. The level of consciousness can be quickly determined by following the acronym:

      A -- Alert

V -- Responds to verbal stimulus
P -- Responds to painful stimulus
U -- Unresponsive

2. Note pupil equality, size, and response to light.
3. Decrease in level of consciousness in suspected head injuries should be treated with assisted ventilation. Hyperventilation will decrease intracranial pressure.

H. Expose
1. While it is important that all life-threatening injuries be discovered in the primary assessment, hypothermia may compound the initial insult. Measures to avoid excessive heat loss should be taken at the scene and in the rig, especially in infants and toddlers.

I. Remember: Airway maintenance, cardiopulmonary resuscitation, and other life-saving measures should be initiated when the problem is identified, rather than after completion of the primary survey.

III. Detailed Assessment

A. The detailed assessment is a systematic head-to-toe evaluation of the patient. Scene time should not be prolonged to complete the detailed assessment, which can be carried out during transport or upon arrival at the hospital.

B. Neck
1. Assessment
a. Patients with facial/head trauma due to blunt injury should be assumed to have a C-spine fracture.
b. Inspect for tracheal deviation. Palpate for subcutaneous emphysema.

C. Head
1. Injuries to head include:
a. Skull fracture
b. Concussion -- Temporary loss of consciousness with no significant anatomical brain injury.
c. Contusion -- Bruise of the brain resulting from small vessel bleeding within the brain tissue. Often leads to prolonged loss of consciousness.
d. Epidural hematoma -- Mass lesion resulting from tear of middle meningeal artery in parieto-temporal region of skull. May cause acute deterioration and cerebral herniation in the field. In pediatric patients, may result from venous bleed and have less acute course. Prognosis excellent if properly treated acutely.
e. Subdural hematoma -- Mass lesion resulting from tear of cerebral veins. Often associated with severe underlying brain injury and poor long term prognosis.
f. Parenchymal hematoma -- Mass lesion within brain tissue itself. Associated with severe primary brain injury and poor prognosis.

2. Field assessment
a. Inspect for signs of penetrating or blunt trauma -- Abrasions, lacerations, skull deformities, scalp hematoma.

1) Clear drainage from nose or ears (cerebrospinal fluid) or bloody discharge from ears suggest closed head injury with basilar skull fracture.
2) Battle's sign, raccoon's eyes are late signs of basilar skull fracture.

b. Palpate skull for bony step-offs or irregularities suggesting underlying fracture.

c. Serial neuro exams
1) Examine pupils for size, equality, reaction to light.
2) Assess level of consciousness.
a) Alert? Responsive to voice? Responsive to pain? Unresponsive?
3) Observe motor activity for unilateral weakness or paralysis. suggesting intracranial mass lesion.
4) Glasgow Coma Scale may be used for children over ~3 years of age. A modified coma scale exists for infants (see Appendix 1).

d. Assess for signs of elevated intracranial pressure (ICP).
1) In trauma, elevated ICP results from increase in volume of intracranial contents due to one of three mechanisms.
a) Increase in volume of brain tissue itself due to cerebral edema.
b) Presence of mass lesion, i.e., hematoma.
c) Increase in intravascular blood volume -- vasodilatation results from hypercarbia associated with hypoventilation.
2) Effect of elevated ICP varies based on magnitude of the increase in contents, rapidity with which change occurs, and relative rigidity of the skull.
3) As intracranial pressure rises, death will occur when:
a) Distortion/compression of brainstem results in acute cardiorespiratory arrest.
b) Intracranial pressure rises to equal or exceed systemic arterial pressure. This leads to cessation of cerebral blood flow and brain death.
4) Early signs of elevated ICP include:
a) Altered level of consciousness -- agitation, lethargy, disorientation
b) Vomiting
c) Headache
5) Late signs and symptoms include:
a) Pupillary dilatation, especially one 'blown' pupil.
b) Bulging anterior fontanel in infants -- anterior fontanel usually close by 12-18 months of age.
c) Posturing (flexor or extensor).
d) Central neurogenic hyperventilation, irregular respirations, or apnea.

e) Cushing's Triad (hypertension, bradycardia and hypoventilation) may not occur.

f) Bradycardia signals imminent cardiac arrest due to elevated ICP and critical brainstem distortion or to hypoxemia due to respiratory failure.

g) The isolated closed head injury in children over 18 months does not account for shock -- look for site of occult hemorrhage if shock is present.

3. Field management

a. Control external bleeding -- children can lose sufficient blood from scalp lacerations to cause shock.

b. Do not remove penetrating objects unless they interfere with essential resuscitation or extrication.

c. Treat suspected elevation of intracranial pressure.

1) Elevate long back board to 30 degrees.

a) Ensure C-spine immobilization and neutral head position -- lateral turning may lead to jugular compression and further elevation of ICP.

b) Elevation contraindicated in presence of shock.

2) Hyperventilation (will vary depending on the age of the child, take the upper level of the normal respiratory rate and add 10.) and supplemental oxygen.

a) Induced hypocarbia via assisted ventilation leads to decreased brain blood volume and decreased ICP.

3) Procedures likely to produce surges of intracranial pressure such as laryngoscopy, intubation, or aggressive suctioning should be employed only when clearly indicated.

a) Administration of 1-2 mg/kg Lidocaine prior to laryngoscopy will decrease ICP response.

4) Shock must be treated with aggressive fluid resuscitation. If cardiovascular status is stable, keep on maintenance IV fluids.

D. Chest

1. Assessment

a. Due to the elasticity of the pediatric chest wall, a significant amount of trauma can occur to the intrathoracic organs in the absence of obvious external chest injury.

b. Visually inspect the chest, both anterior and posterior. Minor deformities, small areas of paradoxical movement, contusions, and abrasions can all be indicative of severe injury.

c. Palpate the entire chest wall.

d. Auscultate breath and heart sounds.

2. Life-threatening injuries to the chest include:

a. Open pneumothorax, flail chest, and pericardial tamponade -- rare in children.

1) Open pneumothorax is treated with vaseline gauze, taped on three sides only and assisted ventilation as needed. Be alert for development of tension pneumothorax.
2) Flail segment is treated with positive pressure ventilation as needed.

b. Tension pneumothorax -- common in children due to mobility of mediastinal structures and shift of the trachea, heart, great vessels and esophagus into hemithorax of the unaffected lung.
1) Poorly tolerated -- consider diagnosis in the face of continued signs of shock despite resuscitative measures.
2) Treatment -- insertion of a 12-16 gauge angiocath / intracath into the second intercostal space at the midclavicular line of the affected hemothorax; supplemental oxygen; assisted ventilation as needed.

c. Large hemothorax -- difficult to diagnose; signs include minimal tracheal deviation, absent breath sounds, and profound shock.
1) Treatment -- supplemental oxygen, assisted ventilation, shock therapy.

E. Abdomen

1. Assessment

a. When abdominal trauma is suspected, the specific diagnosis is not as important as the fact that abdominal injury exists.

b. Most pediatric trauma is blunt trauma and may produce little evidence of severe underlying abdominal injury.

c. Be alert to mechanism of injury -- serious injury should be suspected in all acceleration-deceleration accidents.

d. The abdomen should be thoroughly examined for signs of penetrating trauma, or signs of blunt trauma such as tenderness, bruising, or distention.

2. Field management of abdominal injuries includes treatment of shock, application of sterile saline dressings to eviscerations or penetrating wounds.

F. Extremities

1. Assessment

a. Because bone growth is still occurring in children, skeletal injuries, particularly to long bones, may produce serious disability if not managed properly. Long bone fractures and pelvic fractures may also be associated with blood loss that is proportionately greater in the child than in the adult.

b. Extremities and joints should be palpated and inspected for deformity, tenderness, swelling, bruising, and crepitus.

c. All peripheral pulses should be assessed to rule out vascular injury or compartment syndrome.

2. Field management

a. Dislocated joints and fractures should be splinted in the position found unless they are severely angulated. If pulses are absent, straighten severe angulations to an anatomic position using gentle traction unless resistance is met.

b. A sterile dressing should be applied to open fractures.
c. Consider the use of antishock garments for fractures of lower extremities and/or pelvis.
d. For severe pain control Morphine Sulfate 0.1mg/kg IV/IM under discretion of medical control. Maximum dose 10mg

G. Neurologic Exam
1. Assessment
a. The neurologic exam includes repeated evaluation of the patient's level of consciousness and pupils, as well as evaluation of motor and sensory function.
b. A numerical evaluation such as the Glasgow Coma Scale may be useful in evaluating, documenting and communicating serial exams. The score is derived by summing the scores for best response in three areas: eye opening, verbal response, and motor movement. The Glasgow Scale may be difficult to assign in preverbal infants and toddlers (see appendix).
c. An accurate description of what is seen and heard will allow hospital personnel to assign a coma score based upon the prehospital report form.

H. History: A brief history should be obtained when possible. Obtaining the history should never delay transport. The history should be SAMPLE:
Symptoms, Allergies, Medications, Past illness, Last oral intake, Events preceding injury.

I. Re-evaluate the ABC's.

IV. Burn Injuries
A. Incidence of Burns
1. 1300 children die from burns in the U.S. each year.
2. Burns are the third leading cause of death in childhood.
3. 60,000 pediatric patients with burn injuries are admitted to hospitals each year in the U.S., resulting in significant disabilities.
4. Patients under the age of 15: 70% had hot water, rather than flame injuries, while only 15% of the adult population admitted had injuries due to hot water.

B. Assessment and Field Management of Burns
1. Calculation of total body surface area burned.
a. "Rule of Nines" applies to adults. Because children have relatively large heads and smaller lower extremities than do adults. The "Rule of Nines" must be modified to determine the body surface area burned on a child or infant.
b. For smaller injuries or scattered burns, it is helpful to remember that the palm of the patient's hand = 1% of the body surface area.
c. A detailed assessment of the total body surface area burned is not necessary in the field. Describe anatomically, i.e., 1/2 of L arm, all of back, 3/4 of R leg, etc.
d. Assessment of depth is impossible in the field and is unnecessary. The initial management is the same for any burn that is deeper than first degree.
e. Note circumstances of burns, e.g., chemical, closed space/inhalation injury, home remedies applied.
2. Field management

a. Remove from source of injury, protecting self.
b. Attend to ABC's -- consider C-spine, if other injuries present.
c. Cover patient with clean sheet.
d. Keep patient warm. The patient will lose 70 times more heat through the burn wound than through normal skin. Children have a large surface to volume ratio and are especially vulnerable to heat loss and hypothermia.
e. IV access if:
    1) Burn >15% of body surface .
    2) Long transport time (>30 minutes).
        a) IV may be placed through burned skin; secure with Kerlix if there are no other sites available**.**
f. Elevate burned extremities.
g. Remove jewelry from burned extremity.
h. May cool with clean dressing soaked in tepid water if within 15 minutes of injury and total body surface area involved is < 10%.
i. <u>Do not</u>:
    1) Break blisters.
    2) Apply greasy substances.
    3) Apply ice or cold solutions.

E. Inhalation Injuries
1. Suspect an inhalation injury when:
    a. A flame burn occurs in a closed space.
    b. There are facial burns.
    c. The nasal hairs are singed.
    d. Soot in sputum -- this may indicate significant smoke inhalation.
    e. Oral, nasal or pharyngeal burns.
    f. Presence of stridor.
    g. Child unconscious in smoky area.
2. Direct heat injury to the upper airway may lead rapidly to edema and airway obstruction. Presence of stridor indicates critical airway compromise.
3. The lungs themselves do not sustain heat injury. Lower airway compromise is due to inhalation of toxic products.
4. Carbon monoxide poisoning may be the cause of unconsciousness.
5. Management of inhalation injuries
    a. Elevate head of stretcher.
    b. Secure airway -- upper airway swelling may make endotracheal intubation difficult or impossible. May require smaller than anticipated tube size. Early intubation is preferred, before swelling occurs.
    c. Supply oxygen in high concentration -- high flow, 100% oxygen will speed removal of carbon monoxide from hemoglobin.
    d. Follow burn protocol.
    e. Notify medical control and transport.

F. Electrical Injuries

1. Low voltage -- household current of 110 v or 220 v. Cardiac arrest can occur with household current if low resistance conditions exist due to wet hands and feet, such as in a bathroom. CPR may be necessary.
    a. Remove from source.
    b. ABC's.
    c. Patients with any burns or <u>any</u> history of loss of consciousness should be transported to hospital for evaluation.
    d. Most common electrical burn in children results from toddler chewing on electrical cord, resulting in oral burns.
2. High voltage -- rare in young children; may be seen in older children and adolescents.

V. Near-Drowning
A. Submersion injuries are a leading cause of death in childhood.
1. The majority of incidents occur in swimming pools.
    a. Most submersion injuries in adolescents are associated with the use of alcohol or drugs.
    b. Most submersion injuries in small children are caused by the lack of an effective safety barrier around a pool, and inadequate adult supervision.
B. Definitions
1. Drowning: Submersion accident with death within 24 hours.
2. Near-drowning: Recovery of vital signs following a submersion accident, with survival for at least 24 hours.
3. Secondary drowning: Death due to pulmonary failure, hours to days following the submersion accident.
C. Physiology of Near-Drowning
1. <u>Hypoxemia</u>, metabolic acidosis, and respiratory acidosis represent the common pathway to organ failure and death.
    a. The central nervous system is the organ system most sensitive to these derangements.
    b. Even when the cardiovascular system is successfully resuscitated, neurologic devastation may define the child's ultimate outcome.
2. <u>Hypothermia</u> is a complication of submersion in water of any temperature.
    a. Cold water is relatively protective of the CNS, but only if immersion hypothermia occurs <u>before</u> the compromise of oxygenation.
    b. Severe hypothermia may lead to depression of metabolic function and cardiovascular collapse. Ventricular arrhythmias, and asystole may be seen.
    c. The ultimate outcome of a hypothermic child cannot be determined in the field, regardless of his/her clinical appearance.
3. <u>Pulmonary</u> complications include aspiration, pulmonary edema, atelectasis and pneumothorax.
    a. Aspiration of even small amounts of fresh or salt water leads to marked decrease in pulmonary compliance and hypoxemia.
    b. Vomiting and aspiration of stomach contents may occur during resuscitation and may be avoided by placement of an gastric tube.

D. Assessment of the Near-Drowning Victim
   1. Initial assessment should be directed toward the ABC's and cardiopulmonary resuscitation.
      a. The near-drowning victim's appearance in the field may range from 'normal' to clinically 'dead', depending on the length of submersion, the effects of water temperature, the dive reflex (shunting of blood to the brain and heart), and the degree of CNS and cardiovascular hypoxic injury.
   2. Occult spine or head injuries may be present. C-spine protection should be undertaken in unconscious children, as well as older children who may have been diving.

E. Field Management of the Near-Drowning Victim
   1. Near-drowning is a 'prehospital' disease -- the ultimate outcome of serious immersion accidents is largely dependent on the effectiveness of initial resuscitative efforts.
   2. Outcome is difficult to predict, and resuscitative efforts should never be abandoned in the field.
      a. Airway should be opened and the spine should be immobilized.
      b. Breathing -- good ventilatory support is the treatment of hypoxemia and acidosis.
         1) <u>All patients should receive 100% oxygen</u>.
         2) Bag-valve-mask ventilation, endotracheal intubation, or use of blindly inserted esophageal tracheal/ double lumen airway if patient is >5ft 16 y/o may be required; high inflating pressures may be needed to adequately ventilate -- watch for chest rise.
         3) Consider nasogastric tube if assisted ventilation is necessary -may improve compliance, decreases risk of aspirating stomach contents.
      c. Circulation
         1) If pulse is weak or blood pressure is low, and treat for shock.
         2) In hypothermic patients, time should be taken to ascertain the presence or absence of pulse and respirations. If pulse present, avoid unnecessary manipulation or rough handling and ventilate at 1/2 the normal rate for age. Perform chest compressions for asytole and v-fib only.
         3) Establishment of a peripheral IV may be difficult. Perform intraosseous infusion in the unstable patient where rapid peripheral venous access cannot be achieved.
         4) Apply a cardic monitor.
            a) Supraventricular tachycardia is often seen as a response to hypoxemia -- ensure adequate oxygenation and ventilation.
            b) The pharmacologic therapy of arrhythmias in patients with profound hypothermia (<90 degrees F, 32 degrees C) is not likely to be successful. Poor circulation and hypo-metabolism make the

administration of multiple rounds of drugs potentially dangerous. Although bicarbonate may be given empirically (1 mEq/kg) in the patient with prolonged arrest, the treatment of choice for acidosis in the field is hyperventilation.

5) Hypothermic patients should be dried, covered, and kept in a warm environment during transport.
   a) Do not terminate support in a hypothermic child. Decisions about viability should be made by experts in a hospital setting. Restoration of vital functions may occur with rewarming despite prolonged CPR, although children who remain apneic and asystolic on arrival at the ER are unlikely to recover neurologically.
   b) Consider external rewarming for the patient with T > 88-90 degrees F or 32-34 degrees C during transport. Do not prolong scene time.
   c) IV bags may be wrapped in a heating pad plugged into the invertor on the rig -- warmed fluids may be administered IV, or the bags wrapped in towels and applied to the trunk, scalp, axillae or inguinal regions.
   d) Chemical heat packs may cause burns -- if used, wrap in towels to avoid direct skin contact.
   e) Warm, humidified oxygen delivered via the endotracheal tube is a good route for internal rewarming if a hot pot is available on the rig.
6) Temperatures below 32 degrees C should have treatment centered on maintenance of vital functions and prevention of further heat loss. Attempts at external rewarming in these patients should be kept to a minimum.
7) All near-drowning victims should be transported, with early notification of the receiving hospital. Even patients who look well at the scene and have history of brief submersion times may develop late pulmonary complications.

CRITICAL INCIDENT STRESS DEBRIEFING (CISD)
SUDDEN INFANT DEATH SYNDROME (SIDS), AND

NON-ACCIDENTAL TRAUMA

CRITICAL INCIDENT STRESS DEBRIEFING (CISD), SUDDEN INFANT DEATH SYNDROME (SIDS), AND NON-ACCIDENTAL TRAUMA

OBJECTIVES:

Upon completion of this lesson the provider will:

1. Know the indications for initiating resuscitation of an asystolic infant.

2. Know that a true SIDS victim cannot be resuscitated.

3. Know that support of the parents or caregivers is a critical part of field care of the SIDS victim.

4. Recognize the factors which should raise suspicion of child abuse.

5. Understand the mechanism for reporting child abuse to the appropriate investigative agency.

6. Recognize the signs and symptoms of acute or cumulative stress reactions associated with the care of critically ill children.

7. Be aware of stress management techniques and resources available to the EMS Provider.

CRITICAL INCIDENT STRESS (CIS), SIDS, AND CHILD ABUSE

I. Critical Incident Stress Debriefing (CISD)

A. EMS personnel are routinely exposed to extraordinarily stressful situations. The psychological impact of that acute and chronic stress is increasingly recognized, and critical incident stress is now being addressed by many EMS agencies through a `debriefing' process involving formal CISD teams. Pediatric emergencies, especially those involving trauma, abuse or SIDS, are common sources of critical incident stress for EMT's and paramedics.

1. Stressors cause coping mechanisms to be stretched.
2. Chronic stress or particularly devastating events can overwhelm normal coping strategies and lead to unhealthy or destructive behaviors.
3. Stress reaction may be immediate, delayed, or cumulative.

B. Although each individual crew member may react differently to stressful events, common patterns of stress reaction can be identified.

1. Acute - Critical Incident Stress (CIS)
   a. Definition: Stress experienced due to an event which overwhelms the individual's normal coping mechanisms, rendering the person ineffectual.
   b. The degree and duration of impairment is dependent on the individual, the event, and the availability of support resources.
      1. Factors which contribute to the stress reaction include: the suddenness or intensity of the event; age of victim; number of victims; duration of field resuscitation; age and experience of rescuer; identification with the victim; adequacy of manpower, equipment and training to handle situation.
2. Post Traumatic Stress Disorder (PTSD)
   a. PTSD is a chronic stress reaction following one or more horrible events. It may reflect cumulative stress.
   b. PTSD is characterized by:
      1. Fear of repetition.
      2. Uncontrollable intrusive images such as nightmares and flashbacks.
      3. Psychic numbing, sublimating emotions.
      4. Withdrawing from personal relationships.
      5. Hypervigilance - being easily startled, jumpy.
      6. Physical, behavioral and emotional disorders which did not exist before the stress.
      7. Suicidal thoughts.

C. Pediatric Critical Incidents

1. Certain situations involving pediatric patients predictably induce significant stress reactions in EMS personnel:
   a. Any sudden event that results in death of a child.
   b. Death of a child during a prolonged rescue effort.

c. Child abuse.
d. Trauma involving mutilation.
e. Emergencies with intense media coverage.
f. Identification with the victim.

D. Reactions to Critical Incident Stress
1. Acute physical reactions include fatigue, nausea, tremors, poor coordination, profuse sweating, chills, dizziness, and shock symptoms.
2. Acute cognitive reactions include memory loss, inability to remember names of equipment, etc., decision-making difficulties, trouble establishing major priorities, problem solving difficulties, concentration lapses, inability to remember information, difficulty with simple calculations, e.g., drug dosages, drip rates.
3. Acute emotional symptoms include high anxiety, overwhelming fear, hopelessness, grief, anger, irritability, depression.
4. Eighty-five percent of workers experiencing a critical incident exhibit symptoms within the first 24 hours following the event. Fifty percent of those have symptoms lasting 3 weeks or longer. Not dealing with critical incident stress can lead to Post Traumatic Stress Disorder.

E. Critical Incident Stress Debriefing (CISD)
1. CISD is the support of choice following a critical incident.
a. CISD is crisis intervention, it is **not** psychotherapy, or counciling.
b. It is designed for normal people who have normal reactions to highly abnormal events.
c. CISD assumes that victims of psychological trauma are capable of recovering quickly with proper short term support.
2. Goals of CISD:
a. To return the emergency worker to normal functional abilities ASAP.
b. To maintain utmost confidentiality.
c. To educate and equip the worker with coping tools and strategies.
d. To identify those in need of further support.
3. Mechanism of CISD
a. A debriefing is held 24-72 hours post-event led by a team consisting of 1 or 2 mental health professionals and 1 or 2 peers with crisis intervention training. Peer participation provides a legitimacy to the process, and allows the victims of psychological trauma to identify their reactions as normal.
b. Only those crew members involved are encouraged to attend, but are not required to participate actively.
c. Following the discussion by involved crews, a wrap-up segment provides an educational framework to help them understand what has happened and the fact that they are not unique or abnormal. Coping strategies are discussed.

d. Follow-up sessions are occasionally needed, and are held at the discretion of the crews and CIDS teams.

F. Coping Strategies During the Emergency
1. Prevent psychological trauma to incoming crews - inform them of mutilation, etc.
2. Maintain a high level of pretraining and skill proficiency - preparation breeds confidence and reduces stress.
3. Be aware of those experiencing stress reactions and remove them from scene - don't leave them alone.
4. Don't be overly idealistic - accept limitations.
5. Learn deep breathing exercises to dispel stress.

G. Summary
1. After the emergency, defuse as early as possible and contact the CISD Team as early as possible to mobilize their resources.
2. Have informal crew meetings for ventilation.
3. Identify personnel in need of immediate support and refer to a CISD team. Hold debriefings within 24-72 hours.
4. Physical exercise soon after the event is an effective stress reducer as is regular exercise in reducing chronic stress.
5. Eat right. Sugar and caffeine cause pronounced highs and lows, exacerbating stress.
6. It's okay to cry - release emotion.
7. Spouse nights hosted by a mental health professional may help families understand stress reactions and the impact on marriages.

H. <u>CIS Resources</u>
1. For information on the closest CISM unit call 1-800-CISD-966

II. Sudden Infant Death Syndrome (SIDS)

A. Etiology/Epidemiology
1. Sudden Infant Death Syndrome (SIDS) is the sudden unexpected death of an infant in whom a thorough post-mortem examination (autopsy) fails to demonstrate an adequate cause for death
2. SIDS is the leading cause of death in infants between 1 week and 1 year of age
a. Occurs in 2.4/1,000 live births, accounting for 261 deaths in Illinois in 1994.
3. Peak incidence from 2 to 4 months
a. 90% of deaths occur in the first 6 months of life
b. Rare in first few weeks of life
4. Risk factors:
a. SIDS shares a number of non-specific risk factors with other causes of infant death: male sex; Blacks, Native Americans; low socioeconomic status; prematurity; multiple birth; teenage pregnancy; maternal drug/ cigarette use during pregnancy.

b. Half the infants will have history of a cold in the week preceding death

5. Cause of SIDS is unknown - SIDS cannot be predicted or prevented.

B. Field Assessment

1. Because SIDS usually occurs during sleep, several hours may pass before the death of the infant is discovered. Post-mortem changes which may be seen include:
   a. Frothy, blood-tinged mucous around the baby's mouth or nostrils or on the baby's clothes or blankets.
   b. Livor mortis, or pooling of the blood (skin looks blotchy, with bruise-like marks on underside of body).
   c. Rigor mortis, or stiffening of the body.
   d. Evidence that the baby was very active during the death process - rumpled bed clothes, unusual position or location in the bed. Activity is caused by muscular contractions of the body during death.
   e. Disfiguration of the face and "squashed nose" appearance, when infant has died on his or her stomach.
2. Normal post-mortem changes may make the SIDS victim look like a battered child - avoid judgmental comments or accusations.

SIDS vs. Child Abuse and Neglect

SIDS Victim	Abused/Neglected Child
Exhibits no external signs of injury	Visible signs of injury- broken bones, welts, bruises, burns,etc.
`Normal' post-mortem changes - Pooling can appear like bruising, or bruising like pooling	May appear malnourished
Other siblings appear healthy	Siblings may show evidence of abuse/neglect, often there is only one child who is the victim.
History of child being well when put to sleep	Caretaker's story does not `sound right' or doesn't account for all injuries

3. Obtain a brief history:
   a. Age of the baby

b. Recent or chronic illnesses
c. Medications
d. Unusual behavior
e. Circumstances of event

Avoid questions or comments that could be interpreted as judgmental or critical of parenting skills

4. Assess the environment - information may be helpful in supporting or refuting SIDS diagnosis
   a. Note position of infant in crib
   b. Note condition and characteristics of crib
   c. Note presence of unusual or dangerous objects, e.g., sharp objects, plastic bags
   d. Note presence of medications and transport bottles with child

C. Field Management
1. The goals of a first responder on a SIDS call are:
   a. To provide any indicated emergency treatment to the infant
   b, To provide supportive care to the family until further help can be mobilized
2. CPR should be initiated on any infant who is not obviously dead, i.e., does not have livor or rigor mortis
3. Management of the infant who is obviously dead (livor or rigor mortis) depends on agency policy and parental reaction
   a. Initiation of life support measures may be inappropriate when both the Provider and the family recognize that the infant is dead
   b. When the family does not acknowledge the infant's death, performance of CPR may make them feel that everything possible was done to save their child
4. <u>A SIDS victim cannot be resuscitated</u> - failure to restore cardiopulmonary function is not due to an inadequate resuscitative effort
5. Management of the family of a SIDS victim
   a. Shock, denial, and disbelief are common grief reactions parents experience immediately following the death of an infant. With SIDS, these grief reactions are compounded by the suddenness of death and the absence of a definitive cause of death
   b. The EMT/paramedic should attempt to provide all involved individuals the support necessary to cope with the initial impact of the SIDS crisis
      1. On arrival at the scene, ask the name of the child and use it - using the child's name lets the family know that you recognize the infant as an individual person
      2. Assume a calm, authoritative manner - having someone `in charge' is reassuring to the family
      3. Provide structured information - briefly explain resuscitative effort; give information on destination of

transport; emphasize that parents could not have prevented baby's death

4. Allow time for information to be absorbed, and repeat information several times
5. Review the crisis event - allowing the parent to explain in his/her own words helps them to clarify the event
6. Acknowledge the parent's feelings and the fact that their grief reaction is normal - do not be judgmental about the way family members react, or take personally any expressions of anger
7. Surviving children may be confused, anxious and fearful. Assist parents in explaining what has happened in language that the child can understand
8. Provide guidance by helping family make decisions
9. Provide evidence of expert care - allowing parents to witness your assessment and resuscitation may reassure them that everything possible was done

6. Transport should be undertaken unless agency policy specifically prohibits it. If CPR is not initiated, consider allowing parents to accompany baby in rig. If parents do not accompany baby in transport, encourage and assist them in identifying a third party to drive them to the emergency room and provide them with name of hospital <u>in writing</u>.
7. Complete the Iowa Infant Death Scene Protocol and submit to the medical examiner.
8. Crisis intervention for the EMS Provider
   a. SIDS carries tremendous emotional impact for every health care practictioner. Those with young children may identify with the family's plight. Some may have difficulty being realistic about their role in a SIDS crisis and the goals of their intervention
   b. Prepare for the emotional impact of a SIDS call by:
      1. Training - understanding the medical and social aspects of SIDS; working through a SIDS scenario with role playing
      2. Sharing - own fears about future loss; past losses; successful coping strategies used in past
      3. Understanding that care of the family is the area where you can make an important impact, and that the infant cannot be resuscitated regardless of your efforts
      4. Knowing your own coping limits
   c. After a SIDS call, activate your Critical Incident Stress Debriefing (CISD) team. If formal CISD is not available to you, it is still important to `debrief.'

III. Child Abuse
   A. Etiology/Epidemiology

1. There are four types of abuse categorized into physical, sexual, emotional, and neglect. More than one type may be used on a child.
2. Estimated annual incidence of 1 million cases in the United States, including 4,000 fatalities.
3. 10% of trauma patients under age 3 seen in emergency rooms are thought to be victims of child abuse
4. Factors contributing to abuse
    a. Stress - economic problems, unemployment, illness, crowding
    b. Psychological factors - poor impulse control, depression, drug/alcohol abuse
    c. Poor parenting skills - unrealistic expectations of child, poor role models, unsupportive spouse
    d. Social isolation
    e. Nonbiological `parent' in home
    f. `Problem' child - premature birth, handicap, developmental delay
5. Long-term consequences for the abuse victim may be severe - complications due to CNS injury, serious social pathology, substance abuse, depression, abusive behavior toward his/her own children
6. Reporting of abuse
    a. All states have legislation requiring that suspected abuse be reported to the Department of Children and Family Services (DCFS) by a wide variety of professionals. Health care providers are included in the list and suspicion of abuse should always be reported to medical personnel at the receiving hospital.
    b. All providers are legally obliged to report suspected cases of abuse.
    c. There is <u>no</u> legal liability for reporting a suspicious case which turns out <u>not</u> to be abuse. Failure to report is a simple misdemeanor (Code of Iowa 232.75).
    d. Without intervention, an abused child returned to the home environment has >50% probability of repeat injury, 35% likelihood of severe permanent handicap, and 5% chance of fatal injury

B. Field Assessment
1. Priorities in the assessment of an abused child are the same as those in any trauma victim
2. The prehospital provider is in a unique position to evaluate the possibility of abuse. Observations on the physical environment, parent-child attitudes and interactions, and initial history obtained at the scene will be of great value to the ER staff. Features suggestive of abuse include:
    a. History
        1. History which is vague, inconsistent, or differs between family members
        2. History which does not fit the observed injuries or developmental capabilities of the child, e.g., a two-foot fall off of a bed onto a carpeted floor is not likely to result in

severe closed head injury; a six month old infant cannot turn on the hot water in the bath and scald himself

3. Delay in seeking medical care

b. Parent-child interaction
   1. Parent who is hostile or distant from both child and provider.
   2. Child who is withdrawn, passive, depressed.

c. Physical Findings
   1. Multiple fractures, without an adequate mechanism to explain
   2. Multiple bruises
      a. Bruises due to accidental trauma are most commonly found on the extremities and forehead
      b. Bruises present centrally - over `soft' areas like the chest, abdomen, buttocks, thighs, or face are suggestive of abuse
      c. Bruises of multiple ages, especially in central locations, are suggestive of abuse

Estimation of the Age of a Cutaneous Bruise at Different Stages of Healing

COLOR	AGE
Swollen, tender	0-2 days
Red, Purple, Blue	0-5 days
Green	5-7 days
Yellow	7-10 days
Brown	10-14 days (or longer)
Cleared	2-4 weeks

   3. Skin injuries which clearly reflect the method or object used to inflict the trauma:
      a. Bite marks.
      b. Loop-shaped marks due to beating with electrical cord.
      c. Rope burns in circumferential pattern around neck, wrists or ankles.
      d. Hand print on face, linear marks sometimes with pattern of fingers or implement used.
      e. Grip marks from shaking.
      f. Linear-shaped marks due to beating with belt.
   4. Burns
      a. Cigarette burns

b. Scald burns in `stocking-glove' distribution, suggesting immersion in hot liquid.
c. Burner pattern may suggest forcible contact with stove or heat grate.

5. Trauma to the genital area

C. Field Management of the child with suspected abuse

1. Resuscitation and stabilization should proceed according to usual trauma priorities. The primary duty of the EMS provider is to render appropriate medical stabilization and safe transport of the child to the receiving facility.
   a. Hostility, accusations or attempts to interview the child in private may lead the parents to refuse transport. Police may need to be involved in the event that transport is refused, with a medic staying with the child pending their arrival.
   b. `Detective work' should be left to DCFS and/or the police, whose job it is to prove that abuse occurred.
   c. Victims of alleged sexual abuse should be subject to limited examination in the field. They should be transported without removal or change of clothing, as garments will be collected and examined as evidence by the police.
2. Transport should be undertaken expeditiously, and ER personnel notified in private of observations and suspicion of abuse. An accurate written record of the call is essential, as it may be used in court.
3. As with SIDS, caring for victims of child abuse causes significant psychological stress for prehospital providers. Critical incident stress debriefing is an important mechanism for coping effectively with these calls.

NEWBORN RESUSCITATION

NEWBORN RESUSCITATION

OBJECTIVES:

The course participants should achieve the following objectives from this lesson:

1. Know the equipment and drugs required for neonatal resuscitation.

2. Know the sequence and priorities for neonatal resuscitation.

3. Know how to manage the infant who has passed meconium in utero.

4. Know that oxygenation and ventilation are the keys to a successful newborn resuscitation.

5. Recognize the importance of heat conservation in resuscitating infants.

Newborn Resuscitation

I. The optimum environment for the delivery of a newborn infant is in a well prepared delivery room. Immediate transport of a laboring mother to such a facility is a high priority for the EMT/Paramedic. Unfortunately, control over this event is not always possible and field delivery is sometimes unavoidable.

II. Advanced preparation is vitally important for a safe prehospital delivery and resuscitation of the newborn. The equipment necessary should be self-contained in a newborn resuscitation kit. This kit should be kept separately from adult resuscitation equipment as there will be little overlap in its use.

Neonatal Resuscitation Equipment

A. Items for the Newborn Resuscitation Tray.
   1. Bulb syringe.
   2. Suction catheters (8 and 10 Fr).
   3. Cord clamps.
   4. Scissors.
   5. Gloves.
   6. Syringes (5, 10, and 20 ml).
   7. Towels.

B. Items that should be readily accessible.
   1. Suction with manometer.
   2. Infant or child resuscitation bag (500 - 750cc).
   3. Facemasks (newborn and premature).
   4. Feeding tube (5 and 8 Fr).
   5. Medications:
      a. Oxygen.
      b. Epinephrine 1:10,000.
      c. Glucose.
   6. Blankets**.**

C. Intubation Tray.
   1. Laryngoscope.
   2. Laryngoscope blades (straight 0 and 1).
   3. Stylet.
   4. Endotracheal tubes (2.5, 3.0 and 3.5 mm ID).
   5. Suction catheters (5, 6 and 8 French to be used with the above ET tubes, respectively).
   6. Tape.

III. The Delivery of the Infant - Field delivery will be unavoidable if the mother cannot stop herself from pushing, or if the head is visible at the vaginal opening.

A. History
   1. Is the baby full term?
      a. A premature baby may need a vigorous resuscitation.

2. Is this a multiple birth?
    a. There may be two babies to resuscitate, and a back-up unit may need to be called.
3. Is there meconium?
    a. Meticulous airway management will be needed.
4. Drug use, specifically narcotics?
    a. There is significant respiratory depression if narcotics are used within 4 hours of delivery.

B. Support for mother - The laboring mother should be supported in order to maximize fetal gas exchange.
1. Administered oxygen by mask or nasal cannula.
2. Follow mother's blood pressure carefully and keep medical control informed.
3. Mother should be positioned on her side when possible to avoid compression of the inferior vena cava by the gravid uterus which results in decreased venous return.

C. Ambulance temperature should be increased and appropriate warming devices at hand in advance of delivery.

D. One partner delivers infant in controlled fashion: Once the head has been delivered, the mother should be instructed to pant, to prevent delivery of the shoulders. The oropharynx and nostrils should be suctioned with bulb syringe prior to delivery of the shoulders.

E. Complete the delivery.

F. Keeping the child at the level of the perineum, double clamp the umbilical cord without stripping the blood using cord clamps, hemostats, umbilical tape or suture. Cut the umbilical cord with sterile scissors or blade.

G. The infant is then handed to the second partner, so the first partner can attend to the needs of the mother.

H. Delivery of the placenta will occur spontaneously within 20 minutes of the delivery of the infant.
1. Do not wait for delivery of the placenta to begin transport.
2. Bring the placenta to the hospital for verification that the entire placenta was delivered.

IV. Assessment and Management of the Newborn.

A. Environment
1. All newborns have difficulty tolerating a cold environment. Hypothermia is a serious problem for infants born outside the hospital and special effort must be made to prevent heat loss.
    a. The body and head should be thoroughly dried of amniotic fluid and the infant wrapped in warm towels or blankets.
    b. Chemical heat packs may burn the infant if applied directly to the skin and should be wrapped in a towel, if used.
    c. The vigorous infant may be placed naked against the body of the mother, with covers over both.

B. Positioning

1. To assess or resuscitate, the newborn should be placed on his/her back in neutral or sniffing position.
2. The large occiput of a newborn will naturally cause hyperflexion of the neck. A small roll under the infants shoulders is helpful in maintaining neutral head position.

C. Suctioning
1. To assure an open airway, suction the mouth, then the nose, with a bulb syringe
2. Avoid deep suctioning as it may produce a vagal response with bradycardia.

D. Tactile Stimulation
1. Drying and suctioning produce enough stimulation to induce effective respirations in most infants.
2. Slapping/flicking soles of the feet or rubbing the infant's back will also stimulate the baby to breathe.
3. If the infant fails to establish spontaneous and effective respirations following a brief period of stimulation, positive pressure ventilation is required.

E. Color
1. An infant may occasionally be cyanotic despite adequate ventilations and a heart rate >100. If central cyanosis is present in an infant with spontaneous respirations and an adequate heart rate, blow-by oxygen should be given.
2. Oxygen is not required in infants with cyanosis of hands and feet only.
3. If the child is pale, assess for bradycardia. If the heart rate is acceptable (>100 beats/min), give blow-by oxygen and consider volume resuscitation.

V. Resuscitation of the Newborn

A. Birth results in radical changes in pulmonary and cardiovascular physiology. When a newborn fails to respond rapidly to positioning, suctioning, and stimulation with adequate respiratory effort and heart rate, further resuscitative measures are needed. The goal of resuscitation is to facilitate the initiation of normal cardiopulmonary function.

B. Airway and Breathing
1. Spontaneous breathing should begin after < 15 seconds of stimulation
a. 100% blowby oxygen should be provided if the baby does not pink up.
b. If the respiratory effort is shallow, slow, or absent, positive pressure ventilation should be initiated <u>immediately</u>. Continued tactile stimulation of an apneic infant delays the onset of needed oxygenation and ventilation.
2. Assisted ventilation.
a. Indications for positive pressure ventilation:
(1) Apnea.
(2) Heart rate < 100 beats/minute.
(3) Persistent central cyanosis after delivery of 100% blow-by O_2.

b. The majority of infants requiring positive pressure ventilation will do well with bag and mask ventilation.
   (1) Assessment of proper ventilations is achieved by observing chest expansion.
   (2) Normal newborn respiratory rate is between 30 and 60.
   (3) Bradycardia should respond to adequate oxygenation and ventilation. Heart rate must be monitored.
   (4) If chest expansion is not adequate: reposition the child; check mask seal; open the mouth of the infant; attempt ventilation; reassess. If unsuccessful, suction and reattempt ventilation.
   (5) If chest expansion is still not adequate or bradycardia is not rapidly improving, intubation is indicated.
   (6) If bag and mask ventilation continues for greater than 2 minutes gastric distention will occur, necessitating the placement of a nasogastric or orogastric tube.

c. Indications for endotracheal intubation:
   (1) Bag-mask ventilation is ineffective, i.e., inadequate chest expansion, continued bradycardia, or central cyanosis.
   (2) Tracheal suctioning is required, especially for thick meconium.
   (3) Prolonged positive-pressure ventilation is necessary.

C. Circulation

1. Normal newborn heart rate is 120-160 beats/minute. Newborns cannot increase their stroke volume and are dependent on <u>rate</u> for adequate cardiac output. The adequacy of the heart rate will determine the next steps in the resuscitation sequence. Heart rate can be evaluated by:
   a. Listening to the apical beat with a stethoscope.
   b. Feeling the pulse by lightly grasping the base of the umbilical cord - pulsations will be palpable for approximately 15 minutes after clamping and cutting the cord.
   c. Feeling the brachial or femoral pulse.
2. Placing cardiac monitor leads should not delay resuscitation.
   a. Leads won't stick.
3. If the heart rate is > 100, the assessment can continue.
4. If the heart rate is < 100, positive pressure ventilation should be started immediately.
   a. If the heart rate rises, continue to hand ventilate until the infant breathes spontaneously.
   b. If the heart rate does not increase, reassess the effectiveness of artificial ventilations, i.e., check the mask seal and observe for adequate chest rise.
   c. If the heart rate still does not rise:
      (1) Reposition
      (2) Confirm seal of mask
      (3) Check O_2 source to affirm 100% is being delivered
      (4) Ventilate with infants mouth partially open

(5) Assess adequacy of chest expansion (popoff valve may need to be overridden

d. If the heart rate is 60-80 beats/min and not rapidly increasing despite adequate ventilation with 100% O_2 for 30 seconds, begin chest compressions.

e. If the heart rate is < 60, chest compressions must be performed immediately. The compression to ventilation ratio is 3:1 or 90:30 or 120 compressions per minute.

D. If the newborn does not respond to early resuscitative measures, contact of Medical control is imperative for further guidance.

VI. Medications and Fluids

A. Cardiac dysfunction and shock in the neonate are usually the end result of profound hypoxia.

1. Oxygenation, ventilation and heat maintenance are the only interventions needed to resuscitate the vast majority of newborns.
2. Medications are rarely indicated in the field, and should be administered only if the heart rate remains < 80 beats/minute despite adequate ventilation with 100% oxygen and chest compressions.

B. Epinephrine

1. May be indicated in the neonate with persistent bradycardia despite adequate ventilation with 100% oxygen and CPR.
2. Dose: 0.01-0.03 mg/kg (0.1-0.3 cc/kg of 1:10,000 solution).
3. Preferred route is a vascular site. May be given ET if a line is not available at this time.
   a. If given per ET tube, administer 0.03 mg/kg diluted to total volume of 1cc with normal saline and bag into lungs.

E. Fluid Resuscitation

1. Rarely needed in newborn resuscitation.
   a. Exception is overt hemorrhage from fetal-placental unit as in placental abruption.
2. IV placement is difficult in newborns and should only be attempted in the field if glucose or volume resuscitation are urgently needed.
3. If volume is needed, 10 cc/kg of NS or LR should be administered IV/IO during transport, and clinical status re-evaluated.

F. Glucose

1. Hypoglycemia is generally is not present immediately after delivery but may develop within the first hour.
2. Infants at high risk for hypoglycemia include:
   a. Premature infants.
   b. Small for gestational age, chronically-stressed babies.
   c. Infants of diabetic mothers.
   d. Infants who have undergone prolonged or stressful labor and delivery or extensive resuscitation.
   e. Infants with respiratory distress.
   f. Hypothermic infants.

3. Symptoms of hypoglycemia.
   a. Hypoglycemia may mimic hypoxemia.

b. Symptoms may include jitteriness, lethargy, floppiness, poor perfusion, respiratory distress and apnea, seizures.
c. Some hypoglycemic infants will have no symptoms whatsoever.

4. Severe or prolonged hypoglycemia may result in serious CNS injury or death .
5. Chemstrip determination should be considered 20-30 minutes after delivery if transport is still underway.
6. Therapy of hypoglycemia (Chemstrip <30 mg%)
   a. D5W may be given by bottle to an otherwise healthy infant who is fully conscious and without respiratory distress.
   b. The infant should be given D12.5W, 2-4cc/kg IV push
   c. Repeat chemstrip 10 to 20 minutes after therapy and treat as necessary.

G. Apgar Score

1. The Apgar scoring system is widely used as an indicator of the need for resuscitation at birth. Five objective signs are evaluated, and the total score is noted at 1 minute and at 5 minutes after the complete birth of the infant.
2. The need for resuscitation can be more rapidly assessed by evaluating the heart rate, respiratory activity, and color.
3. Resuscitation should be started immediately as indicated by inadequate respirations and/or heart rate and should not be delayed in order to obtain the one minute APGAR score. APGAR values can be assigned in retrospect.

APGAR SCORING SYSTEM

Category	0	1	2
Respiration	Absent	Slow, irregular	Strong regular
Pulse	Absent	< 100	> 100
Appearance (color)	Blue, white	Acrocyanosis	Pink
Grimace (responsiveness)	None	Mild-moderate	Vigorous crying
Activity (tone)	Flaccid	Some flexion of extremities	Active movement

VII. Perinatal Emergencies

A. Prolapsed umbilical cord.

1. May occur when rupture of membranes and release of the amniotic fluid cause the umbilical cord to be washed down into the birth canal where it is trapped and compressed by the infants head.
2. Prolapse of the cord will result in asphyxiation and death of the infant unless cord compression is relieved.
3. Prolapse is diagnosed when a loop of umbilical cord is seen in the birth canal.
4. Field Treatment.
    a. Mother in a knee-chest position.
    b. Push the infant's head back up to relieve the pressure on the umbilical cord.
    c. Rapid transport to facility equipped for emergency cesarean section. Early notification of the receiving facility is imperative.

B. Abruptio placenta.
1. Placental abruption involves premature separation of the placenta from the uterine wall resulting in maternal and fetal hemorrhage and loss of the infant's oxygen supply. Severe asphyxiation will occur if the baby is not delivered immediately.
    a. Abruption is becoming more common with the increased prevalence of maternal cocaine abuse.
2. Symptoms of abruptio placenta include severe abdominal pain, abdominal rigidity and shock. Vaginal bleeding may or may not be present. Abruptio can be very difficult to diagnose.
3. Field therapy is confined to treatment of maternal shock with vascular access, aggressive fluid resuscitation, administration of 100% O2 and rapid transport to a facility with an OB service.

C. Meconium Aspiration.
1. Meconium aspiration may lead to respiratory distress, chemical pneumonia, pulmonary hypertension and pneumothorax. It is a major cause of neonatal morbidity and death.
2. There is some controversy as to whether meconium aspiration occurs pre- or post-natally. Until that controversy is resolved, aggressive measures should be taken to avoid meconium aspiration at the time of delivery.
    a. As the infant's head is delivered, observe the amniotic fluid for the presence of particulate meconium.
        (1) Meconium is the infant's first green-black thick stool, which may be passed before birth by a stressed newborn. If the fluid is lightly stained or there is thin meconium, don't worry. Do worry if there are thick globs of meconium, called particulate meconium.
        (2) If particulate meconium is present, suction the oropharynx and the nasopharynx thoroughly before delivery of the shoulders. The hypopharynx must be thoroughly cleared of meconium.
        (3) Complete the delivery. Keeping the child at the level of the perineum, double clamp then cut the cord without delay.
        (4) If the infant is crying and ventilating well, give blow-by O_2.
        (5) If the infant is depressed (not breathing), intubate and suction prior to further stimulation.
    b. Once the airway is cleared, the infant is stimulated to breathe.

(1) Administer blow-by O_2 if the infant is breathing spontaneously.

(2) If the infant does not quickly establish spontaneous respirations, positive pressure ventilation with 100% O_2 via bag-valve-mask @ 400ml.

c. Dry the infant thoroughly, taking precautions to avoid heat loss

d. Transport rapidly to the hospital best equipped to handle a neonatal emergency, notifying the receiving facility in advance of your arrival.

VIII. Transport

A. Frequent reassessment of the infant's facial color, heart rate, respiratory effort and pattern should be performed during transport.

B. Hypothermia is a serious risk to all infants, especially those who have undergone prolonged resuscitation. Wrap the baby in a warm dry blanket and cover the scalp with stockinette. Turn up ambulance temperature if this has not already been done in anticipation of delivery. Do not expose baby unless necessary for ongoing resuscitation.

C. Consider Chemstrip determination after 20-30 minutes, or sooner if labor and delivery were prolonged or stressful or the infant is jittery or depressed.

D. Detailed assessment is best conducted during transport, avoiding unnecessary exposure of the infant and consequent heat loss.

E. Transport should be undertaken expeditiously, taking the infant to a hospital with a delivery service so that appropriate equipment and personnel skilled in newborn care will be available. Advance notification of receiving facility is mandatory.

IX. Summary

A. The vast majority of deliveries are normal.

B. Infants respond favorably to basic, simple interventions:

1. Positioning
2. Suctioning
3. Stimulation
4. Oxygen
5. Warming/drying

C. Keep the baby warm and transport to an emergency room designated to accept out of hospital deliveries.

COMMON PEDIATRIC MEDICAL EMERGENCIES

COMMON PEDIATRIC MEDICAL EMERGENCIES

OBJECTIVES

Upon completion of this lesson the Provider will:

1. Identify the most common causes of seizures in children.
2. Know that simple febrile seizures require only supportive therapy.
3. Know the indications for anticonvulsant therapy in the field and complications of their use.
4. List five causes of coma in children.
5. List the indications and contraindications to Ipecac use in the prehospital setting.
6. List four signs/symptoms of life-threatening infection.
7. Describe the treatment of shock in the septic child.
8. List five clinical signs of dehydration in pediatric patients.
9. Know the dose of dextrose for treatment of hypoglycemia.

COMMON PEDIATRIC MEDICAL EMERGENCIES

I. Seizures

A. Etiology/Epidemiology

1. Definition: Abnormal electrical activity in the brain which may result in involuntary motor movement and/or in a period of altered level of consciousness, visual or auditory hallucinations, or altered behavior
2. Status epilepticus is defined as a prolonged seizure, or two or more seizures without intervening return of consciousness
    a. Status may be associated with serious brain damage or death if patient is not oxygenated.
3. 5-10% of all children will have one or more seizures before the age of sixteen
    a. Most common during first two years of life
4. Causes of seizures in childhood
    a. Simple Febrile Seizures
        1. Most common cause of seizures in childhood - occur in 2-5% of otherwise normal children
        2. Features of simple febrile seizures
            a. Occur between ages of 6 months and 6 years
            b. Onset during first 24 hours of acute febrile illness - usually respiratory or ear infection
            c. Seizure lasts <15 minutes - most will last < 5 minutes and will have resolved prior to arrival of EMT
            d. Generalized tonic-clonic activity - no focality
            e. <u>No underlying CNS abnormality</u>, e.g., meningitis, epilepsy, mental retardation
            f. One third of children will have repeat seizure with fever during same or subsequent illness
        3. Simple febrile seizures are <u>not</u> associated with increased risk of epilepsy, brain damage, learning problems. Generally, they are not treated with maintenance anticonvulsant drugs.
    b. CNS infections: meningitis, encephalitis, brain abscess
        1. 13 % of children with meningitis will present with seizures - <u>every child with seizures and fever requires physician evaluation</u>
    c. Trauma: brain contusion, intracranial hemorrhage
        1. Child abuse and shaking injury must be considered in afebrile infant with no prior seizure history
    d. Hypoxic/ischemic brain insult
        1. Birth asphyxia is common cause of neonatal seizures
    e. Metobolic
        1. Hypoglycemia
            a. Seen in ill young infants, older diabetic children with insulin overdose
        2. Electrolyte abnormalities, e.g., low sodium, low calcium
    f. Drugs or toxins, e.g., tricyclic anti-depressants, theophylline, lead

g. Idiopathic epilepsy - recurrent seizures of unknown cause
h. Brain tumor, stroke - rare

B. Field Assessment
1. Initial assessment
a. Consider C-spine injury with post-traumatic seizure
b. Loss of oropharyngeal muscle control may lead to upper airway obstruction - treat with chin lift/jaw thrust
c. High risk for vomiting, aspiration - have suction available
d. Respiratory abnormalities common, including hypoventilation and apnea
1. Administer 100% oxygen to <u>every</u> seizing patient
2. Assisted ventilation may be indicated
a. BVM ventilation may be difficult during seizure due to chest wall rigidity, inability to maintain patent airway
1. Monitor chest rise, color
2. Intubation and/or seizure control with anticonvulsant drugs may be necessary for adequate ventilation
e. Tachycardia and hypertension common during seizure
1. Bradycardia and poor perfusion reflect hypoxemia and acidosis - treat with oxygenation, ventilation, seizure control
f. Chemstrip should be checked on any actively seizing child without prior history of epilepsy
1. Treat for serum glucose <40-60 mg% with 2- 4 cc/kg D25W IV except for neonates.
2. Clinical manifestation of seizure activity
a. Usually unconscious and unarousable
b. Motor findings may consist of generalized or unilateral jerking of extremities, facial twitching, lip smacking, deviation of the eyes. Some seizure disorders will have no associated motor abnormalities.
c. May be subtle in infants - blinking, repetitive sucking movements, "bicycling" movements of the lower extremities, frequent Moro (startle) responses, apneic or cyanotic spells
3. Detailed Assessment
a. Status epilepticus is a true medical emergency and scene time should not be prolonged for extensive history or physical exam
b. Relevant history includes:
1. Has child had fever?
2. Prior seizure with fever?
3. Stiff neck or crying with handling? (suggests meningitis)
4. Known epileptic? Usual medications? Missed doses?
5. Recent head trauma?
6. Possible ingestion? List all meds in house.
7. Is child diabetic? On insulin? (possible hypoglycemia)
c. Physical exam clues to seizure etiology:

1. Bulging fontanel, stiff neck, purpuric rash - suggestive of meningitis
2. Scalp hematomas or lacerations, Battle sign or raccoon's eyes - suggestive of head trauma
3. Focal seizure activity, tonic eye deviation, or weakness or paralysis of an extremity in post-ictal period - may suggest presence and location of intracranial mass

C. Field Management
1. Support ABC's as above
2. Anticonvulsant Therapy
   a. Consider drug therapy for patients in status epilepticus, those with cyanosis or cardiovascular instability secondary to prolonged seizure activity. Most seizures are self-limited and require no treatment other than support of the ABC's.
   b. Valium (diazepam)
      1. Dose: 0.1 mg/kg IV slow push (no faster than 1 mg/minute). Maximum 2.5 mg in child <5 years, 5 mg in older child. May repeat every 10 minutes x3 doses. Give only enough to stop seizure.
         a. Onset is rapid, but duration of action is short. Long acting anticonvulsant must be given if transport time exceeds 10-15 minutes even if Valium successfully stopped seizure.
         b. Valium may produce serious respiratory depression and hypotension. Continuous cardiorespiratory monitoring is imperative, as well as advance preparation for assisted ventilation. Use of phenobarbital as second anticonvulsant markedly increases risk of respiratory arrest.
         c. Valium is extremely irritating to veins and should never be given in a questionable IV.
   c. Ativan (lorazepam)
      1. Dose: Neonates - 0.05 mg/kg over 2-5 minutes may repeat in 10-15 minutes. Dilute with equal volume of NS Infants/children - 0.1 mg/kg slow IV push over 2-5 minutes, do not exceed 4mg per single dose; may repeat second dose of 0.05mg/kg slow IV push in 10-15 minutes . Dilute with equal volume of NS. Adolescents - 0.07 mg/kg slow IV push over 2-5 minutes maximum 4mg per single dose; may repeat in 10-15 minutes. Dilute with equal volume of NS.
         a. onset is 5 minutes with the peak level at 45 - 60 minutes.
         b. adverse reactions may be bradycardia, hypotention and respiratory depression.

   d. Phenobarbital

1. Dose: 10 mg/kg IV given over 5-10 minutes. May repeat x1 after 20 minutes if seizures persist. May be given IM if IV access cannot be obtained, but slow absorption makes this route less desirable.
    a. Onset of action 15-20 minutes with IV administration. Duration of action is long.
    b. Marked respiratory depression may occur, <u>especially when used in a patient pre-treated with Valium</u>. Advance preparation for assisted ventilation is imperative. Slow push decreases risk of respiratory arrest.
    c. Sedative effect limits utility of repeat mental status exams

e. Dilantin (phenytoin)
1. Dose: 15 mg/kg IV over 15 minutes. Must be administered directly into IV tubing to avoid precipitation
    a. Onset of action 15 minutes. Long acting.
    b. Rapid infusion of Dilantin may lead to hypotension, arrhythmias, and cardiovascular collapse. <u>Continuous EKG and blood pressure monitoring during infusion are imperative.</u>
    c. Advantages to Dilantin include absence of respiratory depressant effect, even after Valium administration, and minimal sedative effect. Disadvantages include cardiotoxicity, and tendency to precipitate with dilution and in dextrose containing solutions.

3. Simple Febrile Seizure
a. A simple febrile seizure which has resolved on arrival of the Provider, or which recurs at the scene or in transport requires only supportive therapy
    1. 100% oxygen, airway positioning, and suction should be included in treatment of any seizing child
    2. Anticonvulsant therapy, with attendant need for IV access and risk of respiratory or cardiovascular compromise, is <u>not</u> indicated - <u>don't let your therapy cause more morbidity than the underlying disease process!</u>
    3. Antipyretic therapy
        a. Remove excess clothing
        b. Tylenol (acetaminophen) 15 mg/kg may be given to reduce fever if approved by Medical Control
        c. Additional cooling measures such as sponge bathing are not indicated in the field

b. <u>Every</u> child with presumed febrile seizure needs physician evaluation to assess for sepsis/meningitis. Transport may be undertaken by EMS or by private car, depending on child's clinical status and local protocol.

4. If ingestion is suspected and child has seized, ipecac should not be given due to risk of aspiration with emesis. Bring pill bottles to ER.
5. If meningitis is suspected, masks should be worn by pre-hospital personnel for self-protection. Follow-up with ER physician re need for drug prophylaxis.
6. Transport
    a. Transport should be carried out expeditiously, with continuous monitoring of cardiorespiratory status and frequent neuro evaluations
    b. If child is in status epilepticus, has been seizing repeatedly, or has respiratory depression in the post-ictal period, ALS intercept should be considered
    c. Early notification of receiving hospital should be undertaken.

II. Coma

A. Etiology/Epidemiology

1. Coma is a disturbance of consciousness in which patient becomes unresponsive and cannot purposefully react to stimuli
    a. Coma may be produced by:
        1. Diffuse dysfunction of both cerebral hemispheres
        2. Abnormalities of the reticular activating system in the brainstem
2. Causes of coma can be divided into two major categories:
    a. Metabolic
        1. Anoxia
        2. Hypoglycemia
        3. Diabetic ketoacidosis
        4. Meningitis, encephalitis
        5. Cerebral edema
        6. Intoxication/drug overdose
        7. Epilepsy/post-ictal state
        8. Reye's syndrome
    b. Structural
        1. Trauma
            a. Intracranial hemorrhage - epidural, subdural, parenchymal hematoma
            b. Brain contusion
            c. Diffuse brain swelling
        2. Brain tumor
        3. Cerebral vascular accident/infarction

B. Field Assessment

1. Initial assessment
    a. Airway may be compromised due to loss of oropharyngeal muscle tone - open with chin lift/jaw thrust
    b. Breathing
        1. All children in coma should be given supplemental oxygen at 100%
        2. Abnormal respiratory patterns are frequently seen in the comatose child, including hyperventilation, hypoventilation, irregular respiratory effort, and apnea
            a. Assisted ventilation may be necessary.
            b. Hyperventilation should be initiated if increased intracranial pressure suspected
    c. Circulation
        1. Shock may be present due to underlying metabolic problem (e.g., anoxia, hypoglycemia, sepsis), or to extracranial hemorrhage in the trauma patient.
            a. An isolated intracranial bleed cannot cause shock in the pediatric patient over 18 months of age.
            b. Control ongoing hemorrhage
            c. If hypovolemia suspected, initiate volume resuscitation with 20 cc/kg Lactated Ringers/ Normal Saline IV
    d. Disability (Neuro)
        1. Serial assessment of mental status (Alert? Responsive to voice? Pain? Unresponsive?); pupillary response; motor activity.
    e. Chemstrip glucose determination should be performed
2. Detailed assessment
    a. Coma is a true medical emergency which may be associated with catastrophic events such as cerebral herniation. Scene time should not be prolonged for a detailed assessment, which may be performed in transport or on arrival to the hospital.
    b. Relevant history includes:
        1. Fever? Recent illness? - may have meningitis, sepsis
        2. Trauma? Head injury?
        3. Ingestion of medications, household toxins, alcohol? Recreational drug abuse?
        4. Diabetes? - may be in ketoacidosis or hypoglycemic
        5. Epilepsy? History of febrile seizures? - may be post-ictal
        6. Headaches? Unexplained vomiting? - suggest elevated intracranial pressure
        7. Chronic medical problems? Medications?

c. Physical exam
    1. Pupillary equality, response?
    2. Conjugate gaze? Gaze preference? - may help localize site of lesion
    3. Inspection for signs of head trauma
    4. Palpate fontanel - full fontanel may signal elevated intracranial pressure due to bleed, cerebral edema, meningitis
    5. Assess for neck stiffness (if head trauma not suspected) - may indicate meningitis
    6. Examine skin for bruises or rashes - may suggest abuse, sepsis/meningitis
    7. Serial neurologic exams at scene and in transport imperative
        a. The Glasgow Coma Score may be assigned at the scene or retrospectively if documentation is good. A modified coma score also exists for infants
        b. Seizures, weakness, or paralysis should be noted

C. Field Management
1. Support ABC's as above
2. Assess chem strip and if <60 mg% give 2 - 4cc/kg D25W IV
3. Give Narcan (naloxone) <5yrs old or 20kg give 0.1mg/kg IV/IM/SQ/ET; >5yrs old or 20kg give 2mg IV/IM/SQ/ET
    a. Multiple doses may be necessary to reverse narcotic effects
    b. Duration of action of Narcan shorter than that of narcotics - monitor closely for change in mental status, respiratory effort and re-administer as needed**.**
4. Elevate head 30 degrees if C-spine injury not suspected and patient not in shock
5. Transport should be undertaken as rapidly as possible
    a. <u>Coma is a medical emergency for which hospital care is urgently needed</u>; child should be transported as soon as initial assessment complete and resuscitation underway
    b. Ongoing monitoring of neurologic, cardiovascular and respiratory status is essential
    c. BLS units should activate ALS back-up or consider ALS intercept
    d. Notify receiving hospital early

CHILDREN'S MODIFIED COMA SCORE/GLASGOW COMA SCORE

Eye Opening

INFANTS	CHILDREN, ADULTS
4 Spontaneous	Spontaneous
3 To speech	To verbal stimuli
2 To pain	To pain
1 No response	No response

Best Motor Response

INFANTS	CHILDREN, ADULTS
6 Normal spontaneous movement	Follows commands
5 Withdraws to touch	Localizes pain
4 Withdraws to pain	Withdraws to pain
3 Abnormal flexion	Abnormal flexion to pain
2 Abnormal extension	Abnormal extension
1 No response	No response

Best Verbal Response

INFANTS	CHILDREN, ADULTS
5 Coos and babbles	Oriented
4 Irritable cries	Confused
3 Cries to pain	Inappropriate words
2 Moans to pain	Non-specific sounds
1 No response	No response

III. Poisoning
- A. Incidence/Etiology
  - 1. Poisoning occurs in two distinct pediatric age groups
    - a. Accidental poisoning occurs primarily in young children
      - 1. Over 75% of accidental poisoning episodes occur in children under 5 years of age, with peak incidence in toddlers
    - b. Overdose, as a result of suicide attempt or recreational drug abuse, is a common problem in adolescents
  - 2. Poisoning is the fourth leading cause of death in pediatric patients
- B. Field Assessment
  - 1. Initial assessment
    - a. Remove the child to a safe site if an inhaled toxin such as carbon monoxide is present
    - b. Airway may be compromised in child with decreased level of consciousness due to loss of oropharyngeal muscle tone
    - c. Breathing may be compromised due to impaired respiratory drive or aspiration of stomach contents in the obtunded patient
      - 1. 100% oxygen should be administered to any child with hypoventilation, respiratory distress, or possibility of carbon monoxide exposure

d. Circulatory compromise may be present due to drug induced myocardial depression or arryhthmias, or to hypoxemia in patients with depressed respiratory drive
e. Chemstrip determination should be performed in patients with decreased level of consciousness, and hypoglycemia treated.

2. History should include:
a. What substances were ingested?
b. How much?
c. When did the ingestion occur?
d. Has the child had vomiting? Coughing? Respiratory distress? Seizures? Changes in level of consciousness?
e. Has Ipecac been given?

C. Field Management

1. The treatment of poisoning is largely limited to supportive care and decontamination. Antidotes are rarely available, with the exception of Narcan.
2. Support ABC's
3. Administer 2 - 4cc/kg D25W IV to children with Chemstrip <60 or unexplained decreased level of consciousness
4. Narcan administration should be considered in any child with decreased level of consciousness and/or respiratory depression
5. Gastric decontamination
a. Controversy exists as to the most effective means of decontaminating the stomach. In the emergency room setting, physicians are increasingly utilizing activated charcoal as front line treatment for many poisonings
b. In the field, gastric decontamination is generally limited to administration of syrup of ipecac. If ingestion has been within 30 minutes.
1. Dose
< 1 year or 20 lb - 15 cc
> 1 year or 20 lb - 30 cc
a. Administer with one glass of oral fluids
b. Dose may be repeated if emesis does not occur within 30 minutes
c. Any vomitus obtained should be brought to the hospital for analysis
2. Vomiting should <u>not</u> be induced when:
a. Patient has decreased level of consciousness, impaired gag reflex, or seizures
b. Substance ingested is likely to produce rapid neurological changes, e.g., tricyclic antidepressants
c. Alkali, acid, or hydrocarbon (petroleum product) has been ingested
d. Patient is pregnant

6. Regional Poison Control Center should be consulted when questions arise over appropriate management of specific poisonings (Rush Poison Control

Covers; Cook, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry and Will Counties (312) 942-5969 - Swedish American Hospital Regional Poison Control Center covers all other counties in Illinois at (1-800)-543-2022.

7. Transport pill bottles, containers, etc. with child to hospital
8. Early deaths from poisoning usually result from acute respiratory depression, aspiration, seizures, or rhythm disturbances. Knowledge of the specific toxin is generally not necessary to effectively treat these complications. Protection of the airway and attention to oxygenation and ventilation will reduce the consequences of poisoning, regardless of the toxin involved.

IV. Life-Threatening Infections

A. Incidence/Etiology

1. Young children are more prone to serious infection than most older patients due to developmental and environmental factors.
   a. The infants' immune system is immature and not fully competent.
   b. Infants and toddlers in daycare settings are exposed to a variety of pathogens. Spread of infectious diseases is promoted by close proximity, lack of toilet training, sharing of toys, and tendency to cough and sneeze on each other!
2. Sepsis
   a. Definition: illness resulting from bacterial invasion of the blood stream.
   b. Potentially fulminant: can lead to death of a previously healthy child within hours
      1. Babies are particularly vulnerable to developing sepsis due to the immaturity of their immune system. Most pediatricians will hospitalize and treat any infant under 2 months of age who has a fever, regardless of its apparent cause.
3. Meningitis
   a. Definition: infection of the membranes surrounding the brain and spinal cord (meninges) and of the cerebrospinal fluid
      1. Bacterial infections cause the most serious forms of meningitis; may also be viral in etiology.

B. Field Assessment

1. Life threatening infection must be considered in any previously healthy child who presents with fever in conjunction with altered mental status, cardiovascular, or respiratory compromise.
   a. Sepsis, with or without meningitis, can produce overwhelming shock due to the production of bacterial toxins. Irreversible shock is a common cause of death in children with severe sepsis.
   b. Hypoventilation or apnea may be seen as a consequence of profound acidosis in association with sepsis, or as a consequence of central nervous system infection and elevated intracranial pressure in meningitis

c. Neurologic symptoms and signs seen as a consequence of CNS irritability and increased intracranial pressure with meningitis include:
    1. Irritability, lethargy
        a. Failure to recognize parents or to interact with the environment is a poor prognostic sign
        b. Parents may note that the infant cries with handling, rather than being consoled when picked up. This is due to traction on the irritated spinal cord.
    2. Headache
    3. Vomiting
    4. Seizures
d. Stiff neck may be present with meningitis, but is <u>not</u> a reliable sign in children under 18 months of age.
e. Bulging fontanel may be noted in young infants with meningitis due to increased intracranial pressure. The fontanel should always be assessed in a seated, rather than supine, position.
f. Overwhelming sepsis may be associated with abnormal coagulation and bleeding, which may manifest in the skin as petechiae and purpura. Petechiae appear as tiny, non-blanching, red/purple lesions. Purpura appears as non-blanching, flat, purplish splotches. Presence of petechiae or purpura is an ominous sign, and may be imminent cardiovascular collapse.

C. Field Treatment
1. Definitive care of sepsis or meningitis is outside the scope of practice of prehospital care providers. Early recognition, stabilization of vital functions, and rapid transport are the key elements of field therapy.
    a. Supplemental oxygen should be administered to any child with respiratory compromise or circulatory inadequacy
    b. Assisted ventilation may be necessary, and hyperventilation should be considered if severe acidosis or elevated intracranial pressure are suspected
    c. Impending or frank shock should be treated with establishment of IV/IO access considered.
        1. Children in septic shock may need more than 80 cc/kg of isotonic fluids to restore adequate circulation. <u>Aggressive</u> bolus therapy is essential to maintenance of cardiovascular stability in transport
        2. The profound acidosis associated with cardiovascular collapse in septic shock is most efficiently treated with fluids and hyperventilation, rather than bicarbonate
    d. A young infant with fever requires urgent physician evaluation, regardless of how well he looks in the field. When in doubt, transport.
    e. The presence of petechiae or pupura implies a true medical emergency. Rapid transport with early notification of the receiving facility is essential.

f. Intercept with an ALS service should be considered when signs of severe sepsis or meningitis are present, and transport times are long
g. Infection control:
1. Masks should be worn when caring for the child with petechiae or purpura, due to infection risk.
2. If close contact was involved in the field resuscitation, prophylactic antibiotic therapy may be indicated for the EMS provider involved.

V. Dehydration
A. Incidence/Etiology
1. Dehydration may occur due to inadequate fluid intake or due to extraordinary fluid losses
a. Dehydration is more likely to occur in children than in older individuals for several reasons:
1. Increased frequency of viral infections and propensity to develop vomiting and diarrhea
2. Greater insensible water losses from skin, lungs
a. Greater surface-to-volume ratio
b. Tendency to develop higher fevers than adults
3. Behavioral - Infants and toddlers are not `reasonable', and may refuse attempts to increase fluid intake during illness
B. Field Assessment
1. Signs of dehydration vary with degree of volume depletion.
a. Mild dehydration is characterized by:
1. Dry mucous membranes
2. Absence of tears
b. Moderate to severe dehydration will have the above listed signs as well as:
1. Increased pulse rate
2. Capillary refill time of greater than two seconds
3. Increased depth and rate of respirations
4. Decrease in level of consciousness
5. Depressed anterior fontenelle
C. Field Treatment
1. Definitive therapy varies with degree of dehydration
a. Mild dehydration can often be treated with oral fluids
b. Moderate to severe dehydration generally requires IV rehydration
2. Prehospital care of the child should be limited to rapid assessment and transport unless the patient is in impending or frank shock, hypoglycemic, or transport time is long
a. Airway/Breathing
1. Supplemental oxygen should be administered to the moderately to severely dehydrated child; ventilatory support may be needed in the face of severe dehydration with profound acidosis and CNS depression
2. Precautions against aspiration must be taken in the face of ongoing vomiting

b. Circulation
1. Cardiac compression may be required for support of cardiac output
2. In the face of frank or impending shock IV hydration may be started in the field. Adequacy of circulation should be assessed based on rate and quality of pulses and clinical signs of end organ perfusion (mental status, capillary refill time, extremity warmth). Hypotension is a late sign of shock in children.
a. Bolus with 20 cc/kg over 5 minutes. Repeat boluses, monitoring clinical response (heart rate, capillary refill, level of consciousness).
b. Only isotonic fluids (NS or LR) should be administered to the dehydrated child in the field

c. Chemstrip determination should be carried out, and serum glucose of less than 60 treated with oral glucose paste or IV (2-4cc/kg D25w) glucose, depending on the patient's level of consciousness.
1. Infants and toddlers have limited liver sugar stores, and may become rapidly hypoglycemic on the basis of poor intake

3. Detailed assessment should be done en route
4. Transport should be undertaken expeditiously, and the receiving facility notified

VI. Hypoglycemia
A. Incidence/Etiology
1. More common in children than adults due to limited liver glycogen (sugar) stores
2. Children at special risk include newborns; `stressed' infants, such as those with sepsis, meningitis, prolonged vomiting; diabetics who may have `overshot' their insulin dose

B. Field Assessment
1. Symptoms and sign may mimic those of hypoxemia
a. Anxiety, sweating, tachycardia, tremors
b. Headache
c. Depressed level of consciousness or seizures
d. Poor peripheral circulation
e. In small infants, may be difficult to detect clinically and may be reflected only by:
` 1. Tachypnea or apnea
2. Jitteriness, floppiness or depressed level of consciousness
3. Cyanosis, mottling

2. Helpful historical information may include medications, duration and frequency of vomiting/diarrhea, last p.o. intake
3. Unless hospital care is immediately available, chemstrip determination should be performed in:
a. Any child with seizures or depressed level of consciousness
b. Any severely dehydrated child

c. Any child with known history of hypoglycemia or insulin-dependent diabetes
d. Any child with suggestive signs or symptoms

C. Field Treatment
1. Therapy of Chemstrip <60 mg%
a. If the child is conscious and can tolerate it, sugar-containing fluid should be given by mouth
b. If oral sugar cannot be given, 2-4 cc/kg of D25w should be given IVP
c. Glucagon may be considered, especially in diabetics with hyper-insulinism
1. May increase blood sugar transiently if liver reserves are not depleted
2. Dose: 1.0 Mg IM or IV; may repeat in 20 minutes
d. Follow-up chemstrip determination should be carried out 10-15 minutes after treatment to assure that satisfactory response has been achieved
e. Additional chemstrip screening should be done every 20-30 minutes during transport in order to detect recurrent hypoglycemia.

VII. Diabetes Mellitus in Children
1. Etiology/Incidence
a. Usually requires parenteral insulin, <u>not</u> simple dietary manipulation or oral hypoglycemic
2. Diabetic children get into trouble in one of two ways
a. Hypoglycemia may result from insulin overdose, decreased oral intake, or excess utilization of glucose as with heavy exercise; see above section for symptoms and therapy
b. Hyperglycemia, usually accompanied by ketoacidosis
1. Results from insulin underdosing (often missed doses), excess glucose intake, or infection or other acute problem which renders the child relatively insulin-resistant
2. Signs and symptoms
a. Polyuria (may be manifest as loss of previously-gained bladder control, nocturia)
b. Excessive thirst
c. Vomiting, abdominal pain
d. Fruity odor to breath if child is ketotic (not all are)
e. Urine output may continue inappropriately in spite of the fact that the child is very dry
f. Tachypnea or Kussmaul (rapid and deep) respirations reflect metabolic acidosis out of proportion to degree of dehydration alone
3. Therapy of diabetic ketoacidosis is essentially the same as that of severe dehydration
a. Initial Assessment
b. Priority treatments

1. Possibility of aspiration should be guarded against, as further emesis is likely and level of consciousness may be depressed.
2. Oxygen should be administered and ventilation should be assisted if necessary
3. IV access should be obtained and fluid bolus given of NS of LR

c. Transport should be undertaken as soon as possible; detailed assessment should be carried out en route

4. Remember that not all diabetics are known diabetics: every diabetic must have his first episode of hyperglycemia, and this is often accompanied by a full-blown ketoacidosis. Consider the diagnosis in any child with compatible history and physical findings.

PRACTICAL STATIONS

PEDIATRIC ASSESSMENT

AIRWAY MANAGEMENT

AIRWAY ADJUNCTS
INTUBATION
ADVANCED AIRWAY MANEUVERS

VASCULAR ACCESS

PERIPHERAL
INTRAOSSEOUS
DRUG CALCULATIONS

RHYTHM DISTURBANCES

PEDIATRIC IMMOBILIZATION

PRACTICAL STATION EQUIPMENT LIST

BASIC LIFE SUPPORT

1. 2 Child manikins
2. 3 Infant manikins

3. Alcohol wipes
4. Extra lungs
5. CPR performance sheets

PEDIATRIC ASSESSMENT

1. Stethoscopes (4)
2. Blood pressure cuff: 2 each infant, child, adult
3. Chairs for the parents and children
4. "Exam" table
5. Bath blankets (4)
6. Pen lights (4)
7. Rewards for children participating (crayons, books, Legos)
8. Toys/snacks for the children to play with/eat during the station time
9. Faces masks: 2 each newborn, toddler, and child
10. Length,weight and/or age based resuscitation devise

AIRWAY MANAGEMENT

Station 1: Airway Adjuncts

1. 1 Infant manikin
2. 1 Junior manikin
3. Bag-valve-mask device: infant, child, adult
4. Masks: preemie, neonate, toddler, child, adult
5. Oropharyngeal airways: 00, 0, 1, 2, 3, 4
6. Suction devices-bulb syringe, tonsil tip suction device, and standard suction catheters: 5, 6, 8, 10, 14
7. Oxygen masks: pediatric and adult
8. Nasal cannulas: pediatric and adult
9. Face tent: pediatric
10. Adult non-rebreathing mask
11. 2 Laerdal pocket masks

Station 2: Endotracheal Intubation

1. Intubation heads
2. Bag-valve-mask device for each mannequin
3. Masks: 3 neonate
4. Towels
5. 1/2" Tape, scissors
6. 2 Stethoscopes
7. 3 Laryngoscope handles
8. Laryngoscope blades: MacIntosh 2, 3, and Miller 0, 1(3), 2, 3,
9. Endotracheal tubes: 7.0, 6.5, 6.0, 5.0, 4.5, 4.0, 3.5(2), 3.0(2), 2.5
10. Stylets: 2 small and 1 large
11. 1 Banquet table with cover
12. Blindly Inserted

Station 3: Advanced Airway Maneuvers

1. Tracheostomy tube: one cuffed, one uncuffed
2. Needle decompression set-up: 18-20 g over the needle catheter finger of a glove betadine

3. Cricothyrotomy set-up: 20g with syringe, 14g over the needle catheter, 3.0 ET tube adapter

VASCULAR ACCESS

Station 1: Peripheral IV

1. Over-the-needle catheters: one each of 24, 22, 20, 18 gauge
2. Butterflies: one each of 25, 23, 21, and 19 gauge
3. IV's for student use: one of each per four students
   a. 23 Butterflies
   b. 22 Over-the-needle catheters
4. Pediatric IV arms
5. Model head for scalp vein IV insertion
6. IV solutions
   a. Flush solution
   b. 1000 cc Bag of Ringer's Lactat
   c. "Blood"
7. 3 cc Syringes with needles (any size): one per four students
8. Solution administration set: 2 each mini and maxi drip
9. Alcohol swabs
10. 3 Tourniquets
11. Materials for securing IV:
    a. Arm boards: 2 medium and 2 small
    b. 1" Adhesive tape
12. Scissors
13. Disposal container for needles
14. 1 Buretrol (Metriset)
15. Very large rubber band for head
16. Cotton balls
17. Chux
18. IV poles (2)

Station 2: Intraosseous Infusion

1. Raw chicken legs: 1 per two students or mannequins
2. Bone marrow needle: 1 per four students
3. 5 cc Syringe with needles
4. Exam gloves - 1 box medium
5. Sharps container
6. Medium arm boards: one per chicken leg
7. Flush solution (250 cc bag NS)

Station 3: Drug Calculations

1. Lancets: at least one per student
2. Sterile 2 x 2's: one large package
3. Chemstrips: one per student preferable
4. Band-Aids: one per student
5. Paper
6. Pens: at least six
7. Drug dose table: at least six
8. Chalk board

9. Exam gloves
10. Sharps container

RHYTHM DISTURBANCES

1. Slide set: rhythm disturbances
2. Slide projector and screen
3. Defibrillator and rhythm simulator
   OR
   EKG strips showing dysrhythmias
   - SLOW: Sinus bradycardia
     Second degree block
     Heart block
   - FAST: Narrow (supraventricular tachycardia)
     Wide (ventricular tachycardia)
   - ABSENT: Electromedical dissociation
     Ventricular fibrillation
     Asystole
4. Student handouts:
   a. Summary of the Treatment of Unstable Rhythms
   b. Symptoms and Signs of Impending Circulatory Failure with Rhythms Disturbances
   c. Sinus Tachycardia vs. SVT
5. Conference table and chairs

PEDIATRIC IMMOBILIZATION

1. 1 - Infant manikins
2. 1 - Child, age 4-8 or junior manikins
3. 1 - Car seat
4. 1 - Long backboard with attached straps
5. 1 - Short backboard or KED
6. 3 - Rolls 2" tape, hypoallergenic
7. 1 - Scissors
8. 3 - Pediatric C-collar, 1 each small, medium, large
9. 5 - Blankets
10. 4 - Towels
11. 1 - Pillow
12. 1 - Pediatric immobilization device
13. 1 - Vacu-splint mattress (pediatric size)

PEDIATRIC ASSESSMENT
PRACTICAL SKILLS SESSION

PARTICIPANT OBJECTIVES:

The course participant should achieve the following objectives during this skills station:

1. Demonstrate ability to estimate age based on developmental and physical characteristics of a child.

2. Demonstrate age appropriate approaches to elicit and keep child's cooperation during the exam.

3. List important observations to be made about the child's appearance and condition before touching the patient.

4. Demonstrate the ability to perform vital signs on an infant, toddler and school-aged child, including blood pressure.

5. Describe important factors in taking and interpreting each of the following vital signs: pulse, respirations, blood pressure, temperature.

6. Demonstrate the ability to perform an initial assessment on children from infancy through school age, including evaluation of respiratory effort, heart rate and perfusion and assessment of neurologic status.

7. Identify at least one anatomic or physiologic difference between children and adults for each of the following: head, airway, chest, abdomen, body surface area, blood volume.

8. Demonstrate the ability to triage pediatric patients on a priority basis.

Content and Key Teaching Points:

A. The approach to a child and the EMS providers ability to elicit and maintain the child's cooperation depend on his or her age and developmental level. Awareness of the fears, concerns, and needs associated with each stage of development is the key to working with the ill or injured child. Age appropriate techniques to calming, distracting and getting the child's cooperation are needed. (See Table 1, following this station.)

B. Observation of the conscious child, before touching, can give valuable information on neurologic status, respiratory effort, overall degree of illness.

C. Examination of the young child who is not critically ill should begin with non-threatening physical contact. Areas where greatest cooperation is needed are examined first (i.e., abdomen, chest). Avoid a "toe-to-head" approach.

D. Normal vital signs vary with age. Knowledge of age-related heart rates, respiratory rates and blood pressure values is needed in order to recognize and treat derangements.

E. Explanation of procedures should be given, even to pre-verbal children. Children should be enlisted, when possible, to give historical information and to help with the exam.

F. Demonstrate on infant, toddler and school-aged child appropriate IV sites and landmarks for IO placement.

TABLE 1: AGE SPECIFIC PEDIATRIC ASSESSMENT

	Infant < 8 months	Toddler 9 months-2 years	Child 3 Years Schoolage	Adolescent
Challenges	Nonverbal, small size Doesn't cooperate	Fearful, anxious, stranger anxiety; want to be in control	Eager to please but decompensates under stress	An adult body with child's fears
Provider Fears/ Concerns	Hurting small child	Making child cry, losing cooperation		Noncompliance; lack of communication
Patient Fears/ Concerns	Discomforts (cold, hunger),surprises	Strangers, separating rom parent, losing control over situation, being restrained/hurt	Pain, blood, needles, the unknown, modest	Modesty, disfigurement, bad outcome
Calming Techniques	Use pacifier; talk in gentle steady tone; provide a safe object for patient to hold (keys, tongue blade)	Become less threaten-ing; get down to child's level; engage child in conversation focused on them; make non-threatening physical contact first (hands, feet).	Talk clearly, directly, provide simple explanations; reassurance; use familiar analogies	Talk directly to patient; reassure
Avoiding Pitfalls	Avoid sudden moves or noises, cold surfaces; examine chest first	Don't negotiate or ask permission (will say "no"); don't spend much time explaining(increases anxiety)	Get history from patient; don't give details of injury or procedures	Treat with respect; avoid impatience or anger with patient
Exam site	Anywhere. Infants do not have separation anxiety or fear of strangers	With parent near or in parent's lap; examine painful part last	Anywhere; examine painful part last	Attempt respect pt. modesty in choosing site

PEDIATRIC AIRWAY MANAGEMENT
PRACTICAL SESSION

PARTICIPANT OBJECTIVES

At the conclusion of this skill station, the course participant should be able to:

1. Know the various types of oxygen delivery systems and demonstrate when and how to use them.

2. Demonstrate the proper placement of an oral airway on an infant and child manikin, and show how to select the proper size.

3. Demonstrate the proper use of pediatric bag-valve-mask.

4. Know the advantages and disadvantages of endotracheal intubation and select appropriate intubation equipment for children of different ages.

5. Demonstrate proper intubation technique on an infant manikin.

6. Know the indications and contraindications of the cricothyrotomy.

7. Demonstrate proper technique for cricothyrotomy.

8. Know the appropriate clinical signs that indicate the need for chest decompression.

9. Know the proper procedure for chest decompression.

PEDIATRIC AIRWAY MANAGEMENT
PRACTICAL SESSION

STATION 1: Airway Adjuncts Overview

Content and Key Teaching Points

I. General principles
   A. Supplemental oxygen should be administered to every child in respiratory distress, in the highest concentration available.
   B. Supplemental oxygen is the only airway intervention needed if a child is breathing spontaneously and appears to be ventilating adequately.
   C. Agitation may precipitate worsening respiratory distress/airway obstruction. Minimize intervention in the conscious child who is maintaining his/her own airway. When possible, allow the child to remain with a parent.
   D. Certain positions maximize airway patency and respiratory effort. Allow the child in respiratory distress to maintain their position of comfort, e.g., allow the child to be transported in the seated position if he/she appears to favor it.

II. Oxygen Delivery Systems (Devices are displayed and their use discussed)
   A. Nasal cannula
      1. Available in infant, child and adult sizes.
      2. Not capable of delivering high oxygen concentrations, typically 25-30%
      3. May be taped to the cheeks of an uncooperative infant or toddler who is attempting to remove it! If presence of device is causing agitation, consider switching to blow-by.
      4. It is not the device of choice in most Out-of-hospital situations.
   B. Oxygen masks
      1. Oxygen masks may frighten young children who feel suffocated by having their nose and mouth covered. In pre-school aged children, make the analogy between the oxygen mask and a space mask and let them be a spaceman or astronaut. This game may enhance cooperation and decrease agitation. In the inconsolable child, consider blow-by as an alternate route.
      2. Choose oxygen mask based on O_2 concentration desired:
         a. Simple oxygen mask - low-flow device that will deliver ~ 35 to 60% oxygen with a flow rate of 6-10 L/min.
         b. Partial re-breathing mask - simple face mask with an added reservoir bag. Provides reliable inspired oxygen concentration of ~ 50-60%.
         c. Non-re-breathing mask - a valve placed between the reservoir bag and mask to prevent gas flow back into the bag from the

mask during exhalation. On inspiration the patient draws 100% oxygen from the reservoir and the fresh oxygen inflow. Oxygen flow into the mask is adjusted to prevent collapse of the bag. An inspired oxygen concentrations approaching 95% can be achieved with an oxygen flow of 10-12 L/min and well-sealed face mask.

C. Blow-by oxygen administration

1. Conscious infants and toddlers may become very agitated when oxygen. delivery devices (masks, nasal cannula) are placed on their face. Agitation may worsen respiratory distress. In such cases, allowing a parent to administer blow-by O_2 by holding the hose or mask near the child's face may be the most effective way of delivering supplemental oxygen. A convenient method is to place O_2 extension tubing through the bottom of a paper cup.

III. Methods for Opening the Airway

A. Non-invasive airway management techniques are useful in the spontaneously breathing patient, or to facilitate ventilation during rescue breathing.

1. Indications and techniques are similar to those in adults.

a. Jaw thrust, without head tilt, is the proper technique for opening the airway if C-spine injury is suspected.

b. Chin lift.

1. Avoid hyperextension of the neck, especially in young infants. Hyperextension may lead to collapse of the soft, immature trachea and worsen obstruction.

2. Care must be taken to place fingers under <u>bony</u> part of lower jaw in performing chin lift. Compression of the soft tissues under the chin will lead to displacement of support structures and tongue into oropharyngeal area and tracheal compression in the infant.

3. Newborns and young infants have very large occiputs, causing them to be <u>hyperflexed</u> when lying on a stretcher or backboard. Placing a small towel or diaper roll under their shoulders will bring them into neutral alignment.

4. Obtain sniff position in the child by gently tilting head back with hand on forehead <u>or</u> by placing a small towel under the occiput.

IV. Suction Devices

A. Suction may be necessary for clearing secretions or vomitus from the oral cavity or nares of a child in order to maintain a patent airway. Suctioning is likely to produce agitation in the conscious child, and risks and benefits must be weighed.

1. Suctioning is contraindicated in the conscious child with suspected epiglottitis or foreign body aspiration, as it may precipitate increased obstruction
2. Other complications of suctioning include:
    a. Hypoxemia - due to prolonged suctioning .
    b. Bradycardia - due to hypoxemia or vagal response.
    c. Increase in intracranial pressure.
    d. Gagging, emesis, and aspiration.
    e. Nose-bleed, if deep nasal suctioning is performed.
3. Administer 100% O_2 before and after suctioning. Suctioning episodes should be limited to 5 seconds to avoid hypoxemia and bradycardia. Heart rate must be monitored during suctioning. If rate drops below normal value for age, stop suctioning immediately and oxygenate and ventilate patient.

B. Suction Devices
1. Bulb syringe - commonly used to clear nose and mouth of secretions, blood, meconium in newborn delivery.
2. Large bore flexible suction device - useful for the removal of thick secretions and particulate matter from the pharynx; should be at hand for field intubations.
3. Flexible suction catheter - Age-appropriate catheter size (5, 8, 10 or 12 French) may be used for deep nasal or endotracheal tube suctioning. May also be used to suction thin oral secretions.

V. Oropharyngeal Airways
A. Most children with correct positioning, can be ventilated without the use of an artificial airway. Use of oral airways is limited to <u>unconscious</u> children <u>with absent gag reflex</u>.
1. Loss of oropharyngeal muscle tone in the unconscious child leads to proximal airway obstruction with the tongue. This may be relieved,and bag-valve mask ventilation facilitated, by oral airway placement.

2. Placement in a conscious child, including most patients who are seizing or post-ictal, induces gagging and vomiting, with risk of aspiration. Airway placement must not be attempted in such patients.

B. Proper function of oral airway requires measuring prior to use on each child.
1. Airway length should equal distance between mouth and angle of the jaw - too small or too large an airway may worsen obstruction.

C. Insertion Technique
1. Insert directly with use of a tongue depressor. Placement by rotating may lead to injury to soft palate.

VI. Esophageal Obturator Airway (EOA)/ or Combi Tube - Designed for use in adult patients. EOA/Combi-tube has <u>No</u> place in airway management of children or adolescent under 16 years old or smaller than 5ft.

VII. Bag-Valve-Mask Ventilation

A. Bag-valve-mask ventilation of pediatric patients requires age-appropriate equipment and excellent technique. Demonstration of skill on infant and pediatric manikins should be part of BLS airway certification and re-certification programs.
   1. Every ambulance should have a 400ml pediatric resuscitator (self-inflating bag-valve-mask device)
      a. Always use oxygen reservoir with self-inflating resuscitator
      b. Infant and pediatric resuscitators may have pop-off valves which activate at ~40mmHg. Pop-off valve activation may prevent delivery of adequate tidal volume, and will decrease concentration of inspired oxygen delivered. Bypass pop-off manually or tape down to inactivate. Monitor chest rise to assess adequacy of BVM ventilation.
   2. Pediatric kit must include masks which will fit children from birth (including premature) through adolescence. Good seal is most easily achieved with masks with soft, inflated cuff.
   3. Two-rescuer technique may be essential in children with difficult airways, e.g., epiglottitis or foreign body aspiration with complete obstruction

B. Nasogastric/orogastric tubes
   1. Prolonged positive pressure ventilation in infants and young children leads to gastric distention. This leads to difficulty in ventilation due to impaired diaphragmatic excursion, and increased risk of vomiting/aspiration.
   2. NG/OG tube placement should be considered if BVM ventilation is to be continued during transport.
   3. How to measure: from tip of nose to xyphoid process

VIII. Oxygen powered breathing devices should <u>not</u> be used in pediatric patients. High inflating pressures delivered with such devices will result in gastric distention and may cause serious pulmonary damage in children.

PEDIATRIC AIRWAY MANAGEMENT
PRACTICAL SESSION

STATION 2: Endotracheal Intubation Overview

Content and Key Teaching Points

I. General Principles
   A. Endotracheal intubation should be attempted only by highly-trained medical providers who maintain their skill levels through experience or frequent retraining. Demonstration of skill on infant and pediatric manikins should be an integral part of classroom training.
      1. Indications for field intubation of the pediatric patient include: inability to oxygenate/ventilate via bag-valve-mask; prolonged transport time and ongoing need for assisted ventilation; need for tracheal suctioning; need for access route for resuscitation medications.
      2. Risks of intubation are similar in pediatric and adult patients.
         a. Infants become hypoxemic more quickly than adults when deprived of oxygen. Paramedics must be especially conscious of duration of intubation attempts in pediatric patients and ensure adequate pre-oxygenation via BVM prior to each attempt.

II. Intubation Technique
   A. Safe and successful intubation requires age-appropriate equipment
      1. Infants are most easily intubated using a straight laryngoscope blade. A straight or curved blade may be used in children, according to paramedics experience and degree of comfort with the equipment. Blade size is chosen according to age (see Appendix).
      2. Endotracheal tubes
         a. Tube size is dictated by age (see Appendix). Size can be approximated by choosing tube equal to diameter of child's little finger or nostril. Tube of one size bigger and one size smaller should be at hand.
         b. Cuffed tubes are not used in children under 8 years of age, due to differences in airway anatomy
         c. Intubation of infants, using small tubes, may be facilitated by use of a stylet to guide the tube through the cords. Care should be taken that tip of stylet is at least a centimeter proximal to the tip of the tube, to avoid tracheal damage.

B. Intubation Procedure

1. Although basic skills are the same in adult and pediatric intubation, differences in anatomy and landmarks exist:
    a. Everything is smaller! If no recognizable landmarks are seen when blade is inserted, it is probably in the esophagus. Withdraw slowly and watch for cords to come into view.
2. Cricoid pressure (Sellick maneuver) is sometimes utilized to enhance visualization of cords, which may be difficult due to their anterior placement in young children.
    a. Performed by applying gentle pressure to the anterior trachea at the level of the cricoid ring, compressing the esophagus behind it
    b. Technique may also be used to decrease gastric distention during BVM ventilation, since tracheal pressure causes collapse of the esophagus
    c. Cricoid pressure should be used with caution in young infants where it may cause tracheal compression/obstruction due to incomplete formation of cartilaginous tracheal rings
3. Young children become hypoxic rapidly. Limit each intubation attempt to 20 seconds, and preoxygenate with 100% O_2. Heart rate must be monitored during intubation attempts, as hypoxia rapidly leads to bradycardia in children.
4. Do not force a tight tube. The narrowest part of the child's airway is <u>below</u> the cords.
5. Watch as tube is advanced, as the airway is short and mainstem bronchus intubation is a common complication. The tip of an uncuffed tube should be 2-3cm below cords. Pediatric tubes have three sets of rings marking their distal end - if the second ring is at the level of the cords, the tube is in mid-tracheal position. Tube position can also be assessed by centimeter marking at the lips (See table at end of practical).
6. Secure tube carefully. The infant or young child's airway is short, and a small amount of displacement can lead to mainstem bronchus intubation or accidental extubation, even if the tube was initially placed correctly.
7. Watch for improved clinical status. The child who remains cyanotic and bradycardic despite bagging should have his ET tube reassessed for position and patency. Bradycardia in children is almost always due to hypoxia.

ENDOTRACHEAL INTUBATION TABLE

Age	ET Tube Size	Depth of Oral Intubation (cm)	Blade Size	Suction Catheter
Premature newborn	2.5-3.0	6 + weight (kg)	0	5F-6F
Term newborn	3.5	6 + weight (kg)	1	6F
6 months	3.5	11	1	8F
1 year	4.0	11	1	8F
3 years	4.5	13	2	8-10F
5 years	5.0	14	2	10F
6 years	5.5	15	2	10F
8 years**	6.0	17	2	10-12F
12 years	6.5	19	3	12F
16 years	7.0	20-24	3	12F
Adult female	7.5	22-24	4	12F
Adult male	8.0	22-24	4	14F

** Utilize uncuffed endotracheal tubes under age 8.

STATION 3: Advanced Airway Maneuvers

1. Tracheostomy Tubes
   - A. Replacement
     1. Plastic or metal with plastic being more common in children
     2. Sizes:
        - a. Newborn 00 - 1 (uncuffed)
        - b. Pediatric 1 - 5 (cuffed or uncuffed)
        - c. Adult 4 - 8 (cuffed)
     3. Types (See figures 1 thru 5)
        - a. Tracheostomy tube without obturator
        - b. Tracheostomy tube with obturator
        - c. Fenestrated tracheostomy tube
        - d. Tracheostomy tube with inner cannula
        - e. Decannulation plug
   - B. Tracheostomy Disasters
     1. Acute dislodgment
        - a. Hyperextend the neck
        - b. Use an obturator
        - c. Replace tube with the same size tube
        - d. If difficult: Use KY jelly
          Smaller tracheostomy tube is available
          Resistance is an indication of improper placement

          DO NOT FORCE TUBE INTO PLACE
     2. Anterior dissection into trach
        - a. Use suction catheter
        - b. Do not push against resistance
     3. Clinical presentation of anterior dissection
        - a. Resistance in bagging
        - b. No chest rise with bagging
        - c. Subcutaneous air
     4. Tracheostomy Obstruction
        - a. Suction tracheostomy tube
        - b. Remove and clean inner cannula if present
        - c. If unable to clear obstruction, remove tracheostomy tube and replace with endotracheal tube
   - C. Suctioning the tracheostomy tube
     1. Assemble Equipment
        - a. Gloves

b. Suction machine or device
c. Sterile water
d. Suction catheters (see table 1)

2. Procedure
   a. Connect catheter to suction machine and check for correct suction pressure. Pediatrics usually require less than 100mm of pressure.
   b. Insert suction catheter, without suction,into tracheostomy tube. **(Do not push suction catheter against resistance)**
   c. Apply suction and slowly withdraw the catheter while rolling it between your fingers to facilitate secretion removal.
   d. Suction procedure should be no longer than 10 seconds. Allow adequate time between each catheter insertion for re-oxygenation.
   e. Rinse the catheter in sterile water before re-suctioning.
   f. Suction oral airway after suctioning tracheostomy tube.

II. Needle Decompression

A. General Principles

1. A tension pneumothorax results when a lung leak due to blunt or penetrating trauma fails to seal. This one way valve effect leads to a build up in air in the pleural space with each breath.
2. In young children this may be particularly problematic due to their mobile mediastinum allows for rapid compromise of their pulmonary and cardiac function. **EARLY DIAGNOSIS IS CRITICAL.**

B. Indications for the need for needle decompression are: 1. apprehension, 2. agitation, 3. hyperresonant percussion with breath sounds decreased or absent, 4. distended neck veins, 5. tracheal deviation away from site of injury, 6. possible subcutaneous emphysema, 7. shock, 8. increasing cyanosis air hunger (ventilation severely impaired)

C. Needle decompression technique

1. Select appropriate size catheter (see chart)

AGE	SIZE(KG)	CATHETER SIZE
<1	<10	20g
1-5	10-20	18g
5-12	20-40	16g
>12	>40	14g

2. Make one way valve by inserting of catheter through the finger of a glove.
3. Locate 2nd intercostal space over the top of the 3rd rib in the midclavicular line on the affected side of the chest.
4. Quickly prepare the site with betadine
5. Firmly introduce the catheter at a 90^0 angle, sliding over the top of the 3rd rib.
6. Listen for "pop" as needle enters the pleural space. As catheter enters through parietal pleura, air should escape under pressure through the flutter valve.
7. Advance catheter over-the-needle and flutter valve will come into position of function. Removed needle. Flutter valve will prevent air from entering during inhalation and allow air to escape during exhalation. (Figure C)
8. Secure catheter in place with 4x4's and tape. Do not allow catheter to kink.
9. Reassess respiratory status and TRANSPORT immediately.
10. Contact medical control and advise of patient condition.

D. Complications
1. Laceration of intercostal vessel with resultant hemorrhage. The intercostal artery and vein run around the inferior margin of each rib. Poor needle placement can lacerate one of these vessels.
2. Creation of a pneumothorax if not already present. If your assessment was not correct, you may give the patient a pneumothorax when you insert the needle into the chest.
3. Laceration of the lung. Poor technique or inappropriate insertion (no pneumothorax present) can cause laceration of the lung, causing bleeding and more air leak.
4. Infection. Adequate skin preparation with an antiseptic will usually prevent this.

III. Cricothyrotomy
A. General Principles
1. The need for a cricothyrotomy is rare, but may be life saving in the child with complete upper airway obstruction caused by foreign body, severe orofacial injuries infection or laryngeal fracture.
2. Theoretically, cricothyrotomy should facilitate effective delivery of oxygen to most patients with upper airway obstruction since the most common site of pediatric airway obstruction is at or above the glottis.
3. This procedure may not be effective in children less than 12 years old because the narrowest part of the airway is the subglottic cricoid ring.

B. Cricothyrotomy technique
1. Palpate cricothyroid membrane anteriorly between thyroid cartilage and cricoid cartilage.

2. If time allows, prep area with Betadine swabs.
3. Use a 14-gauge catheter over-the-needle device with syringe and puncture skin midline and directly over the cricothyroid membrane.
4. Direct needle at 45-degree angle posteriorly and inferiorally
5. Insert needle through lower half of cricothyroid membrane. Aspiration of air signifies entry into the tracheal lumen.
6. Withdraw stylet while advancing catheter downward.
7. Attach the catheter needle hub to a 3.0 ET tube adapter and "Y" connector (ventilate at 1:4 ratio)
8. Auscultate chest for adequate ventilation. Pop off valve of the BVM must be disabled to provide the high peak inflation pressures needed.

PEDIATRIC VASCULAR ACCESS
PRACTICAL SKILLS SESSION

PARTICIPANT OBJECTIVES:

At the conclusion of this skill station, the course participant should be able to:

1. Locate sites for placement of peripheral IVs in children.

2. Know what size and kinds of catheters to use, the preferred site of cannulation, and the priorities in intravenous cannulation.

3. Demonstrate correct technique for vascular access via scalp veins.

4. Know the indications for intraosseous infusion and demonstrate the technique.

5. Demonstrate the proper set-up for stopcock and sryringe delivery system for fluid boluses to a pediatric patient.

STATION 1: PERIPHERAL ACCESS

Content and Key Teaching Points

I. Peripheral IV insertion
  A. Multiple sites are potentially available
    1. Scalp vessels are prominent and usually not entirely obscured by hair in neonates and infants
    2. Dorsum of the hand vessels or the "intern's vein" at the wrist may be used and restraint of the forearm is relatively easily achieved
    3. Dorsum of the foot vessels or the saphenous vein at the ankle can be used by are more difficult to secure in a kicking child
    4. Most children have at least one sizable vein in the antecubital space, but stabilizing the elbow may be more difficult than securing the hand
  B. Choice of needle
    1. Butterfly
      a. Available in sizes down to 25 gauge
      b. Easier to place but more difficult to secure and maintain in place during transport
      c. Useful for obtaining blood specimens but because they tend to infiltrate easily, they are not the needle of choice for fluid administration.
    2. Over-the-needle catheter (Quikcath, Jelco, etc.)
      a. Available in sizes down to 24 gauge
      b. More difficult to insert but much more likely to survive taping and patient movement
  C. Insertion technique
    1. For scalp veins
      a. Restrain the patient
      b. Shave the selected site and surrounding skin
      c. Place a rubberband tourniquet around the head
      d. Clean skin overlying the vein with an antiseptic solution
      e. Check the patency of a butterfly needle or an over-the-needle catheter by injecting sterile solution through the system.
      f. Disconnect the syringe from the needle or catheter but leave fluid in the system.
      g. Stretch the skin over the vein and identify the direction of blood flow.
      h. Introduce the needle through the skin; advance it into the vein until blood flows back freely.
      I. Remove the tourniquet.
      j. Test the position of the needle by introducing a small amount of sterile solution.
      k. Tape needle in place.

l. Evacuate any air in the connecting tubing and attach the infusion.

2. For upper and lower extremities
   a. Immobilize extremity to be used and stretch the vein. For antecubital fossa veins, place a soft roll of gauze behind the elbow to hyperextend it; for the hand veins, hold the hand firmly with the wrist flexed.
   b. Use a cannula with an inner stylet needle and a clear hub in order to see blood flashback immediately.
   c. Flush the cannula with sterile saline.
   d. Apply a tourniquet proximal to the vein.
   e. If time permits, puncture the skin slightly distal to the proposed venipuncture site with an 18- or 20-gauge needle to facilitate entry of the cannula.
   f. Insert the cannula with the stylet into the vein with the "up" down.
   g. Slowly advance the need a few millimeters further.
   h. Advance the cannula into the vessel and remove the stylet.
   I. Check for the free flow of blood from the cannula, tape it in place, attach an infusion set.

D. Useful tips
   1. Rubbing or patting site of intended venipuncture may enhance local vein filling; rubbing with alcohol may also render local veins more palpable.
   2. If time permits, wrapping the site in warm (NOT HOT) packs will improve vein distention.
   3. Elevating the child's legs, placing him in Trendelenburg position, or even using an anti-shock garment may increase likelihood of finding a suitable vein in an upper extremity.
   4. Active muscle activity of an extremity will increase local blood flow; however, few children who are ill enough to require an IV in the prehospital setting are able to cooperate in this endeavor, while random thrashing is usually counterproductive.
   5. Placing a finger proximal to the insertion site allows one to palpate the vein throughout the procedure while simultaneously stretching the skin and vein slightly to minimize vein rolling.
   6. Choosing an insertion site where two veins merge is likely to enhance success, as such veins roll less.
   7. Nicking the skin entrance site with a large needle will improve chances of successful insertion of an over-the-needle catheter, as the catheter is less likely to become frayed or to pop suddenly through both the skin and vessel.

STATION 2: INTRAOSSEOUS ACCESS

II. Intraosseous Infusion

A. A technique for venous access that was first described over 60 years ago. Successfully used during the 1930-40s for administration of blood and fluids. Blood from the bone marrow of the tibia passes into the general circulation

B. Indications

1. Alternative route for vascular access in children with cardiac arrest or shock
2. Any solution which can be given IV can be administered via tibial marrow (crystalloid, colloid, blood, sodium bicarbonate, calcium, epinephrine, atropine, glucose, lidocaine, bretylium, dopamine, dobutamine)

C. Technique

1. Proximal tibia is preferred location
   a. The landmarks are easily identified
   b. There are no adjacent structures of any consequence
   c. There is a large marrow cavity
2. Prep site with iodine solution
3. Needles
   a. 15 to 19 gauge bone marrow needles, with stylets to eliminate the problem of plugging
4. The site for penetration of the tibia is the flat medial surface of the proximal tibia, 1 finger breadth below and medial to the tibial tuberosity
5. Insertion
   a. The needle is inserted perpendicular to the skin or at slight angle away from the knee
   b. Apply pressure and screw the needle through the cortex of the bone, with a rotary motion. As the needle passes into the marrow, a slight give is felt. At this point, the needle should stand without support
   c. Remove stylet and aspirate with a syringe. Proper placement is confirmed by aspiration of bone marrow
6. Attach IV tubing
   a. Flow rates to gravity may be unacceptably slow.
   b. Consider placing an IV solution in pressure bag inflated to 300 torr or 'pushing' the fluid bolus with a syringe and three-way stopcock attached to the IV tubing.

D. Contraindications

1. The infusion rate may not be adequate for resuscitation of ongoing hemorrhage or severe shock. It is a good alternative route when venous access if difficult or while it is being attempted
2. Recently fractured bones cannot be used

E. Complications

1. Extravasation of fluid is the most common 2^{o} to improper placement of dislodged needle
2. Other complications reported in the literature are rare.

DYSRHYTHMIA RECOGNITION PRACTICAL STATION

This skill station was adapted from the Textbook of Pediatric Advanced Life Support, published by the American Heart Association, 1994.

Participant Objectives

1. Recognize that arrhythmias are not a common problem in pediatrics, and that drug therapy is infrequently needed.

2. Recognize the importance of airway management in treating the pediatric patient with cardiovascular compromise.

3. Identify and classify dysrhythmias as: Slow, Fast, Absent.

4. List the characteristics which distinguish the stable vs. the unstable patient with a dysrhythmia.

5. Prioritize resuscitative interventions based on dysrhythmia classification and patient stability.

Teaching Strategies and Procedures

In a small group setting, the instructor emphasizes the recognition of categories of cardiac rhythms, rather than specific diagnoses. While discussing the classification schema, the demonstration of rhythms takes place. Rhythm demonstration is best performed using a dynamic monitor -- a defibrillator hooked to a rhythm simulator device -- but static strips or slides may be employed if a simulator is not available.

The format should be interactive. For example, in demonstrating the 'slow' rhythms, the instructor will ask the students 'What's this?', while displaying sinus bradycardia, second and third degree AV block. At this point, the instructor explains that it makes no difference in the initial management of the patient that one cannot see P waves or intervals, or the specific relationship of the P waves to the QRS complexes. What is important is that the rhythm is recognized as being slow, and that it is correlated with the patient's condition to determine if immediate treatment is required.

$$CO = HR \times SV$$

(Cardiac output + heart rate x stroke volume)
and describe physiologically how cardiac output may be compromised.

The instructor may then proceed to discuss the treatment of that classification of rhythms, emphasizing that all of the specific rhythms within the group are treated in the same fashion.

Time and Teacher:Student Ratio:

1. Total time: 45 minutes
2. Teacher:Student Ratio: 1:12

Equipment:

1. Defibrillator and rhythm simulator
   OR
   EKG strips showing dysrhythmias
   - SLOW: Sinus bradycardia
     Second degree block
     Third degree block
   - FAST: Sinus tachycardia
     Supraventricular tachycardia
     Ventricular tachycardia
   - ABSENT: Electromechanical dissociation (sinus rhythm without pulse)
     Ventricular fibrillation
     Asystole

   OR
   Slide set of rhythm strips
2. Conference table and chairs
3. Slide projector and screen (if slides will be used)
4. Chalk board

Content and Key Teaching Points

I. Arrhythmias are not a common problem in pediatrics. When dysrhythmias are seen, they most often represent a complication of a non-cardiac problem, and treatment is appropriately directed to that underlying cause, e.g., bradycardia due to hypoxemia; tachycardia due to hypovolemia.

II. Aggressive airway management should be undertaken in every child with an arrhythmia. Regardless of the exact nature of the dysrhythmia, only rhythms associated with cardiovascular instability -- i.e., inadequate cardiac output -- should be treated in the field with drugs or electricity. When drugs are given, a precalculated dose chart (dose by age/weight) should be used.
   - A. Definition of the Unstable Patient
     1. Dysrhythmia associated with inadequate cardiac output, or which threatens to deteriorate into a lethal rhythm in the field.
   - B. Assessment of Cardiac Output
     1. Pediatrics/Adults -- BP + Perfusion

2. Newborn -- Heart Rate + Perfusion
Heart rate, not BP, is assessed in the newborn due to difficulty in obtaining rapid, accurate BP; Bradycardia is always an unstable rhythm in the newborn.

C. Clinical Manifestations of Inadequate Cardiac Output
1. Reflect poor perfusion of various organ systems leads to signs.
a. CV -- abnormal pulse rate or quality
b. CNS -- irritability, decreased level of consciousness
c. Skin -- mottling, pallor, cyanosis, delayed capillary refill, cool extremities, sweating
d. Respiratory -- tachypnea

III. Rhythm Classification
A. FAST
1. Show on simulator:
a. Sinus tachycardia
b. SVT
c. Ventricular tachycardia
1) Ask: `What's this?', and show each rhythm. Explain that each, for purposes of diagnosis and treatment, is simply `fast' and can be further classified as wide vs. narrow complex.
2. CO = HR x SV
CARDIAC OUTPUT IS DECREASED DUE TO INADEQUATE STROKE VOLUME IN THE FACE OF `TOO FAST' A RATE.
3. Treatment of fast rhythms.
a. Stable fast rhythm needs no treatment except oxygen and transport.
b. Unstable fast rhythm treat underlying cause.
1) If non-cardiac by history, exam -- treat for hypoxemia, shock, hemorrhage, fever, etc.
2) If cardiac -- oxygenation, ventilation then electricity.
a) Discuss cardioversion dose (0.5-1.0 joule/kg), paddle size, synchronized cardioversion vs. defibrillation.
b) Discuss SVT vs. sinus tach.

B. Slow
1. Show on simulator:
a. Sinus bradycardia
b. Second degree block
c. Third degree block
1. Ask "What's this?" with each rhythm.
2. Exact Dx doesn't matter -- is patient stable or unstable?
3. CO = HR x SV

CARDIAC OUTPUT IS DECREASED HEART DESPITE NORMAL STROKE VOLUME, BECAUSE HEART RATE IS "TOO SLOW"

4. Treatment of slow rhythms.
   a) Stable slow rhythm needs no treatment except O_2 and transport.
   b) Newborn with bradyarrhythmia = unstable. Treat with stimulation, oxygenation, ventilation, CPR, epi.
   c) Child with unstable bradyarrhythmia: oxygenation, ventilation, CPR, Atropine.
   d) Pathological bradycardia most commonly results from serious hypoxemia and acidosis. Respiratory support is the front line treatment.

C. ABSENT

1. Show on simulator:
   a. Asystole
   b. V-fib, V-tach
   c. PEA

2. CO = HR x SV

NO CARDIAC OUTPUT BECAUSE NO HEART RATE AND/OR STROKE VOLUME.

3. Asystole is the only `Absent' rhythm commonly seen in children. It occurs as a terminal rhythm following worsening sinus bradycardia in the setting of profound hypoxemia and acidosis.
4. Treatment of absent rhythms.
   a. V-fib -- defib , CPR, O_2, epi, lido, bretylium.
   b. Asystole -- CPR, O_2, epi, Atropine.
   c. PEA -- CPR, O_2, epi
      1) Look for underlying cause -- hypovolemia, tension pneumo, tamponade.

IV. When slides and dysrhythmias classification has been covered, two or three brief scenarios are presented to the participants as examples of stable and unstable patients with dysrhythmias. Participants may ask for and receive further historical and physical exam information, then discuss appropriate management. Participants may volunteer or may be selected by the instructor. Each case, including a brief discussion of the proposed management reviewing key content points, should take no more than 5 minutes.

Scenario 1: Arrhythmia III -- Slow Rhythm, Unstable Patient

You are in the hospital to increase your clinical expertise in caring for children. You are teamed with an RN on the infant ward. You hear the cardiac alarm on one of your charges.

You rush to the bedside where you see a distraught mother feeding her baby. The monitor shows sinus bradycardia. Knowing what you do about the most common cause for bradycardia in this population, what will you do?

Instructor Information:

1. Formula dribbling from mouth.
2. No spontaneous respiratory effort.
3. HR 40.
4. Monitor shows narrow complexes.
5. Color -- pale with facial cyanosis.
6. Weak radial pulse.
7. Unresponsive

Acceptable Action:

1. Chin-lift/jaw thrust
2. Suction the airway.
3. Bag-valve-mask ventilation with 100% 0_2
4. Reassess pulse.
5. Attach monitor leads.

Unacceptable Actions:

1. Starting an IV before initiating airway management.
2. Attempting intubation before clearing the airway and starting non-invasive assisted ventilation.
3. Administering Atropine or Epinephrine.

Case Development:

When acceptable actions are performed, the infant's heart rate rises, spontaneous respirations resume, and the baby starts crying. If the airway is not managed and supplemental oxygen administered, the baby becomes asytolic and the case ends.

Content Points:

1. Slow rhythms in children usually represent sinus bradycardia and are due to hypoxemia.
2. The treatment of the unstable pediatric patient with a slow rhythm is oxygenation and ventilation. No further intervention, in the form of drug treatment, is often necessary.
3. IV access is a lower priority than airway management in the patient with a slow rhythm.

4. The use of Atropine or Epinephrine prior to oxygenation and ventilation is not likely to resuscitate the patient.

Scenario 2: Fast Rhythm: Unstable Patient

You are called to evaluate an 8-month-old female with a five-day history of vomiting and diarrhea. Mom states that the infant is "not acting right." On initial observation, you note a lethargic infant with mottled skin and no spontaneous movement.

Instructor Information:

1. Scene is safe and PPE is available.
2. Airway is patent.
3. Respiratory rate 60, with good air entry, clear lungs.
4. Heart rate 170, narrow complexes.
5. Brachial pulses absent; femoral pulse weak.
6. Capillary refill 4 seconds.
7. Extremities cool, skin mottled.
8. BP -- no infant cuff in rig!
9. Cries with painful stimulus but no response to mother's voice.
10. Temperature 37^0 C (98.6^0 F)

Acceptable Actions:

1. Administer supplemental 0_2.
2. Apply cardiac monitor.
3. If BLS -- transport.
4. If ALS:
   a. Obtain peripheral IV/IO line
   b. Administer 20 cc/kg LR/NS boluses, re-evaluate after each bolus.
   c. Notify receiving facility and transport.

Unacceptable Actions:

1. Any treatment of heart rate with cardioversion or drugs.
2. Airway intervention (other than 0_2).
3. Not using isotonic fluid (e.g., D5W).
4 Prolonged field attempts at IV placement if transport time is short.

Case Development:

If the child receives supplemental 0_2, she remains stable in transport. If vascular access is achieved and fluid boluses given, she becomes more alert and perfusion improves.

Content Points:

1. Sinus tachycardia is the most common 'fast' rhythm in children and treatment is directed to its underlying cause -- in this case, hypovolemia from fluid loss.
2. The diagnosis of early shock is difficult in children, due to their intact compensatory mechanisms and ability to maintain cardiac output with very fast heart rates. Blood pressure is the least reliable sign of impending shock, as hypotension may not develop until the child is 20-25% dehydrated. Clinical signs of shock should be evaluated and volume resuscitation started on that basis.

Scenario 3: Absent Rhythm

You are the first responder at the scene of a near drowning. A two-year-old boy fell into the family pool, with a submersion time of approximately 2 minutes. On your arrival, the child is cyanotic and receiving ineffective chest compressions by his baby-sitter.

Instructor Information:

1. Scene is safe and PPE is available
2. Airway obstructed by tongue.
3. No spontaneous respiratory effort.
4. Pulseless, monitor shows asystole.
5. Unresponsive.

Acceptable Actions:

1. Open airway -- chin lift/jaw thrust.
2. Suction.
3. Initiate bag-valve mask ventilation with 100% 0_2.
4. Chest compressions -- 100/minute.
5. Reassess pulse.
6. Attach monitor leads.
7. Notify receiving facility and transport.

Unacceptable Actions:

1. Starting an IV before initiating airway management.
2. Attempting intubation before clearing the airway and starting non-invasive assisted ventilation.
3. Administering Atropine or Epinephrine prior to assessing effects of oxygenation/ventilation.

Case Development:

When acceptable actions are performed, the child develops a normal sinus rhythm, initiates spontaneous respirations and cries. If the airway is not managed and supplemental oxygen given, the child continues apneic and pulseless, and the case ends.

Content Points:

1. Hypoxemia in children leads to progressive bradycardia and asystole, often without intervening ventricular dysrhythmias.
2. The initial treatment of asystole is oxygenation, ventilation and chest compressions. Drug therapy should be considered only if these measures fail to produce a perfusing rhythm.
3. Profound hypoxmia often leads to permanent neurologic devastion, even in the face of a successful cardiac resuscitation.

Scenario 4: Arrhythmia I -- Fast Rhythm, Stable Patient

You and your partner get called to a home where a toddler is found playing on the floor. He looks a little short of breath and is irritable but continues playing. The child's mother states that the child's heart rate is very fast and that this has happened before. She wants to take the child to the hospital right away. What will you do now?

Instructor Information:

1. Scene is safe and PPE is available
2. Heart rate 300 beats/minute, narrow complexes.
3. Systolic blood pressure - 90 mm Hg.
4. Respiratory rate is 60, with mild flaring.
5. Skin is cool peripherally, pink, capillary refill is 2 seconds.
6. Afebrile.
7. No history of vomiting, diarrhea or decreased intake.

Acceptable Actions:

1. Give oxygen as tolerated.
2. Attach monitor.
3. Notify receiving facility.
4. Transport with the mother in attendance.
5. Continue to monitor perfusion in transport.

Unacceptable Actions:

1. Any drug treatment of this arrhythmia immediately.
2. Cardioversion of this arrhythmia, since the patient is stable.

Case Development:

1. If nothing invasive is done, the toddler remains stable in transport.
2. if cardioversion is attempted, the child arrests and the case is stopped.

Content Points:

1. Only unstable rhythms need immediate treatment. Review the criteria for 'unstable'. note that although cardiac problems are common in adults, they are rare in children. Even when they are encountered, as in this infant with SVT, most patients are stable and no immediate treatment is necessary.
2. The differentiation of SVT and sinus tachycardia may be reviewed here (refer to table: Sinua Tachycardia vs. SVT).

TABLE 1
SUMMARY OF THE TREATMENT OF UNSTABLE RHYTHMS

Heart Rate	Most Common Diagnosis	Treatment
Slow	Sinus	Newborn: Ventilation, oxygenation, chest compressions, Epinephrine Child: Ventilation, oxygenation, chest compressions, epinephrine
	Heart block	Ventilation, oxygenation, chest compressions, Atropine, Isoproterenol or Epinephrine infusion
Fast	Narrow QRS SVT	Synchronized cardioversion if unstable
	Atrial fibrillation	Synchronized cardioversion if unstable
	Atrial flutter	Synchronized cardioversion if unstable
	Wide QRS* Ventricular tachycardia	Defibrillation[+]
Absent	Ventricular fibrillation	Defibrillation, CPR, oxygen, Epinephrine, Lidocaine, Bretylium
	Asystole	CPR, oxygen, Epinephrine, Atropine
	PEA	CPR, Epinephrine, treat underlying causes, e.g., hypovolemia, tension pneumothorax, cardiac tamponade, etc.

*Although wide complex SVT does not need Lidocaine, in the unstable situation the differentiation between ventricular and supraventricular origin is often difficult. When in doubt, it should be treated as ventricular tachycardia.

[+]Unstable ventricular tachycardia at the extremely rapid rates seen with these patients is treated with emergency countershock. It may be difficult to distinguish QRS and T-wave. Thus, unsynchronized cardioversion is recommended. Ventricular tachycardia without a pulse is managed like ventricular fibrillation.

TABLE 2
SYMPTOMS AND SIGNS OF IMPENDING CIRCULATORY FAILURE WITH RHYTHM DISTURBANCES

Definition of the Unstable Patient

OBJECTIVE MEASURES:

Child — BP -- Hypotension (mm Hg) = < 70 + (2 x age in years)

Newborn — Pulse -- Bradycardia = < 80 beats/min

CLINICAL CRITERIA:

Symptoms: Irritability, sweating, anorexia, vomiting, altered mental status.

Signs: Mottling, pallor, cyanosis, cool moist skin, delayed capillary refill, increased respiratory rate, and the classical signs of congestive heart failure rales, enlarged liver, and edema.

TABLE 3
SINUS TACHYCARDIA VS. SVT

Supraventricular tachycardia (SVT) may be difficult to distinguish from sinus tachycardia. The following points may help distinguish these rhythms.

	Sinus Tachycardia	Supraventricular Tachycardia
HR	180-215, rate may fluctuate	> 220 (usually 250-350), rate constant
HX	Fever, anxiety, volume loss from bleeding, vomiting, diarrhea, etc.	Irritability, poor feeding, vomiting, tachypnea, pallor, altered mental status
PE	Fever, signs, of dehydration, poor perfusion	Signs of poor skin perfusion, rapid respiratory rate, rales, edema, enlarged liver
ECG	Rarely helpful, P-wave may not be seen	Regular rhythm, P-wave not seen

PEDIATRIC IMMOBILIZATION

PARTICIPANT OBJECTIVES:

1. Demonstrate the adaptation of adult equipment to effectively immobilize the infant or child trauma victim.
2. Demonstrate removing a child from a car seat, for immobilization.
3. Demonstrate immobilization of a child in the appropriate pediatric immobilization device.

Teaching Strategies and Procedures:

This is an entirely interactive station in which the instructor and students demonstrate effective techniques for adapting adult equipment to immobilize children. Live models or manikins are utilized.

Time and Student:Teacher Ratio:

1. Total Time: 30 minutes
2. Student:Teacher ratio: 5:1

Equipment List:

1. 1 - Long backboard with attached straps
2. 1 - Short backboard or KED
3. 3 - Rolls 2" tape, hypoallergenic
4. 5 - Blankets
5. 3 - Pediatric C-collar, 1 each small, medium and large
6. 4 - Towels
7. 1 - Pillow
8. 1 - Scissors
9. 1 - Car sear
10. 1 - Infant sized manikins
11. 1 - Child, age 4-8
12. 1 - Hare Traction device
13. 1 - Pediatric Immobilization device
14. 1 - Pediatric Vacuum Splint Mattress

Content and Key Teaching Points

I. Extrication of a child from the child safety seat
   A. Manual C-spine immobilization is taken by one rescuer
   B. The safety seat is removed from the vehicle, with the assistance of a second rescuer, in the upright position.
   C. C-spine immobilization is maintained until the safety straps are removed.
   D. Cervical collar is applied, while maintaining stabilization.
   E. Manual stabilization is maintained while the safety seat is centered on the back board and slowly tilted into the supine position.
   F. The child with the large head, place a towel under the area where shoulders will eventually be placed on the board to prevent the head from tilting forward.
   G. The rescuer at the head calls for a coordinated long axis move onto the backboard.
   H. Manual stabilization is maintained until the proper padding is applied to the torso and neck prior to placement of the straps.

II. Use of a Short Spine Board
   A. Review indications
      1. Effective for smaller children as an immobilization and restraining device.
      2. Degree of injury or mechanism of injury determines need.
      3. Any change in LOC or a head injury is assumed to have a spinal injury until cleared by X-ray.
   B. C-spine immobilization
      1. Neutral in-line immobilization without traction.
      2. Cervical collar if correct size is available.
      3. Use towels or blanket roll if collar not available.
      4. Explain intended moves and reassure patient.
      5. Log roll patient onto board.
      6. Use sides of KED to secure torso.
      7. Use blankets or towels to fill in gaps.
      8. Use sides by head to help secure head.
      9. Use towels or blankets to fill in gaps.
      10. Use tape across forehead only.
      11. Place unit onto long backboard for transport.

III. Use of Long Backboard
- A. Review indications
  1. Degree of injury or mechanism of injury determines need.
  2. Any change in LOC or head injury is assumed to have a spinal injury until cleared by X-ray.
- B. C-spine immobilization
  1. Neutral in-line immobilization without traction.
  2. Cervical collar, if correct size is available.
  3. Use blanket rolls or towels if collar not available.
  4. Manual stabilization is only technique truly 100% effective.
  5. Explain intended moves and reassure patient.
  6. Log roll patient onto board.
  7. Use blanket rolls and towels to fill in gaps.
  8. Place straps across shoulders and hips.
  9. Secure head with a blanket roll or commercially available head immobilizers.
  10. Tape across forehead only.
  11. Fasten legs to spine board.

IV. Use of pediatric specific immobilization device.
- A. Review of indications
  1. Effective for the 2-10 year old population
  2. Size of 28-54 inches tall and 20-90 pounds
  3. Degree of injury or mechanism of injury determines need.
- B. Proper Technique
  1. Neutral inline c-spine immobilization without traction
  2. Apply appropriate size cervical collar
  3. Log roll patient onto device with ears aligned with the slots of the head support.
  4. Align the color-codes restraints with the patient as follows:
     a. Chest restraint (red) - even with patient's armpits.
     b. Upper-hip restraint (yellow) - just above the patient's hips (on the iliac crest).
     c. Lower-hip restraint (yellow) - just below the patient's hips.
     d. Thigh restraint (green) - just above patient's knees.
     e. Leg restraint (blue) - even with patient's ankles.
  5. When padding is needed, place the Pedi-Pad on the Pedi-Pac.
  6. When individual leg immobilization is needed, fasten the leg restraint.
  7. Fasten the wrist restraints. (Figure I)
  8. Tighten the restraints to limit movement but not to impair circulation.

9. Bring the shoulder restraints over the patient's shoulders, and fasten the shoulder restraints to the chest restraint. (Figure J)
10. Wrap the head-support around the patient's head. The slots in the head support should be in line with the patient's ears.
11. Place a forehead/chin restraint on the patient's forehead (Figure L). Press the forehead/chin restraint against the fastening strips on the sides of the head-support flaps.
12. Thread each end of the forehead/chin restraint through a D-ring (Figure M).
    Fasten the end of the forehead/chin restraint to the fastening strip on the top of the forehead/chin restraint. Tighten the forehead/chin restraint snugly.
    Use the second forehead/chin strap is to secure the patient's chin, if needed.

V. Use of pediatric Evac-U-Split mattress
   A. Review of indications
      1. Effective for 2-10 year old population
      2. Size of 75-80 pounds
      3. Degree of injury or mechanism of injury determines needs.
   B. Proper technique
      1. Neutral inline C-spine immobilization without traction
      2. Apply appropriate size cervical collar.
      3. Align the child with yellow logo and yellow positioning buckle at head end.
      4. Keep beads evenly distributed throughout the mattress and evacuate air for
         slight ridgidness.
      5. Log roll the child in place and release the vacuum to allow the mattress to soften and conform to the shape of the patient.
      6. Secure straps snugly around patient
      7. Evacuate the air from mattress.
      8. Tape should be used to secure the forehead.

TEACHING STATIONS

Station #1 Multitrauma

Station #2 Near-drowning

Station #3 Shock

Station #4 Seizures

TEACHING STATIONS EQUIPMENT LIST

Station 1: Multitrauma

1. Junior manikin
2. Infant manikin
3. Bag-valve-mask device with infant and child sized masks
4. Endotracheal tubes - size 4.0 and 5.0
5. Stethoscope
6. IV catheters: Angiocath 18, 20, 22, Butterfly 20, 23 and intraosseous needle
7. Oral airways: size 1 and 3
8. Cervical collar - pediatric
9. Intubation head, laryngoscope and blades (optional)

Station 2: Near-drowning

1. Timmy manikin (3-year-old)
2. Adolescent model or manikin
3. Cervical collar - adult
4. Oral airways - size 2, 4
5. Bag-valve-mask device with toddler and adult sized masks
6. Oxygen mask or nasal prongs - adult size
7. Resuscitation drugs: Epinephrine, Atropine, and Sodium Bicarbonate, Lidocaine
8. Stethoscope
9. Endotracheal tubes - size 4.0, 4.5, 6.5
10. IV catheters - Angiocath 18, 20, 22, Butterfly 23, and intraosseous needle
11. Laryngoscope with a 2 Miller blade and a 3 MacIntosh (optional)
12. Length, weight and/or age based tape resuscitation devise

Station 3: Shock

1. Infant manikin
2. Bag-valve-mask device with infant size masks
3. Endotracheal tube: size 3.0, 3.5 and 4.0
4. Stethoscope
5. Poster with drug doses, ET tube sizes, weights etc.
6. IV catheters: Angiocath 22, 24, Butterfly 23, 25, and intraosseous needle
7. Oxygen mask or nasal prongs; infant size
8. Chemstrip
9. Infant intubation head, laryngoscope and No. 1 blade (optional)
10. Length, weight and/or age based resuscitation devise

Station 4: Seizures

1. Junior manikin
2. Bag-valve-mask device with infant and toddler sized masks
3. Endotracheal tubes - size 4.5, 5.0
4. Stethoscope
5. IV catheters: Angiocath 20, 22
6. Oral airway: size 2
7. Precalculated dose chart
8. Chemstrip
9. Nasogastric tube: size 10
10. Intubation head, laryngoscope with Miller 1 and 2 blades (optional)
11. Length, weight and/or age based resuscitation devise

STATION #1

MULTITRAUMA PRACTICAL STATION

PARTICIPANT OBJECTIVES:

1. Demonstrate the ability to perform a rapid initial assessment of the pediatric trauma patient.

2. Recognize hypovolemic shock and treat appropriately.

Teaching Strategies and Procedures:

Participants, in small groups will be given the opportunity to discuss and practice resuscitation priorities and psychomotor skills. Scenarios will be presented that will address the child with multi-system injuries, emphasizing care of the child with a head injury.

This is a teaching and skills practice station, not a testing station. The instructor may choose a team leader, or allow the students to self-select their roles. The format should be interactive with the instructor presenting the initial scenario, then providing additional historical and physical exam information in response to the participants' questions. Case progress depends on whether the student's actions are acceptable or unacceptable.

If a student is having difficulty managing the case, other participants may give direction. Inappropriate management is better handled by stopping the scenario and discussing key points than by having the patient's condition deteriorate.

The instructor may wish to take notes on the case management. When the case is completed, the instructor and participants should review its management, acknowledging correct treatment decisions and critiquing errors. Any content points not made in the course of the scenario should be addressed in a short didactic session or discussion at this time.

Time and Student:Teacher Ratio:

1. Total time: 30 minutes
2. Student:Teacher ratio: 5:1

Equipment List:

1. Junior manikin
2. Infant manikin
3. Bag-valve-mask device with infant and child sized masks
4. Endotracheal tubes -- size 4.0 and 5.0
5. Stethoscope
6. IV catheters: Angiocath 18, 20, 22, Butterfly 20, 23 and Intraosseous needle
7. Oral airways: size 1 and 3
8. Cervical collar -- pediatric

9. Intubation head, laryngoscope and blades (optional)
10. Length, weight and/or age based resuscitation devise

Content and Key Teaching Points

1. Emphasize that hypotension in children >18 months is rarely due to brain injury except as a terminal event. Shock and impending shock should be treated vigorously.

2. In absence of shock, keep fluid intake to maintenance levels to minimize cerebral edema.

3. Emphasize the importance of continued reassessment.

4. Blood loss from scalp wounds can be extensive, especially in children.

5. If the patient is unconscious and the injury is due to a vehicular accident, there is up to a 10% chance of cervical spine injury.

Scenario 1: Multitrauma: A five-year-old was involved in a pedestrian/motor vehicle accident. The child was thrown approximately 25 feet from the initial point of contact. The patient has been moved from the road onto a sidewalk. When the paramedics arrive, he is not moving and is breathing with very noisy respirations. He has a laceration over his left temporal area, numerous abrasions, and swelling and bruising of his left thigh.

Instructor information given upon request:
1. Scene is safe and personal protective equipment is available.
2. Airway -- patient has vomited and his airway is partially obstructed.
3. Respiratory rate is 14.
4. Heart rate: 140 beats/min.
5. Extremities are cold and capillary refill is >2 seconds.
6. There are no signs of external bleeding, except for the scalp laceration.
7. He responds to pain by withdrawing and moaning. He does not open his eyes. His left eye is swollen shut.
8. His pupils are equal and sluggish.
9. Patient's approximate weight is 17 kg.

Suggested sequence for Initial assessment and Resuscitation:
1. Scene is safe and personal protective equipment in place.
2. Open airway using jaw-thrust. Maintain strict immobilization of the head and neck. Suction the airway and insert an oral airway only if gag reflex is absent.
3. Bag-valve-mask ventilation with 100% oxygen.
4. Hyperventilate -- Endotracheal intubation may be required if the airway or adequate ventilation cannot be maintained.
5. Control bleeding from scalp laceration.
6. Insert an IV and bolus with 20 cc/kg of LR.
7. Patient should be well immobilized to the backboard.
   Left leg should be splinted.
8. Transport and notify receiving facility.

9. Skin signs, vital signs and LOC should be continually reassessed. Fluid boluses should be repeated if signs of shock persist.

Case Development: The child has an inadequate response to the first fluid bolus, but shows improved skin signs and decreased heart rate with the second bolus.

Scenario 2: "Shaken Baby Syndrome" -- Isolated Head Injury: You are called to a house for a 9-month-old baby who has stopped breathing. Mother's boyfriend is baby-sitting and states that the baby fell off the couch. The baby is lying in the crib. There are no obvious signs of trauma. The child is lethargic and breathing slowly.

Instructor information given upon request:
1. Scene is safe and personal protective equipment is available.
2. Airway is open -- respirations are 8 and shallow.
3. Skin is warm and capillary refill is normal.
4. Heart rate is 140.
5. Left pupil is 8 mm and fixed. Right pupil is 5 mm and reactive.
6. Full exam reveals linear bruises on both upper arms.
7. Patient weighs approximately 9 kg.

Suggested sequence for Initial assessment and Resuscitation:
1. Scene is safe and personal protective equipment in place.
2. Maintain airway and immobilization of cervical spine.
3. Bag-valve-ventilation while preparing for endotracheal intubation.
4. Intubate and hyperventilate with 100% oxygen.
5. Start an IV .
6. Transport with head elevated.
7. Skin signs, vital signs, and neuro exam should be assessed frequently.

Case Development: If ventilation is inadequate, the infant will continue to deteriorate, becoming progressively bradycardic and hypertensive.

Case Discussion: The "shaken baby syndrome" is characterized by diffuse CNS injury with subdural hematoma and retinal hemorrhages, often in the absence of external evidence of trauma. Treatment is focused on the management of elevated intracranial pressure. When an injury, as in this case, is not adequately explained by the history given, the EMS provider should always suspect abuse.

STATION #2

NEAR-DROWNING STATION

PARTICIPANT OBJECTIVES:

1. Recognize that all near-drowning victims should receive supplemental oxygen.

2. Demonstrate the initial approach to the near-drowning victim, with emphasis on the ABC's.

3. Know that support should not be terminated in the field in child who is hypothermic.

4. Know that hyperventilation is the treatment of choice in the field for acidosis.

Content and Key Teaching Points

1. The ultimate outcome of serious immersion accidents is largely dependent on the effectiveness of initial resuscitative efforts. Hypoxemia and acidosis must be corrected in the field to optimize outcome.
2. Swimming and diving accidents frequently include a spinal injury.
3. Treatment should not be terminated in the field in the child who is hypothermic.
4. The preferred field treatment for acidosis is hyperventilation.
5. Resuscitation drugs should be limited to one round in hypothermic patients due to decreased metabolism and circulation.

Scenario 1: A 15-year-old male has been involved in a swimming accident at a spot that is popular with local teenagers. The boy was reported to have jumped or dove from a rock outcropping into the river. He did not surface immediately and was pulled from the water a few minutes later about 25 yards downstream.

Instructor information given upon request:

1. Scene is safe and personal protective equipment is available.
2. Airway is partially obstructed.
3. Respiratory rate is 8.
4. Heart rate: 120 beats/min.
5. Extremities are cold.
6. The boy does not respond to his name and is not moving spontaneously. He opens his eyes to painful stimuli and pushes the examiners hand away.
7. There is an abrasion on his forehead.

Suggested sequence for Initial assessment and Resuscitation:

1. Scene is safe and personal protective equipment in place.
2. Open airway with jaw-thrust and immobilize the cervical spine.
3. Administer supplemental oxygen.
4. Check pulses and capillary refill.
5. Assess level of consciousness.
6. Expose and examine for other injuries.
7. Attach heart monitor.
8. Dry and wrap in warm blankets.
9. Transport rapidly with continued reassessment of respiratory, cardiovascular, and neurologic function.

Scenario 2: A three-year-old and his brother were walking along a frozen irrigation ditch. The three-year-old tried to retrieve a toy and fell through the ice. When you arrive a first responder has already begun CPR. No one knows how long the child was under water.

Instructor information given upon request:

1. Scene is safe and personal protective equipment is available.
2. Patient is apneic.
3. Heart rate is 40, no peripheral pulses palpated.
4. Pupils are fixed and dilated.
5. No response to painful stimulation.
6. No evidence of external injuries.

Suggested sequence for Initial assessment and Resuscitation:

1. Scene is safe and personal protective equipment in place.
2. Open airway.
3. Ventilate with bag-valve-mask and prepare to intubate.
4. Intubate (3 years old = 15 kg; 4.5 mm endotracheal tube).
5. Begin chest compressions.
6. Establish peripheral access if it can be rapidly achieved or place IO line.
7. Attach heart monitor.
8. Take core temperature.
9. Give epinephrine, 15 mg via IV, IO, or ET route.
10. Reassess rhythm and ventilation.
11. Continue ventilation and chest compressions.
12. Transport.

STATION #3

SHOCK AND SHOCK MANAGEMENT

PARTICIPANT OBJECTIVES:

1. Demonstrate assessment skills in evaluating adequacy of perfusion.

2. Verbalize arguments for and against starting an IV in the field versus transport without vascular access.

3. Demonstrate knowledge of appropriate IV sites in children of different ages.

4. Describe the protocol for initiating intraosseous infusion.

5. Demonstrate interventions, assessments, and repeated interventions that lead to the resuscitation of a child with shock or simple dehydration.

Teaching Strategies and Procedures:

Participants, in small group, will be given the opportunity to discuss and practice resuscitation priorities and psychomotor skills. Scenarios presented will address the child with dehydration and/or shock.

This is a teaching and skills practice station, not a testing station. The instructor may choose a team leader, or allow the students to self-select their roles. The format should be interactive with the instructor presenting the initial scenario, then providing additional historical and physical exam information in response to the participants' questions. Case progress depends on whether the student's actions are acceptable or unacceptable.

If a student is having difficulty managing the case, other participants may give direction. Inappropriate management is better handled by stopping the scenario and discussing key points than by having the patient's condition deteriorate.

The instructor may wish to take notes on the case management. When the case is completed, the instructor and participants should review its management, acknowledging correct treatment decisions and critiquing errors. Any content points not made in the course of the scenario shons

Time and Teacher:Student Ratio:

1. Time: 20 minutes
2. Teacher:Student ratio: 1:6-8

Equipment List:

1. Infant manikin
2. Bag-valve-mask device with infant size masks
3. Endotracheal tube; size 3.0, 3.5 and 4.0
4. Stethoscope
5. Poster with drug doses, ET tube sizes, weights, etc.
6. IV catheters: 22G, 24G Angiocath; 23G, 25G Butterfly; intraosseous needle
7. Oxygen adjunts(NRB,Simple Mask)
8. Chemstrip
9. Infant intubation head, laryngoscope and No. 1 blade (optional)
10. Length, weight and/or age based resuscitation devise

Content and Key Teaching Points

1. Early (compensated) shock is characterized by:
   - Diminished pulses
   - Delayed capillary refill
   - Decreased level of consciousness
   - Increased heart rate
   - Tachypnea

2. Hypotension is a late sign of shock. Blood pressure may not fall until 20-25% of the circulating blood volume is lost acutely.

3. Factors to consider in the decision to place an IV in the field include:
   - Effect of prolonged scene time and delay to definitive treatment
   - Transport time
   - Patient status/stability
   - Need for emergent IV therapy in prehospital phase
   - Experience of EMT in pediatric IV placement

4. Size of IV catheter and placement site will vary with patient age. Common sites in infants and toddlers include antecubital fossa, dorsum of hands and feet, greater saphenous vein at the ankle, scalp veins.

5. In the child in shock, attempts at the scene to secure peripheral IV access should not exceed two minutes. Consider intraosseous line placement when peripheral access cannot be rapidly achieved in infants and toddlers in shock.

6. Initial fluid resuscitation of shock is with 20 cc/kg of Crystalloid (NS or LR) IV or IO. Repeat boluses are given based on clinical response.

7. Emphasize the approach of assessment, action, assessment.

Scenario 1: Dehydration: You are called to the home of a young mother and her three-week-old baby. The mother tells you that the baby has been having frequent watery stools over the last 24 hours, is feeding poorly and is fussy. She has not yet established a physician for the baby and has no transportation to get to an emergency room.

Information available to participant upon request:

1. Scene is safe and personal protective equipment is available.
2. Airway is open and clear.
3. Breathing -- Infant is crying. Respiratory rate 40 breaths/min.
4. Circulation -- Heart rate 160, BP 65/45. Pulses are palpable peripherally but are diminished. Capillary refill is 3 seconds.
    a. Fontanelle sunken.
    b. Mucous membranes dry.
    c. No tearing.
    d. Urine output -- unknown due to mixing with stool.
5. Child is alert, responsive but irritable.
6. Existing diaper is heavy with a large watery stool.

Suggested sequence for Initial assessment and Resuscitation:
When an dehydrated infant is alert and perfusion is adequate, emergent IV rehydration is not indicated in the field. Oral rehydration may be initiated by offering the baby Pedialyte or D5W. Transport to the ER is imperative, because diarrhea in conjunction with decreased oral intake can lead rapidly to severe dehydration, metabolic acidosis and shock in this age group.

Scenario 2: Resuscitation of the child with shock: You are called by the grandmother of a 4-month-old male infant. The baby has been vomiting and having watery diarrhea for two days. The grandmother is not sure if the infant has urinated at all today. The baby's lips are dry and his fontanelle is sunken.

Instructor information given upon request:

1. Scene is safe and personal protective equipment is available.
2. Airway -- open, clear.
3. Breathing -- tachypneic at 70 breaths/min.
4. Circulation
    a. Heart rate 190.
    b. BP is 60/35.
    c. Femoral and brachial pulses only.
    d. Extremities cold to elbows and knees.
    e. Capillary refill is 5 seconds.
    f. Infant does not respond to his grandmother.

Suggested sequence for Initial Assessment and Resuscitation:

1. Scene is safe and personal protective equipment in place.
2. Give free flow 100% oxygen.
3. Rapidly establish intravenous access. Consider IO, if IV cannot be quickly placed.
4. Estimate child's weight (5 kg).
5. Give 20 cc/kg (100 cc) of normal saline as quickly as possible (over 5 minutes).
6. Check Chemstrip -- result is 40 mg/dl.
7. Give 2-4 cc/kg (10-20 cc) D25W IV.
8. Reassess
    a. Airway -- open, clear.
    b. Breathing -- tachypneic at 70 breaths/min. Aeration is good without evidence of rales.
    c. Circulation
        - Heart rate 170.
        - BP 66/40.
        - Femoral and brachial pulses only.
        - Extremities cold to mid-calf, mid-forearm.
        - Capillary refill is 3 seconds.
        - Child is more alert.
9. Repeat fluid bolus.
10 Reassess vital signs, skins signs, capillary refill, mental status.
11. Repeat Chemstrip -- 100 mg/dl.
12. Repeat fluid bolus as necessary based on assessment.

Note: Fluid volumes of up to 60-80 cc/kg may be necessary to adequately resuscitate a child in hypovolemic or septic shock. Reassessment of vital signs and signs of perfusion after each fluid bolus will dictate the amount of volume to be administered. Chemstrip should always be checked in infants with history of prolonged illness, poor intake or decreased mental status.

STATION #4:

SEIZURE MANAGEMENT

PARTICIPANT OBJECTIVES:

1. List four common causes of seizures in children and the historical information and physical exam findings which will help to define that etiology, e.g., febrile seizures, hypoglycemia, CNS intoxication, trauma, epilepsy, ingestion.

2. Define a simple febrile seizure and describe its proper field management.

3. Define status epilepticus.

4. Demonstrate the initial approach to the seizing child, with emphasis on the ABC's.

5. Know that administration of supplemental O_2 and a Chemstrip are required procedures in caring for any actively seizing child.

6. List three anticonvulsants used in the treatment of status epilepticus, indications for their use in the field, routes of administration, and complications.

7. Identify respiratory depression as a major complication of the pharmacologic treatment of seizures in the field.

8. Identify the intraosseous route as a potential means of administering anticonvulsants in status epilepticus when venous access cannot be readily achieved.

Teaching Strategies and Procedures:

Participants, in small groups, will have the opportunity to discuss and practice treatment priorities and psychomotor skills in the management of a child with seizures. Scenarios will be presented which address the child with a simple febrile seizure, needing no field treatment, and the child in status epilepticus, requiring advanced life support.

This is a teaching and skills practice station, not a testing station. The instructor may choose a team leader, or allow the students to self-select their roles. The format should be interactive with the instructor presenting the initial scenario, then providing additional historical and physical exam information in response to the participants' questions. Case progress depends on whether the student's actions are acceptable or unacceptable.

If a student is having difficulty managing the case, other participants may give direction. Inappropriate management is better handled by stopping the scenario and discussing key points than by having the patient's condition deteriorate.

The instructor may wish to take notes on the case management. When the case is completed, the instructor and participants should review its management, acknowledging correct treatment decisions and critiquing errors. Any content points not made in the course of the scenario should be addressed in a short didactic session or discussion at this time.

Time and Teacher:Student Ratio:

1. Total time: 20 minutes
2. Teacher:Student ratio: 1:5

Equipment List:

1. Timmy manikin
2. Bag-valve-mask device with infant and toddler sized masks
3. Endotracheal tubes -- size 4.5, 5.0
4. Stethoscope
5. IV catheters: Angiocath 20, 22G
6. Oral airway: size 2
7. Precalculated dose chart
8. Chemstrip
9. Nasogastric tube: 10 Fr
10. Intubation head, laryngoscope with Miller 1 and 2 blades (optional)
11. Length, weight and/or age based resuscitation devise

Simple Febrile Seizure:
Content and Key Teaching Points

1. Definition of a simple febrile seizure: patient 5 months-5 years of age; occurs in first 24 hours of febrile illness; nonfatal, generalized tonic-clonic seizure; less than 15 minutes duration; no underlying neurologic / developmental abnormality; no evidence CNS infection.

2. The majority of febrile seizures will have stopped before EMS arrives on scene.

3. Febrile seizures are not associated with long term neurologic complications. The morbidity of field treatment should not exceed that of the disease process itself! No field treatment, other than supportive measures, should be initiated in the child with a brief, self-limited febrile seizure.

4. All children with febrile seizures should be evaluated by a physician. Transport of the non-seizing child may, on occasion, be safely undertaken by parents.

Scenario 1: A 24-month-old boy, well until this AM when he complained of ear pain, had a 2 minute generalized tonic-clonic seizure at daycare. On arrival of your Medic unit, the child is sleepy but arousable and hot to the touch. While the parents are being phoned for information about the child's health history and private physician, you witness a second generalized seizure lasting 90 seconds.

Instructor information given upon request:

1. Scene is safe and personal protective equipment is available.
2. Vital signs: HR 140, R 20, BP 100/65, Temp 39.5 C /103.1 F (per parents), Chemstrip 160.
3. History negative for head trauma, ingestions, seizure history.
4. Seizure is nonfocal, involving upper and lower extremities. Pale with poor respiratory effort during episode.
5. Postictal state: sleepy; does not arouse to voice but withdraws from pain; good respiratory effort with mild upper airway obstruction; pink, with 2 second capillary refill.

Suggested sequence for Initial Assessment and Resuscitation:

1. Scene is safe and personal protective equipment in place.
2. Open airway by positioning head, chin-lift/jaw-thrust.
3. Supplemental O_2.
4. Evaluate circulation (pulses, capillary refill).
5. Chemstrip -- 160 mg/dl.
6. No IV necessary.
7. Serial neuro exams.
8. Tylenol as directed by medical control.
9. Transport to private physician or emergency room for evaluation, via parents or EMS.

Case Development: If paramedics place IV and give anticonvulsants, patient develops respiratory depression and requires assisted ventilation.

Status Epilepticus:
Content and Key Teaching Points

1. Airway protection, oxygenation and ventilation are priorities, regardless of the etiology of a seizure. Assisted ventilation may not be effective in the actively seizing patient due to muscular rigidity and difficulty opening the airway.
2. Treatment of seizures with a combination of benzodiazepines (Valium, Ativan) and barbiturates (Phenobarbital) may lead to profound respiratory depression and apnea. Treatment with >0.3 mg/kg Valium alone is likely to result in respiratory depression. Preparation for assisted ventilation must be made before using these drugs.
3. IV or IO anticonvulsants should be considered in children with ongoing seizures, especially in the face of respiratory depression, cyanosis, or long transport time.
4. Tricyclic antidepressant overdose may lead to rapid neurologic deterioration, seizures, respiratory failure and cardiac arrhythmias in children. The combination of supraventricular tachycardia and seizures should always suggest tricyclic overdose. Seizures may be very difficult to control. Phenobarbital should be avoided due to cardiac depressant effect. Intubation is frequently needed.

Scenario 2: You receive a call to a home daycare where a 2-year-old boy is having a generalized seizure. The child is on the floor, with clenched jaw, and poor respiratory effort. The daycare provider knows of no prior seizure history, or preceding illness. She found a bottle of her Elavil (amitriptyline) tablets open

in the kitchen where the child had been playing, with an unknown number of pills missing. Duration of seizure at the time of EMS arrival is 10 minutes.

Instructor information given upon request:

1. Scene is safe and personal protective equipment is available.
2. Vital signs: HR 180, R 15, BP 120/90, afebrile.
3. Airway is partially obstructed by tongue; child has vomited.
4. Air movement is poor with little chest rise.
5. Skin pale, cool with cyanosis around the mouth; radial pulses palpable.
6. Neuro exam: ongoing generalized seizure activity with dilated, slowly reactive pupils; no response to stimuli.

Suggested sequence for Initial Assessment and Resuscitation:

1. Scene is safe and personal protective equipment in place.
2. Open the airway, suction vomitus, ± insert oral airway.
3. Attempt bag-valve-mask ventilation with 100% O_2.
4. Prepare for intubation (2 years old = 12 kg; Miller 2 blade, 4.5 mm OD oral endotracheal tube; ? Anectine 1 mg/kg IV/IO or 4 mg/kg I).
5. Evaluate circulation (pulses, capillary refill, color).
6. Establish IV access -- consider IO.
7. Apply cardiac monitor.
8. Valium 0.1 mg/kg IV/IO -- repeat every 5 minutes for seizure control.
9. Reassess ABC's.
10. Consider NG tube placement.
11. Transport with ongoing cardiac monitoring, hyperventilation, neurologic checks.

Case development: If child is not intubated, bag-valve-mask ventilation is ineffective in face of ongoing seizure. If Valium is given, seizure is controlled but ventilatory assistance is needed -- bag-valve-mask or endotracheal tube. If the patient is ventilated with bag-valve-mask and an NG not placed, the patient vomits.

APPENDICES

Pediatric Vital Signs

Age	Heart Rate	Blood Pressure (systolic)	Respirations	Weight (kg)
Newborn	100-160	50-70	30-60	3
1 - 6 wks	100-160	70-95	30-60	4
6 months	90-120	80-100	25-40	7
1 year	90-120	80-100	20-30	10
3 years	80-120	80-110	20-30	15
6 years	70-100	80-110	18-25	20
10 years	60-90	90-120	15-22	30

(From Seidel,J.S. and Henderson,D.P. Prehospital Care of Pediatric Emergencies, 1987)

CHILDREN'S MODIFIED COMA SCORE/GLASGOW COMA SCORE

Eye Opening

INFANTS	CHILDREN, ADULTS
4 Spontaneous	Spontaneous
3 To speech	To verbal stimuli
2 To pain	To pain
1 No response	No response

Best Motor Response

INFANTS	CHILDREN, ADULTS
6 Normal spontaneous movement	Follows commands
5 Withdraws to touch	Localizes pain
4 Withdraws to pain	Withdraws to pain
3 Abnormal flexion	Abnormal flexion to pain
2 Abnormal extension	Abnormal extension
1 No response	No response

Best Verbal Response

INFANTS	CHILDREN, ADULTS
5 Coos and babbles	Oriented
4 Irritable cries	Confused
3 Cries to pain	Inappropriate words
2 Moans to pain	Non-specific sounds
1 No response	No response

APGAR CHART

	Score		
Muscle Tone	0	1	2
Activity	Limp	Some Flexion	Action, good flexion
Pulse	Absent	>100/min	<100/min
Reflex Irritability* (Grimace)	Absent	Some grimace or avoidance	Cough, cry, or sneeze
Color (appearance)	Blue/pale	Pink body, blue hands/feet	Pink
Respirations	Absent	Slow, irregular, ineffective	Crying

*Nasal or oral suction catheter stimulus

EQUIPMENT GUIDELINES ACCORDING TO AGE AND WEIGHT

EQUIPMENT	Premie 1-2.5 kg	Neonate 2.5-4 kg	6 months 6-8 kg	1 year 10-12 kg	2-3 years 13-15 kg	4-5 years 16-18 kg	6-7 years 19-24 kg	8-10 years 25-30 kg
Airway - oral	Infant	Infant/ Small	Small	Small	Small	Medium	Medium	Medium/ Large
O_2 Ventilation Mask	0 Premie	0 Newborn	1 Infant/ Child	1 Child	2 Child	3 Child	4 Child	5 Small Adult
Bag-valve Device	Infant	Infant	Child	Child	Child	Child	Child/ Adult	Adult
Suction Catheter	5-6	6	6-8	8	10	10	10	10-12
Intraosseous Device	18	15	15	15	15	15	n/a	n/a
Nasogastric Tube (french)	5	5	8	8	10	10	10-12	12

PROTOCOLS