



Pediatric Advanced Life Support

Provider Manual



Table of Contents

Unit One: General Concepts	7
Pediatric Advanced Life Support (PALS) Preparation	7
Organization of the PALS Course	7
Delivering the Most Up-to-Date Guidelines Available	7
2015 PALS Guideline Changes	8
Changes to Pediatric BLS in 2015	9
PALS Guideline Changes since 2015	9
Pediatric Chain of Survival	10
Unit Two: Pediatric Evaluation	12
Evaluate-Identify-Intervene	13
Evaluate the Child	13
Primary Assessment	14
Secondary Assessment	17
Diagnostic Tests	18
Identify	19
Intervene	19
Unit Three: The Team in PALS	20
Unit Four: Recognition of Respiratory Distress/Failure	22
Hypoxia	23
Hypercarbia	23
Signs of Respiratory Problems	24
Unit Five: Management of Pediatric Respiratory Distress or Failure	25
Upper Airway Obstruction Management	25
Lower Airway Obstruction Management	26
Lung Tissue Disease Management	28
Disordered Control of Breathing Management	28
Equipment for Respiratory Management	29
Pediatric Length-Based Resuscitation Tape	29
Unit Six: Recognition of Pediatric Shock	31
Pathophysiology in Shock	31
Compensatory Mechanisms in Shock	32
Signs of Shock by Type	33

Unit Seven: Management of Pediatric Shock..... 34

Initial Management..... 34

Management of Shock by Type 35

Shock: Fluid and Medications 35

Intraosseous Access..... 37

Unit Eight: Recognition and Management of Pediatric Bradycardia..... 39

Signs and Symptoms of Bradycardia 39

Underlying Causes of Bradycardia 39

Bradycardia with a Pulse and Poor Perfusion..... 40

Unit Nine: Recognition and Management of Pediatric Tachycardia 41

Signs and Symptoms of Tachycardia 41

Initial Management of Tachycardia and Emergency Interventions 42

Tachycardia with Poor Perfusion..... 44

Tachycardia with Adequate Perfusion 45

Unit Ten: Recognition and Management of Pediatric Cardiac Arrest 47

Cardiac Arrest Rhythms 47

BLS Components for Management of Cardiac Arrest 47

Advanced Life Support (ALS) in Cardiac Arrest..... 48

Pediatric Cardiac Arrest 49

Manual Defibrillation for VF or Pulseless VT 51

Special Circumstances..... 52

Unit Eleven: Pediatric Post-Resuscitation Support..... 53

DOPE..... 54

Maintenance Fluids..... 55

Management of Shock Following Successful Resuscitation 56

Patient Transport 57

Unit Twelve: Medications Used in PALS 58

Unit Thirteen: Rhythm Recognition..... 65

Sinus Rhythm..... 66

Sinus Bradycardia 66

Sinus Tachycardia 67

Sinus Rhythm with First Degree Heart Block 67

Second Degree AV Heart Block 68

Supraventricular Tachycardia (SVT) 69

Atrial Fibrillation (AF) 70

Atrial Flutter 70

Asystole 70

Pulseless Electrical Activity (PEA) 71

Ventricular Tachycardia (VT) 71

Ventricular Fibrillation (VF) 71

Myocardial Infarction (MI) 72

References 73

List of Figures

Figure 1: Pediatric Chain of Survival 10

Figure 2: BLS Infant and Child Algorithm 11

Figure 3: PALS Sequence Algorithm 12

Figure 4: Evaluate-Identify-Intervene Sequence 13

Figure 5: Team Location 20

Figure 6: Respiratory Distress to Cardiac Arrest 22

Figure 7: Upper Airway Obstruction Interventions 25

Figure 8: Lower Airway Obstruction Interventions 26

Figure 9: Lung Tissue Disease Interventions 28

Figure 10: Disordered Control of Breathing Interventions 28

Figure 11: Pathophysiology of Shock 31

Figure 12: Types of Shock 35

Figure 13: Intraosseous Access 37

Figure 14: Schematic of Intraosseous Access 38

Figure 15: PALS Bradycardia Algorithm 40

Figure 16: PALS Tachycardia Initial Management algorithm 42

Figure 17: Synchronized Cardioversion 43

Figure 18: PALS Tachycardia Poor Perfusion Algorithm 44

Figure 19: PALS Narrow QRS Tachycardia Adequate Perfusion Algorithm 45

Figure 20: PALS Wide QRS Tachycardia Adequate Perfusion Algorithm 46

Figure 21: ALS Interventions in Cardiac Arrest 48

Figure 22: PALS Cardiac Arrest Algorithm 50

Figure 23: Manual Defibrillation in Pediatric Cardiac Arrest 51

Figure 24: PALS Post-Arrest Shock Management Algorithm 56

Figure 25: Standard ECG 65

Figure 26: Normal Sinus Rhythm 66

Figure 27: Sinus Bradycardia 66

Figure 28: Sinus Tachycardia 67

Figure 29: First Degree Heart Block 67

Figure 30: Second Degree Heart Block Type I 68

Figure 31: Second Degree Heart Block Type II 68

Figure 32: Third Degree Heart Block 69

Figure 33: Supraventricular Tachycardia 69

Figure 34: Atrial Fibrillation 70

Figure 35: Atrial Flutter 70

Figure 36: Ventricular Tachycardia 71

Figure 37: Ventricular Fibrillation 71

Figure 38: Comparison of Normal, STEMI and NSTEMI ECG Tracings 72

List of Tables

Table 1: Comparison of PALS Guidelines 8

Table 2: PALS Guideline Changes Since 2015 9

Table 3: Primary Assessment Model 14

Table 4: Normal Respiratory Rates 15

Table 5: Normal Heart Rates 15

Table 6: Normal Blood Pressure 16

Table 7: Pediatric Glasgow Coma Scale 16

Table 8: Secondary Assessment History 17

Table 9: Diagnostic Tests in PALS 18

Table 10: Identify Cause of Condition 19

Table 11: Team Expectations in PALS 21

Table 12: Tissue Hypoxia Signs and Treatment 23

Table 13: Hypercarbia Signs and Treatment 23

Table 14: Clinical Signs by Respiratory Problem 24

Table 15: Classification of Asthma 27

Table 16: Pediatric Length-Based System 30

Table 17: Compensatory Mechanisms in Shock 32

Table 18: Signs of Shock by Type 33

Table 19: Interventions for Initial Management of Shock 34

Table 20: Signs of Bradycardia by System 39

Table 21: Signs of Tachycardia by System	41
Table 22: BLS Components in Cardiac Arrest	47
Table 23: Post-Resuscitation Priorities and Treatments	54
Table 24: Calculation of Maintenance Fluid.....	55
Table 25: Resuscitation Medications.....	58

Unit One: General Concepts

In the pediatric population, cardiac arrest usually results from one of these three problems:

- Progressive respiratory distress and failure (the most common cause)
- Progressive shock (second most common)
- Sudden cardiac death from ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) (5-15% of all pediatric cardiac arrest cases).

Pediatric Advanced Life Support (PALS) Preparation

Prior to attending a PALS course, the student must familiarize themselves with the key concepts that will be used during the course:

- ECG rhythm recognition
- Infant and child basic life support (BLS)
- Pediatric pharmacology
- PALS algorithms and treatments.

Organization of the PALS Course

In the PALS course, the student will demonstrate competency in four key skills stations that include simulations that stress the role of the team in the pediatric resuscitation process:

- One- and two-rescuer BLS for both infants and children
- Management of respiratory emergencies
- Rhythm disturbances and electrical therapies
- Vascular access.

The student will be asked to participate as team leader and team member in the skills stations. After successful completion of the skills, the student must successfully complete and pass a written exam testing the cognitive skills associated with pediatric resuscitation.

Delivering the Most Up-to-Date Guidelines Available

The International Liaison Committee on Resuscitation (ILCOR) has been the definitive source for resuscitation guidelines for decades. ILCOR recommendations are based on cutting edge biomedical and clinical research. Organizations such as the American Heart Association (AHA) and the European Resuscitation Council (ERC) contribute to Consensus on Science and Treatment Recommendations (CoSTR) and then publish their findings in the journals *Circulation* and *Resuscitation*, respectively.

For decades, ILCOR conducted a scientific review process every five years (i.e. 2005, 2010, 2015) and published their results. These results were made into provider training manuals, student training manuals, and other resources. In fact, *American Resuscitation Council* used these peer-reviewed publications to create our learning materials, provider manuals, and exam questions. In 2016, however, ILCOR decided to update and publish their guidance every year to keep up with advancements in the field of resuscitation research. We, too, are dedicated to staying at the forefront of science. As such, we will update all of our education materials as ILCOR publishes new guidelines each year.

2015 PALS Guideline Changes

The last time ILCOR published 5-year guidance was in 2015. These PALS guidelines replaced 2010 guidelines and older. Any 2015 guidelines that have been updated since 2015 are crossed out.

Guideline	Old Guideline	2015 Guideline
Sequence	CAB (compressions, airway, breathing)	Confirmed in the 2015 guidelines
Compression depth	Used “at least” without a maximum depth	Infants to children up to puberty: compress the chest up to 1/3 of the chest diameter; Puberty and adolescence: use adult compression depth between 2 and 2.4 inches (5 to 6 cm)
Frequency	At least 100 compressions per minute	Between 100 and 120 compressions per minute
Compression-only CPR	Infants and children require compressions and respirations, but compressions are better than nothing	Infants and children still require <i>compressions and respirations</i> for optimal CPR since most pediatric emergencies affect respiration primarily; Compression-only CPR is useful in infants/children in cardiac arrest
Fluid resuscitation	Aggressive fluids	Treat septic shock with isotonic IV fluids at a dose of 20 mL/kg, though use with caution in resource-limited settings (i.e. no critical care)
Atropine premedication	Use a minimum atropine dose of 0.1 mg to prevent paradoxical bradycardia	Do not routinely use atropine as premedication for endotracheal intubation; atropine can be used in patients at increased risk of bradycardia
Vasopressors	Use epinephrine for cardiac arrest	<i>Consider</i> using epinephrine during cardiac arrest
Extracorporeal CPR	Consider extracorporeal CPR only for children in standard resuscitation-refractory cardiac arrest	Extracorporeal CPR may be considered in at-risk children who have a cardiac arrest within a hospital with proper protocols, personnel, and equipment available
Amiodarone and lidocaine	Amiodarone preferred to lidocaine for pulseless VT/VF unresponsive to shock	Amiodarone and lidocaine equally effective for pulseless VT or VF unresponsive to shock

Guideline	Old Guideline	2015 Guideline
Post-cardiac arrest	Comatose patients should be cooled to between 32°C and 34°C for 12-24 hours	Comatose patients with cardiac arrest outside of the hospital should be cooled to 32°C to 34°C for 2 days followed by 3 days of normothermia or a total 5 days of normothermia; no recs for in-hospital cardiac arrest; treat fever aggressively
Post-cardiac arrest	New recommendation for 2015	Maintain systolic BP above the fifth percentile by age, use intra-arterial pressure monitoring
Post-cardiac arrest	No recommendations about PaCO ₂	Titrate oxygen to achieve PaO ₂ between 94% and 99%; keep PaCO ₂ within normal range

Table 1: Comparison of PALS Guidelines

Changes to Pediatric BLS in 2015

Pediatric BLS was changed in 2015 to incorporate the use of cell phones into the algorithm. In an out-of-hospital cardiac arrest (OHCA), the lone rescuer may call 911 before providing CPR if that rescuer has a cell phone available. When others are nearby, they should be instructed to call 911 using an available cell phone, then get an automated external defibrillator (AED).

When a **lone rescuer** finds an **infant or child up to the age of puberty** who is the victim of an **unwitnessed** collapse, the rescuer should give 2 minutes of CPR before leaving the victim to go get help/call 911/get AED. If the lone rescuer has a working cell phone, 911 should be called first.

When a **lone rescuer** finds an **infant or child up to the age of puberty** who is the victim of a **witnessed** collapse, the rescuer should leave the victim to go get help/call 911/get AED. If the lone rescuer has a cell phone, call 911 first.

When a **lone rescuer** finds an **adolescent (puberty and older)** who is the victim of a **witnessed** or **unwitnessed** collapse, the rescuer should leave the victim to go get help/call 911/get AED. If the lone rescuer has a cell phone, call 911 first.

PALS Guideline Changes since 2015

ILCOR has published guideline updates each year since 2017. The changes are shown in Table 2 below.

2017 PALS Guidelines (BLS Update) ¹⁻³
Bystanders should provide CPR with ventilation for infants and children less than 18 years of age with OHCA
Bystanders who cannot provide rescue breaths as part of CPR for infants and children less than 18 years of age with OHCA, should at least provide chest compressions.
2018 ACLS Guidelines ^{4,5}
PALS Pediatric Cardiac Arrest Algorithm was unchanged
Amiodarone or lidocaine may be used for ventricular fibrillation/pulseless ventricular tachycardia that does not respond to defibrillation.

2017 PALS Guidelines (BLS Update) ¹⁻³
2019 PALS Guidelines ⁶⁻¹¹
EMS dispatchers should offer dispatcher-assisted CPR instructions for presumed pediatric cardiac arrest
EMS dispatchers should offer dispatcher-assisted CPR instructions for pediatric cardiac arrest when no bystander CPR is in progress
Bag-mask ventilation is a reasonable alternative to endotracheal intubation or supraglottic airway in the management of children during OHCA
Extracorporeal CPR may be considered for pediatric in-hospital cardiac arrest for cardiac diagnoses if it can be implemented competently and efficiently
It is unclear whether extracorporeal CPR is beneficial for pediatric OHCA
Continuous measurement of core temperature during targeted temperature management is recommended.
For infants and children between 24 hours and 18 years of age who remain comatose after out-of-hospital or in-hospital cardiac arrest, it is reasonable to use either targeted temperature management 32°C to 34°C followed by targeted temperature management 36°C to 37.5°C or to use targeted temperature management 36°C to 37.5°C. There is insufficient evidence to support a recommendation about treatment duration.
2020 PALS Guidelines
Awaiting peer-reviewed publication of 2020 ILCOR updates

Table 2: PALS Guideline Changes Since 2015

Pediatric Chain of Survival

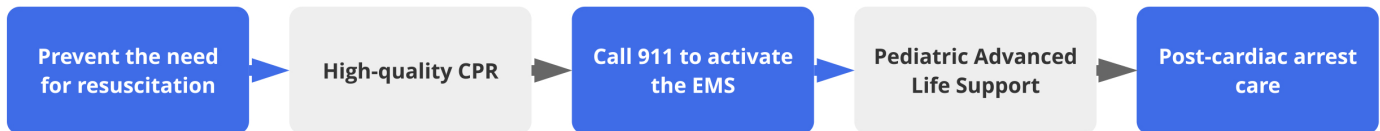


Figure 1: Pediatric Chain of Survival

In infants and children, it is better to monitor for signs of respiratory distress before overt respiratory failure occurs, requiring resuscitation. If resuscitation is required, it should include high-quality CPR and activation of EMS (e.g., call 911). Qualified providers should perform PALS followed by post-arrest care following return of spontaneous circulation (ROSC).



Figure 2: BLS Infant and Child Algorithm