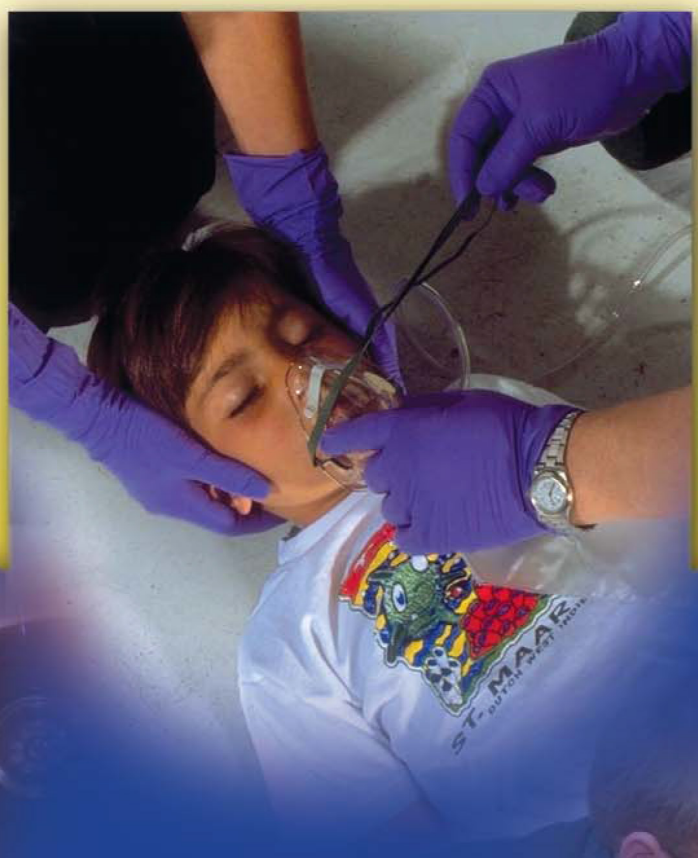
ITLS
International
Trauma Life Support



Pediatric Trauma Life Support

For Prehospital Care Providers

Ann Marie Dietrich, MD, FACEP, FAAP
Steven Shaner, EMT-P
Ohio Chapter
American College of Emergency Physicians

John Campbell, MD, FACEP,
Editor

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International Trauma Life Support
3000 Woodcreek Drive, Suite 200
Downers Grove, IL 60515 USA
Phone: 888.495.4857
630.495.6442 (international)
Fax: 630.495.6404
Web: www.itrauma.org
Email: info@itrauma.org

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FORWARD TO THE UPDATE

Trauma remains the major cause of death for children in developed countries and a leading cause of death in the developing world. Appropriate care of the injured child can greatly reduce the morbidity and mortality in this vulnerable population. Your commitment to improving pediatric trauma care, as evidenced by your giving of your time to participate in this course, is greatly appreciated. The authors and editors of the *Pediatric Trauma Life Support* (PTLS) course have gathered the most recent information in the field management of the pediatric trauma patient and collated this into this document along with updated references. As you will see, certain areas remain controversial, especially in contrast to management of the adult trauma patient. We recommend you periodically visit the ITLS website, www.itrauma.org, for updated information.

Thank you for what you do.

Ann Dietrich, MD, FACEP, FAAP

Editor, *Pediatric Trauma Life Support for Prehospital Care Providers*

Roy L. Alson, PhD, MD, FACEP

Editor, *International Trauma Life Support for Emergency Care Providers*

Definition

For this course and book, a pediatric patient is defined as one who is able to be assessed using a length based tape system (LBTS) (such as the Broselow® or SMART Tape® or similar). Patients who are longer than the tape are physiologically "adults" and should be managed using the ITLS adult trauma guidelines.

CHAPTER 1
The Injured Child

An injured child presents unique challenges, based on changing anatomy, physiology and psychology. In addition, emotional impact on the emergency medical responder (EMR) can have further impact on the child's care. Since the release of the 3rd edition of the *Pediatric Trauma Life Support* (PTLS) manual and course, there has been an increase in the number of incidents involving penetrating injuries to children, both from conflicts and criminal events. There has also been a rise in bombings from terrorist events. EMRs should be familiar with the mass casualty guidelines for their jurisdiction.

UPDATES

Mechanism of Injury
The mechanism of injury in children is 80-90% blunt trauma and 10-20% penetrating. Blunt mechanical force may result in penetrating injury from fender edges, door handles, shrapnel, etc.

Motor Vehicle Collisions
In children ages 5 to 19 years: Injuries from motor vehicle collisions are the top cause of death from injury.

Suffocation
Toddlers are most at risk from suffocating by choking on food or other small objects.

Drowning
Drowning is the most common cause of death from injury in children ages 1 to 4 years. Note that compression-only CPR is not as effective in the drowning victim and that ventilation is a key component of the resuscitation of the drowning victim.

Poisoning
Each day, more than 300 children ages 0 to 19 years in the United States go to emergency departments because of poisoning. Common sources of poisoning include household chemicals, cleaners, and medicines.

Burns
Younger children are more likely to be burned by hot liquids or steam. Older children are more likely to be burned from direct contact with fire.

Falls
Falls are the most common cause of nonfatal injuries for children ages 0 to 19 years. Anatomic differences in body habitus as the child ages will change the body's point of impact.

REFERENCES

Brinsfield, K., et al. *Bombings: Injury Patterns and Care Curriculum*. Course offered by the American College of Emergency Physicians (ACEP) and the Centers for Disease Control and Prevention (CDC). Information page accessed July 25, 2016, at http://www.acep.org/blastinjury/

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Unintentional Injury Prevention (2008). *CDC Childhood Injury Report: Patterns of Unintentional Injury Among 0-19 Year Olds in the United States 2000-2006*. Accessed May 2, 2016 at http://www.cdc.gov/safechild/child_injury_data.html

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Unintentional Injury Prevention (2012). *Child injury*. Accessed August 22, 2012, from http://www.cdc.gov/vitalsigns/ChildInjury/index.html

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Unintentional Injury Prevention. (2012). *Protect the ones you love: child injuries are preventable*. Accessed August 23, 2012, from http://www.cdc.gov/safechild

Daley, B.J. "Considerations in Pedatric Trauma: Overview, Epidemiology, Specific Injuries." Medscape, last updated November 2015. Accessed from http://emedicine.medscape.com/article/435031-overview

Jacobs, L.M., N. McSwain, M. Rotondo, D.S. Wade, W.P. Fabbri, A. Eastman, F.K. Butler, J. Sinclair; Joint Committee to Create a National Policy to Enhance Survivability from Mass Casualty Shooting Events. "Improving survival from active shooter events: the Hartford Consensus." *Bulletin of the American College of Surgeons* 98, no. 6 (June 2013):14-6.

Kawato, H., M. Hitosugi, K. Mizuno, Y. Matsui, and S. Tokudome. "Analysis of child-vehicle collision injuries by vehicle type." *Journal of Pediatric Surgery* 48, no. 7 (July 2013):1588-92.

"Scientific Data, Statistics and Surveillance." CDC Injury Prevention & Control: Data & Statistics (WISQARS). CDC Web page, last reviewed January 2016. Accessed on May 2, 2016 from http://www.cdc.gov/injury/wisqars/dataandstats.html

Semple-Hess, J., and R. Campwala. "Pediatric Submersion Injuries: Emergency Care and Resuscitation." *Pediatric Emergency Medicine Practice* 11, no. 6 (June 2014): 1-24.

"Ten Leading Causes of Death by Age Group." CDC Injury Prevention & Control: Data & Statistics (WISQARS). CDC Web page, last reviewed February 2016. Accessed from: http://www.cdc.gov/injury/wisqars/leadingcauses.html

Traub, S. "Communicating Effectively with Children." University of Missouri Extension, GH6123, revised April 2016. Accessed at http://extension.missouri.edu/p/GH6123

CHAPTER 2 & 3

Assessment of the Pediatric Trauma Patient

The basic components in the assessment of the injured pediatric patient remain unchanged. By using a standardized approach for each patient, you reduce the risk of missing key findings. The sequence that should be followed is:

- ITLS Primary Survey
  - Scene Size-Up
  - Initial Assessment
  - Mechanism of Injury
    - Rapid Trauma Survey or Focused Exam
  - Critical Transport Decision and Interventions
- ITLS Ongoing Exam
- ITLS Secondary Survey

Remember that the assessment of the event begins during response, based on the information provided. Keep in mind that based on the MOI, the injury patterns seen in the pediatric patient will vary with age.

UPDATES

Preparation

Instead of a brand name, the term has been changed to "length based color coded tape". Use a LBCCT, but also use common sense!

ITLS Primary Survey

Airway loss remains the primary cause of correctable trauma arrest in children. Exsanguinating bleeding is much less common in this age group. For most pediatric blunt trauma, the ABC sequence should be followed as opposed to the CABC sequence recommended by ITLS for adult patients.

Spinal motion restriction (SMR) is still advised in children. There is no research to discontinue the use of SMR in pediatric patients. Larger, heavier heads and the possibility of SCIWORA have made pediatric trauma centers continue to advocate for SMR along with appropriate spinal clearance protocols. Based on age, assessment of spinal injury in children can be a challenge. Note that pediatric trauma centers try to remove the "transport device" (i.e., backboard) as soon as possible after assessment. As more information becomes available, ITLS will provide updated guidelines on SMR in pediatric patients.

Patient Assessment Algorithm

The order of the ITLS patient assessment has changed to:

1. PTLS Primary Survey
2. ITLS Ongoing Exam
3. PTLS Secondary Survey

The ITLS Ongoing Exam is more common and may replace a Pediatric Secondary Survey. Note that the ITLS Ongoing Exam should be performed any time there is an intervention or change in patient status and with short transport times, as the EMR may not have time to perform the full Pediatric Secondary Survey.

Serum Lactate

Serum lactate is a marker of tissue hypoxia. It has been used in the field on adult patients to help predict those patients with normal vital signs that may have occult internal injury. It is not well studied in pediatrics. There is some evidence to suggest that a lactate level over 4.7 is associated with severe injury but lacks adequate sensitivity or specificity. Lactate levels under 2.0 are reassuring for absence of severe injury, and levels between 2.0 and 4.7 are indeterminate in predictive potential for injury or outcomes.

REFERENCES

Baren, J. *Pediatric Emergency Medicine*, 1st ed. Philadelphia, PA: Saunders Elsevier, 2008.

Bickley, L.S. *Bates Guide to Physical Exam and History Taking*, 11th ed. Philadelphia, PA: Lippincott, Williams & Wilkins, 2015.

Dieckman, R. *Pediatric Education for Prehospital Professionals*, 2nd ed. Sudbury, MA: American Academy of Pediatrics and Jones & Bartlett, 2006.

Knight, J.C., M. Nazim, D. Riggs, J. Channel, C. Mullet, R. Vaughn et al. "Is The Broselow Tape A Reliable Indicator For Use In All Pediatric Trauma Patients? A Look At A Rural Trauma Center." *Pediatric Emergency Care* 27, no. 6 (June 2011): 479-482.

Leonard, J.R. "Cervical Spine Injury Patterns in Children." *Pediatrics* 133e (2014): 1179.

Pieretti-Vanmarcke, R., et al. "Clinical Clearance of the Cervical Spine in Blunt Trauma Patients Younger than 3 Years: A Multicenter Study of the American Association for the Surgery of Trauma." *Journal of Trauma - Injury Infection & Critical Care* 67, no. 3 (September 2009): 543-550.

Ramanathan, R. "Utility of Administration of Serum Lactate in Pediatric Trauma."*Journal of Pediatric Surgery* 50, no. 4 (April 2015): 598-603.

Rogers, F.B., and K. Rittenhouse. "The Golden Hour in Trauma: Dogma or Medical Folklore?" *The Journal of Lancaster General Hospital* 9, no. 1 (Spring 2014).

White, C. "NAEMSP Position Paper: EMS Spinal Precautions." *Prehospital Emergency Care* 18 (2014): 306-314.

CHAPTER 4 & 6

The Pediatric Airway & Airway Management and Thoracic Trauma Skills

Adequate ventilation and oxygenation are critical to the management of the pediatric trauma patient. The size of the pediatric airway and the lack of experience of EMRs increases the challenge in the unstable patient. Regular training in the management of the pediatric airway will improve outcomes.

UPDATES

Two major changes in the management of the pediatric airway are:

1. Use of cuffed tubes as the first choice for endotracheal intubation in all pediatric patients.
2. The Sellick maneuver, in which gentle pressure is applied to the cricoid cartilage to prevent regurgitation, has been shown to be ineffective and is no longer recommended. EMRs can decrease incidence of regurgitation by proper ventilation with the bag-valve-mask, and not using excessive pressures or volumes.

In thoracic trauma, the flexible ribs of younger children decreases risk of flail segments. With the rise of penetrating trauma due to war, terrorism and gun violence, the risk of both open and tension pneumothoraces has increased. Be aware that the large needles used in adults for chest decompression may cause injury if inserted fully in young children.

REFERENCES

de Caen, A.R., M.D. Berg, L. Chameides, et al. “Part 12: Pediatric Advanced Life Support: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.” *Circulation* 132, no. 18, suppl 2 (November 3, 2015): S526-42.

Maconochie, I.K., A.R. de Caen, R. Aickin, et al. “Part 6: Pediatric Basic Life Support and Pediatric Advanced Life Support: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.” *Resuscitation* 95 (October 2015): e147-68.

Stewart, J., S. Bhananker, and R. Ramaiah. “Rapid-sequence intubation and cricoid pressure.” *International Journal of Critical Illness & Injury Science* 4, no. 1 (Jan-March 2014): 42–49.

CHAPTER 7

Pediatric Shock and Fluid Resuscitation

UPDATES

Tourniquet Use for Uncontrolled Extremity Bleeding

In adult trauma, data from combat casualties has led to a revision of the ABC approach to CABC, where the first "C" represents controlling life-threatening bleeding. In this situation, tourniquet application is life-saving. Such bleeding should be obvious to the EMR on approach. Most pediatric trauma is blunt, with early deaths associated with loss of airway and internal bleeding (non-compressible hemorrhage). The airway is always the first priority in the pediatric patient.

Tranexamic Acid (TXA)

Tranexamic acid (TXA) is recommended for treating life-threatening hemorrhage in adults. Few studies deal with the use of TXA in the civilian pediatric population. In the Ped-Trax study, dealing with combat type wounds in children, TXA was noted to have some mortality benefit but there is not enough evidence at this time to recommend universal use of TXA. Use should be based upon a decision by medical direction.

REFERENCES

Borgman, M., R.I. Matos, L.H. Blackbourne, P.C. Spinella. "Ten years of military pediatric care in Afghanistan and Iraq." *Journal of Trauma and Acute Care Surgery* 73, no. 6, suppl 5 (December 2012): S509-13.

Eckert, M.J., T.M. Wertin, S.D. Tyner, D.W. Nelson, S. Izenberg, and M.J. Martin. "Tranexamic acid administration to pediatric trauma patients in a combat setting: the pediatric trauma and tranexamic acid study (PED-TRAX)." *Journal of Trauma and Acute Care Surgery* 77, no. 6 (December 2014): 852-8; discussion 858.

Sokol, K.K., G.E. Black, K.S. Azarow, et al. "Prehospital interventions in severely injured pediatric patients: Rethinking the ABCs." *Journal of Trauma and Acute Care Surgery* 79, no. 6 (December 2015): 983-9.

CHAPTER 9

Pediatric Abdominal Trauma

There are no major changes in the approach and management of abdominal trauma in the pediatric patient. Remember that presentation of shock in a pediatric patient is different from adults due to differences in anatomy and physiology of the pediatric patient. Tachycardia is an early sign. While anxiety and pain can cause tachycardia, you must look for occult injury. Abdominal bleeding is not readily apparent on the scene.

REFERENCES

American College of Surgeons. "Pediatric Trauma." In *Advanced Trauma Life Support for Doctors*, 9th ed. Chicago: Author, 2012.

Bloom, I., M. White, A. Yancey. "Chapter 13: Abdominal Trauma." In *International Trauma Life Support for Emergency Care Providers*, 8th ed, edited by J.E. Campbell and R.L. Alson, 255-264. Upper Saddle River, N.J.: Pearson, 2015.

Chameides, L., M. Ralston et al. *Pediatric Advanced Life Support: Provider Manual*. Dallas: American Heart Association, 2011.

Saldino, R., and D. Lund. "Abdominal Trauma" In *Fleisher & Ludwig's Textbook of Pediatric Emergency Medicine*, 7th ed., edited by R. Bachu, K.N. Shaw et al, 1115-1125. Philadelphia, PA: Lippincott, Williams and Wilkins, 2016.

Tepas III, J.I., M. Fallat, T.M. Moriaty. "The Child with Abdominal Injury" In *APLS: The Pediatric Emergency Resource*, 5th ed., edited by S. Fuchs and L. Yamamoto, 165-168. Burlington, MA: Jones and Bartlett, 2012.

Tuggle, D.W., N.S. Kreykes. "Chapter 43. The Pediatric Patient." In *Trauma*, 7th ed., edited by K. Maddox. New York: McGraw-Hill, 2013.

CHAPTER 10

Pediatric Head Trauma

There are no major changes in the approach to the management of traumatic brain injury (TBI) in the pediatric patient. Focus should remain on ensuring good oxygenation and perfusion, which reduces the incidence of secondary brain injury.

CHAPTER 11

Pediatric Spinal Trauma

There has been much written recently about changes in how we manage spinal trauma in the adult patient. Spinal motion restriction (SMR) in the adult is applied on those patients who have indicators for spinal injury. Due to differences in anatomy and physiology, it is difficult to perform the same level of assessment in pediatric patients.

UPDATES

1. Spinal precautions (SMR) should be observed for any child with an altered mental status, focal neurologic deficits, or normal mental status and no neurologic complaints, but with complaints of neck pain or decreased neck mobility.

2. For children with risk factors for spinal injury, utilize SMR during patient movement. A cervical collar may be used as long as the appropriate size is available. Place it carefully on the child. If an appropriately sized collar is not available (especially in children less than 1 year of age), towels may be used to restrict the child's neck motion while maintaining the neutral position (Refer to Fig. 11 in the text). If the child has altered mental status, compromised ABCs, or cannot move themselves to the ambulance stretcher, the child should be secured to an extrication device (e.g., longboard) to limit spinal motion during patient movement. Padding should be used under the shoulders and neck to bring the cervical spine into alignment. The extrication device should be secured according to NHTSA Guidelines for Safe Transport. If an extrication device is not used, than the child should be secured to the mattress of the ambulance with/without a child restraint per NHTSA Guidelines for Safe Transport. Once you have secured the body, stabilize the head using a head motion restriction device, towel rolls, or whatever is available.

3. If necessary for patient resuscitation or movement, secure the child to an extrication device (long spineboard) using padding under the shoulders and neck to offset any possible cervical spine flexion. Always ensure that the child's neck is in the neutral position, regardless of how the child is secured. If the car seat is not damaged and the child has no signs of neurologic injury or ABC compromise, you may transport the child in the car seat.

4. Carefully evaluate the chest and abdomen for any DCAP-BTLS. Substantial (surgical or life-threatening) injury to the torso has been shown to be associated with spine injury in children. This should not only raise the suspicion of a visceral injury, but also suggest possible cervical, thoracic or lumbar spinal trauma.

REFERENCES

Dorney, K., A. Kimia, M. Hannon, K. Hennelly, W.P. Meehan III, M. Proctor, D.P. Mooney, M. Glotzbecker, R. Mannix. "Outcomes of pediatric patients with persistent midline cervical spine tenderness and negative imaging result after trauma." *Journal of Trauma and Acute Care Surgery* 79, no. 5 (November 2015): 822-7.

Halsey, J.N, I.C. Hoppe, A.A. Marano, A.M. Kordahi, E.S. Lee, M.S. Granick. "Characteristics of Cervical Spine Injury in Pediatric Patients With Facial Fractures." *Journal of Craniofacial Surgery* 27, no. 1 (January 2016): 109-11.

Pieretti-Vanmarcke, R., et al. "Clinical Clearance of the Cervical Spine in Blunt Trauma Patients Younger than 3 Years: A Multicenter Study of the American Association for the Surgery of Trauma." *Journal of Trauma - Injury Infection & Critical Care* 67, no. 3 (September 2009): 543-550.

Schöneberg, C., B. Schweiger, B. Hussmann, M.D. Kauther, S. Lendemans, C. Waydhas. "Diagnosis of cervical spine injuries in children: a systematic review." *European Journal of Trauma and Emergency Surgery* 39, no. 6 (December 2013): 653-65.

CHAPTER 13
Extremity Trauma

UPDATES

1. While extremity trauma is common in children who are active, the incidence of Non Accidental Trauma (NAT) is increasing. Be alert to clues at the scene that an adult or adolescent may have been involved in causing the injury. Multiple visits to the same residence for pediatric trauma, injury patterns that do not match the child's capabilities, or stories that differ between the child and adult need to be reported.

2. Because even what appears to be a relatively small amount of blood can cause hypovolemic shock in a small child, active or ongoing significant bleeding should be controlled promptly. A tourniquet should be considered early in arterial bleeding or amputation with ongoing bleeding to limit continued blood loss. It should also be an early consideration in children with ongoing significant bleeding not promptly managed with a pressure dressing. As always, children with evidence of shock should be rapidly transported after the ITLS Primary Survey.

3. While backboard use is being reevaluated in many EMS systems, backboards are still an option to splint an unstable pelvic fracture or a hip/femur fracture. Alternatively, in pelvic fracture, a pelvic wrap or sheet can be used, depending on the child's size. In femur fracture (not hip), a properly sized traction splint may be used, and use of the backboard may help stabilize the traction splint and limit painful movement. If using a backboard, pad for comfort when appropriate.

REFERENCES

Thornton, M.D., K. Della-Giustina, P.L. Aronson. "Emergency department evaluation and treatment of pediatric orthopedic injuries." *Emergency Medicine Clinics of North America* 33, no. 2 (May 2015): 423-49.

Canty, G. "Orthopedic Injuries." In *Pediatric Emergency Medicine*, 3rd ed., edited by G.R. Strange, W.R. Ahrens, R.W. Schafermeyer, R. Wiebe, 297-304. New York: McGraw-Hill, 2009.

CHAPTER 14
Pediatric Burns

UPDATES

Burn Classification

The classification of burns can be simplified to minor, moderate and severe. A classification of "high risk burns" are those of full thickness in a child, or burns of the hands, face, foot or genitals.

Be alert that burns may be non-accidental trauma.

Cyanide Poisoning

Hydroxocobalamin is recommended for treatment of cyanide poisoning. Exposure to smoke in a confined space is the best predictor of smoke inhalation.

REFERENCES

Jamshidi, R., and T.T. Sato. "Initial assessment and management of thermal burn injuries in children." *Pediatrics in Review* 34, no. 9 (September 2013): 395-404.

Kearns, R.D., P.B. Rich, C.B. Cairns, J.H. Holmes, B.A. Cairns. "Electrical injury and burn care: a review of best practices." *EMS World* 43, no. 9 (September 2014): 34-40, 55.

Krishnamoorthy, V., R. Ramaiah, S.M. Bhananker. "Pediatric burn injuries." *International Journal of Critical Illness & Injury Sciences* 2, no. 3 (Sept-Dec 2012): 128–134.

CHAPTER 15
Pediatric Submersion Injuries

UPDATES

Definitions

Drowning is defined as a process resulting in primary respiratory impairment from submersion/immersion in a liquid medium. A liquid/air interface is present at the entrance of the victim's airway, preventing the breathing of air. The victim may live or die, but whatever the outcome, they have been involved in a drowning incident.

Old terms no longer used include: wet versus dry downing, near drowning, and secondary drowning.

Note that there is no difference between drowning in freshwater versus saltwater.

The immersion syndrome is a form of drowning caused by sudden exposure to very cold water (<20°C or 68°F) that may be due to a vagal induced dysrhythmia. The two most commonly precipitated arrhythmias are asystole and ventricular fibrillation.

Statistics

In 2012, it is estimated 372,000 people died from drowning worldwide. Drowning is the 3rd leading cause of unintentional injury death. Globally, the highest rates are among 1- to 4-year-olds, followed by 5- to 9-year-olds.

Drowning is found in all economies and regions; however, it accounts for 91% in low-middle income countries. Over 50% occur in the western Pacific and southeast Asia regions.

Children 5 to 14 years old die from drowning more frequently than any other cause. In Australia, drowning is the leading cause of death in children 1 to 3 years old. In China, it is the leading cause of death in children 1 to 14 years old, and in the United States, it is the 2nd leading cause in children 1 to 14 years old.

REFERENCES

Rose, E.R., and T.K. Denmark. "An Evidence Based Approach to the Evaluation and Treatment of Drowning and Submersion Injuries." *Pediatric Emergency Medicine Practice* 8, no. 6 (June 2011).

CHAPTER 16

Pediatric Traumatic Cardiopulmonary Arrest

There are no major changes. Emphasis is on the identification of treatable causes of traumatic cardiac arrest. Remember that most cardiac arrests in children are respiratory based.

CHAPTER 19
Trauma in the Newborn

UPDATES

Neonatal Resuscitation

The Golden Minute

The Golden Minute (60-second) mark includes completing initial steps, reevaluating, and beginning ventilation if required. This 60-second mark emphasizes the importance of avoiding unnecessary delay in the initiation of ventilation, the most important step for successful resuscitation of the newly born infant who has not responded to the initial steps.

Temperature Management

Temperature should be recorded as a predictor of outcomes and as a quality indicator. The temperature of newly born non-asphyxiated infants is to be maintained between 36.5°C and 37.5°C after birth through admission and stabilization.

Initial Stabilization and Assessment

When completing the initial stabilization and assessment, the assessment of amniotic fluid is omitted. The order of the assessment questions has changed to:

1. Term gestation?
2. Good tone?
3. Breathing or crying?

Approach to the Newly Born Infant with an Abnormal Initial Assessment

Airway

The airway should always be the top priority.

Suctioning

Suctioning immediately following birth (including suctioning with a bulb syringe) is reserved for babies who have obvious obstruction to spontaneous breathing or who require PPV.

Meconium

If the infant born through meconium-stained amniotic fluid presents with poor muscle tone and inadequate breathing efforts, the initial steps of resuscitation should be completed under a radiant warmer.

PPV should be initiated if the infant is not breathing or the heart rate is less than 100/min after the initial steps have been completed.

Routine intubation for tracheal suctioning in this setting is not suggested because there is insufficient evidence to continue recommending this practice.

Breathing:

Spontaneously breathing preterm infants with respiratory distress may be supported with continuous positive airway pressure initially rather than with routine intubation for administering PPV.

Preterm O_2 Resuscitation

Resuscitation of preterm newborn less than 35 weeks gestation with high O_2 (65% or greater) is not recommended.

Monitoring Fetal Heart Rate

The use of a 3-lead ECG for rapid and accurate measurement of the newborn's heart rate may be reasonable.

Alternative to ET Intubation

A laryngeal mask airway (LMA) is recommended during resuscitation of term and preterm newborns, gestation at 34 weeks or more, and if tracheal intubation is unsuccessful or not feasible.

Discontinuing Resuscitation

If the Apgar score is 0 at 10 minutes of resuscitation and the heart rate is 0, ventilation may be discontinued. However, the decision to continue or discontinue must be individualized:

- Was the resuscitation optimal?
- Is there available advanced neonatal care?
- Is hypothermia present?
- Are there specific pre-delivery circumstances?
- Have the family's wishes been expressed?

REFERENCES

American Heart Association. "Part 13: Neonatal Resuscitation." In *Web-based 2010 & 2015 Integrated Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care*. Accessed from: https://eccguidelines.heart.org/index.php/circulation/cpr-ecc-guidelines-2/part-13-neonatal-resuscitation/

Appendix A

REFERENCES

AAP Section on Transport Medicine. *Guidelines for Air and Ground Transportation of Neonatal and Pediatric Patients*, 4th ed., edited by R.N. Insoft and H.P. Schwartz. Elk Grove Village, IL: American Academy of Pediatrics, 2015.

Bigham, M.T., and R. Orr. "The Air Medical Transfer Process of the Critically Ill or Injured Pediatric Patient." In *Principles and Direction of Air Medical Transport*, 2nd ed., edited by I.J. Blumen, 441-463. Salt Lake City, UT: Air Medical Physician Association, 2015.

Brown, J.B., C.M. Leeper, J. Sperry, et al. "Helicopters and injured kids: Improved survival with scene air medical transport in the pediatric trauma population." *Journal of Trauma and Acute Care Surgery* 80, no. 6 (May 2016): 702-10.

Locke, T., J. Rekman, M. Brennan, and A. Nasr. "The impact of transfer on pediatric trauma outcomes." *Journal of Pediatric Surgery* 51, no. 5 (May 2016): 843-7.

Stroud, M.H., M.S. Trautman, et al. "Pediatric and neonatal interfacility transport: results from a national consensus conference." *Pediatrics* 132, no. 2 (August 2013): 359-366.

Appendix B

REFERENCES

The National Response Framework and the National Incident Management System. Accessed on April 15, 2016, from http://www.fema.gov/national-response-framework