PALS Precourse Package 2015

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Thank you for choosing SkillStat Learning Inc. for your Pediatric Advanced Life Support (PALS) training needs. SkillStat Learning Inc. has delivered advanced practice programs to healthcare professionals across British Columbia for more than 20 years.

Please read through this precourse package prior to attending your PALS course. It includes relevant information needed to help you successfully prepare and succeed in your PALS training.

**PALS GENERAL PREREQUISITES:**

- Heart & Stroke Foundation of Canada (HSFC) Basic Life Support for Healthcare Provider (BLS-HCP) course within the last 12 months. Please register for the BLS-HCP course as an add-on to the PALS course (every PALS course through SkillStat includes an optional BLS-HCP course concurrently) or register for a BLS-HCP course before a PALS course.
- Current registration as a healthcare professional including physicians, residents, medical students, paramedics, nurses, nursing students, respiratory therapists, allied health professionals, naturopaths, dentists and military levels QL5 and above.

**KNOWLEDGE PREREQUISITES:**

- Basic ECG rhythm interpretation skills (see our Six Second ECG Essentials or Mastery courses and our Six Second ECG Simulator online)
  - Sinus rhythms: bradycardia, normal, tachycardia
  - Atrial rhythms: tachycardia, flutter, fibrillation
  - Junctional rhythms: typical, accelerated, tachycardia
  - Ventricular: typical, accelerated, tachycardia, fibrillation
  - AV Blocks: 1st degree, 2nd degree (types I & II), 3rd degree
- An understanding of basic PALS pharmacology
- Knowledge of the PALS algorithms (cardiac arrest, respiratory emergencies, shock management, unstable tachycardias, unstable bradycardias)
- Basic Life Support procedures and protocols
COURSE DESCRIPTION:

The PALS Provider and PALS Renewal courses address therapeutic interventions for cardiopulmonary arrest, acute arrhythmias, respiratory emergencies and shock states through didactic instruction, case-based learning scenarios and active simulations.

The Pediatric Advanced Life Support (PALS) Provider Course is for health care practitioners who have not taken PALS within the last two years. The PALS Renewal Course is for those who have successfully completed a PALS course within the last two years. Both courses (Provider and Renewal) cover the following topics:

- Emergency cardiovascular care (ECC) science and core principles
- Basic and advanced airway management
- Intravenous access options (including intraosseous)
- Electrical Therapies (AED, defibrillation, synchronized cardioversion and transcutaneous pacing)
- Team leadership dynamics
- Applied scenarios utilizing the PALS algorithms (cardiac arrest, respiratory emergencies, arrhythmia management, shock states)
- Practical evaluation of team leadership and airway management within active simulations
- Written evaluation

COURSE EVALUATION:

To successfully complete a PALS course the following must be achieved;

- Attend entire duration of course
- Obtain 84% or higher on a closed book multiple choice written exam
- Pass practical evaluation process
  - Competency in skill stations (IO access, AED use, electrical therapy interventions, basic airway management)
  - Competency in team leading of a cardiac arrest situation
COURSE RESOURCES:

- This precourse package (includes course description, ECC Essentials 2011 PALS Algorithms Learning Document, links to online resources and a pre-course written self-evaluation – a practice quiz prepared by the HSFC)

- *The PALS Provider Manual* - it is strongly recommended that you have the 2010 ACLS manual

- *Handbook of Emergency Cardiovascular Care for Healthcare Providers*: This handbook is an excellent resource for the course and can be carried as a quick reference book when at work. It contains BLS and ALS content for neonatal, paediatric, and adult age groups

- SkillStat Learning Tools (Six Second ECG Simulator) and resources (Library) from our site at [www.skillstat.com](http://www.skillstat.com)

REMEDICATION:

- Written Exam: If you are unable to achieve 84% on the written exam, you are eligible to write an alternate exam after waiting a minimum of 7 days but not longer than 6 weeks after the original course start date. If unsuccessful on this second exam attempt, you will receive an incomplete course status for the entire PALS course (please see our Complete Success Policy below for other options)

- If you are unable to meet the criteria to pass the practical evaluation, one additional opportunity may be given during the course for a formal evaluation of practical skills (please see our Complete Success Policy below for other options)

- If you are unsuccessful on both the written and practical evaluation components, an incomplete status for the course will be given and no provision for remediation and re-evaluation will be made. These standards governing PALS course delivery are laid out by Heart and Stroke Foundation of Canada. You *are welcome* to attend another PALS course though at no cost (see our Complete Success Policy)

- **SkillStat’s Complete Success Policy**: if you are either unsuccessful in a PALS course OR sense that additional practice in another course would be beneficial, you are invited to attend another PALS course *at no cost* within 6 weeks of the original course date

PREPARING FOR THE COURSE

It is suggested that you take 8-16 hours to prepare for a PALS course. Before the course, please read the precourse package with attention to the algorithms, the online resources and the precourse practice quiz. Also complete as much of the PALS Provider Manual as time permits. We go the distance to help with concepts and skills throughout the course. The more prepared you are, generally the better the experience for you.
CONTINUING EDUCATION CREDITS (MAINPRO)

Continuing education credits for the PALS course are available upon course completion. Please request a CME letter for Mainpro credits via email or at the ACLS course. The PALS Provider course offers MAINPRO-M1 credits=15, MAINPRO-C=8 credits. The PALS Renewal course offers MAINPRO-M1 credits=8, MAINPRO-C=4 credits.

CANCELLATION, REFUND AND TRANSFER POLICIES

1. No cancellation or transfer fee will be charged if notice of course cancellation or transfer is given 30 days prior to the start of a course.
2. A refund of 90% of course tuition is available for course cancellations made 16-29 days before a course date. A transfer fee of 10% of the course tuition will be applicable if notice to transfer to another course date is given 16-29 days prior to the start of a course.
3. In the event of a cancellation within 15 days of a course start date, the entire tuition or group fee is not refundable. A transfer fee of 20% of the total fees will be applicable when arranging to attend another course date.
4. Purchased books are non-refundable after the shrink-wrap is removed.
5. SkillStat Learning reserves the right to cancel a course and refund registration fees due to insufficient registration or other circumstances beyond our control.
6. If a course is cancelled by SkillStat then the student will be given the option of either receiving a full refund or transferring to the next available date at no charge.
7. SkillStat Learning assumes no liability for cancellation of a course. Any ancillary costs related to the student taking a class (including but not limited to: air travel, travel costs, hotels, per-diems, mileage, lost employee wages or salary) are the responsibility of the student and/or their employer. If a class is cancelled, SkillStat Learning's liability is limited to the amount of the registration fee only.
8. Requests for transfer, cancellation or refund should be made in writing (email or fax is acceptable) to SkillStat Learning.
Pediatric Care

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Published: May 2011, British Columbia, Canada
On October 18, 2010 the International Liaison Committee On Resuscitation released a major 5 year update to the CPR and Emergency Cardiovascular Care Guidelines. The American Heart Association (AHA) and the European Resuscitation Council (ERC) in turn released unique interpretations of this release.

This document is an education tool for healthcare professionals tasked with the emergency cardiac care of Infants and children in hospital. This version was produced to supplement the executive summary and reference documents of the AHA and the ERC. This summary of 2010 emergency cardiovascular care guidelines combines recent resuscitation science, suggested procedures and guiding principles into an organized approach to in-hospital pediatric emergency cardiovascular care. We hope that a solid understanding and long term concept adoption of the latest in emergency pediatric care science is enhanced with this supplement.

Introduction

The algorithms included here are not intended to replace established AHA | ERC guidelines or sound medical judgement. Resuscitation science is dynamic, with frequent updates. Find the 2010 guidelines in detail, executive summaries and updates online.

- International Liaison Committee for Resuscitation (http://www.ilcor.org/en/home/)
- American Heart Association (http://guidelines.ecc.org)
- European Resuscitation Council (http://www.cprguidelines.eu/2010/)

Much thanks to the reviewers of this document. Their significant investment of time and their many suggestions are added to this document. Despite great effort invested in this document, an error free result rarely occurs despite several reviews and edits. Please direct any suggestions or questions to ecc2011@bcecc.ca

A 36 month period of evidence evaluation by 356 resuscitation experts from 29 countries coordinated through the International Liaison Committee on Resuscitation (ILCOR) culminated with a significant 5-year update release of The 2010 International Consensus on CPR Science with Treatment Recommendations (CoSTR) in October 2010. The American Heart Association (AHA) in turn released the 2010 CPR and Emergency Cardiovascular Care (ECC) Guidelines. The European Resuscitation Council published Guidelines for Resuscitation 2010.

The Heart and Stroke Foundation of Canada (HSFC), a founding member of ILCOR, has co-released the 2010 Guidelines for CPR and ECC. The HSFC “sets the Canadian Guidelines for CPR, defibrillation and other aspects of emergency cardiovascular care in Canada.” These guidelines represent the best current understanding of resuscitation science applied to those imminently at risk for a cardiac arrest, in a cardiac arrest and in the first hours post-arrest.

Key Highlights of the 2010 CPR and ECC Guidelines

- Change in basic life support sequence of steps from ABC (airway, breathing, chest compression) to CAB (chest compressions, airway, breathing) for adults and pediatric patients (not newborns) to reduce the time to start chest compressions
- The reduced importance of pulse checks for pediatrics and adults; healthcare providers often cannot find a pulse quickly or reliably in those who are hemodynamically compromised; limit pulse checks to no longer than 10 seconds
- Together with an absence of pulse, abnormal ‘gasps’ and/or brief seizure activity may also indicate a cardiac arrest
- Continued strong emphasis on high quality CPR with minimum interruptions in chest compressions
- Emphasis to limit interruptions in chest compressions before defibrillations to no longer than 5 seconds (chest compression interruption of even 5-10 seconds before defibrillation is associated with reduced success); chest compressions should continue while monitor-defibrillator is charging
- Use of waveform capnography (end tidal carbon dioxide – $P_{ET}CO_2$) to continuously monitor tracheal tube placement, to assess the quality of CPR, and indicate the return of spontaneous circulation

Please note: This is a guide to supplement the AHA ERC guidelines. Please consult the guidelines for educational purposes only.
Continued emphasis on deferring early tracheal intubation unless done by highly skilled practitioners with interruption of chest compressions not to exceed 10 seconds; alternatives include advanced supraglottic airways (i.e. laryngeal mask airway, King Laryngeal Tube) or the use of an oropharyngeal airway with a bag-valve-mask

Strong emphasis on coordinated post-cardiac arrest care with the inclusion of a comprehensive post resuscitation protocol

Continued emphasis on effective resuscitation team dynamics and team leadership

The 2010 Guidelines for CPR and ECC reinforce the critical time constraints before, during and after a cardiac arrest. The hemodynamically unstable patient can progress to full cardiac arrest in seconds to minutes. For the arrested patient, seconds determine success. Consider the following:

- Brain damage can occur after only 180 seconds into a cardiac arrest
- Coronary perfusion reaches 30% of normal after about 9 seconds of quality CPR and falls to ineffective levels after only a 2-3 second interruption
- Odds for a successful defibrillation diminish after interruptions in compressions of more than 5 seconds

To help ensure a rapid effective response, algorithms are provided to highlight relevant concepts and actions of the most likely pediatric emergencies facing in-hospital health care providers. Quality of performance of the team leader and the team members in providing timely, effective care is a major determinant in a successful outcome. Remaining current in resuscitation knowledge and skills helps to ensure this level of performance.

This booklet includes the essential treatment algorithms for the resuscitation of Infants and Children. Core principles for every algorithm are included to provide quick reference and draw attention to time-sensitive actions that optimize successful outcomes. Rapid reference sheets for electrical therapy, pediatric vitals, references and an abbreviation dictionary round out this package.

This document is freely available to be downloaded and copied for learning and teaching. Any changes to this document, alternative packaging or its inclusion into commercial products require the written permission of the authors.

The past six months has seen the release of guidelines that likely represents the best ECC science in 50 years. We hope that this booklet will help hospital-based healthcare professionals learn, adopt and share these guidelines to the ultimate benefit of their patients.
<table>
<thead>
<tr>
<th>Recognition</th>
<th>Adult: Adolescent and Older</th>
<th>Child: 1 year to Adolescent</th>
<th>Infant: Under 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unresponsive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No breathing or only gasping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No definite pulse palpated within 10 seconds</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CPR Sequence</th>
<th>C – A - B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressions</td>
<td>Heel of hand placed on centre of the chest on lower half of sternum; second hand placed over first</td>
</tr>
<tr>
<td>Landmark</td>
<td>Heel of hand placed on centre of the chest on lower half of sternum Optional: second hand placed over first</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lone Rescuer:</th>
<th>2 fingers placed just below the nipple line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Rescuers:</td>
<td>2 thumbs placed just below the nipple line with hands encircling chest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compression Rate</th>
<th>At least 100/minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change compressors every 2 minutes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compression</th>
<th>At least 5 cm (2 inches)</th>
<th>At least 1/3 the anterior-posterior diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chest Wall Recoil</th>
<th>Allow full recoil between compressions</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Airway</th>
<th>Head tilt – chin lift (jaw thrust if trauma is suspected)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Compression to Ventilation Ratio (without advanced airway)</th>
<th>30:2 for single rescuer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2 rescuers</td>
<td>15:2 for two rescuers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rescue Breaths</th>
<th>1 breath every 5-6 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 breath every 6-8 seconds (8-10 breaths/minute)</td>
<td></td>
</tr>
<tr>
<td>Breaths delivered asynchronously with chest compressions</td>
<td></td>
</tr>
<tr>
<td>About 1 second per breath with visible chest rise</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rescue Breaths with advanced airway</th>
<th>Breaths delivered asynchronously with chest compressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal thrusts until effective or person is unresponsive (chest thrusts for those who are pregnant or in wheelchair – back of wheelchair placed against solid surface)</td>
<td>About 1 second per breath with visible chest rise</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FBAO - Responsive</th>
<th>5 back blows followed by 5 chest compressions until effective or infant becomes unresponsive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal thrusts until effective or person is unresponsive (chest thrusts for those who are pregnant or in wheelchair – back of wheelchair placed against solid surface)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FBAO - Unresponsive</th>
<th>30 compressions – open airway – remove foreign body only if seen - 2 attempts to ventilate – Repeat until ventilation is successful</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>AED</th>
<th>Use AED as soon as possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use adult pads (8-12 cm in diameter)</td>
<td></td>
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</tbody>
</table>

| Use AED when available | |
| If no access to a pediatric attenuated AED, use adult AED | |
| If pads are too large consider an anterior-posterior pad position | |

Abbreviations: AED, automated external defibrillator; CPR, cardiopulmonary resuscitation; FBAO, foreign body airway obstruction.

Note: ERC and Red Cross recommendation for 'FBAO responsive' is 5 back blows alternating with 5 abdominal thrusts.
Pediatric Basic Life Support for Healthcare Providers

Activate Emergency Response
Get AED / Defibrillator

Check pulse: Max 10 seconds

- Give 1 breath every 3 seconds
- If pulse remains < 60 bpm with poor perfusion after ventilations add chest compressions
- Continue to frequently monitor pulse and signs of life while giving rescue breaths

Definite pulse

No pulse or unsure?

Begin CPR (CAB)
30 compressions : 2 breaths - lone rescuer
15 compressions : 2 breaths - two rescuers

After 2 min, activate emergency response and get AED/defibrillator if not already done

Give 1 shock
Resume CPR immediately for 2 min

Shockable rhythm?

- Resume CPR immediately for 2 minutes, follow prompts of AED to reassess rhythm
- Continue until ALS arrives or signs of life occur

Not Shockable

Quality CPR
- After assessing no pulse or unsure begin with compressions then open airway and give 2 breaths (CAB)
- Push Hard (1/3 anterior posterior chest diameter), Fast (100-120/min) & allow for Full Recoil on horizontal hard surface
- Compression interruption < 5 sec
- With 2 person CPR but without advanced airway, deliver 15:2 compressions to ventilations
- With 2 person CPR with an advanced airway, one rescuer provides continuous compressions while the second rescuer delivers breaths once every 6-8 seconds
- Change chest compressor every 2 min

Core Principles
- Cardiac arrest in pediatrics most often due to a respiratory crisis or shock state
- Maximize time on chest (CPR)
- Deliver quality CPR
- Do not over ventilate – rate or volume

Electrical Therapy
- For infant/Child defibrillation use following priority for method chosen:
  - manual defibrillator (2J/kg, then 4J/kg)
  - pediatric attenuated AED
  - Adult AED
- If pad size is an issue (too large) use an anterior-posterior pad placement

For educational purposes only
Activate Emergency Response
Begin CPR
Attach Monitor-Defibrillator

**ASYSTOLE / PEA**

- CPR for 2 min
- IV/IO Access
- Epinephrine
- Consider advanced airway

Rapid Identification and Treatment of Most Likely Cause
- History, Physical Exam & Investigations
  - Hypovolemia
  - Hypoxia
  - Hyper/Hypo K+/H+
  - Hypothermia
  - Tension Pneumothorax
  - Tamponade
  - Toxins
  - Thrombosis-PE / MI

**VF / VT?**

- Shock
- CPR for 2 min
- IV/IO Access

Rapid Identification and Treatment of Most Likely Cause
- History, Physical Exam & Investigations
  - Hypovolemia

**ASYSTOLE / PEA**

- CPR for 2 min
- IV/IO Access
- Epinephrine
- Consider advanced airway

**VF / VT?**

- Shock
- CPR for 2 min
- IV/IO Access

Rapid Identification and Treatment of Most Likely Cause
- History, Physical Exam & Investigations
  - Hypovolemia

**VF / VT?**

- Shock
- CPR for 2 min
- Epinephrine
- Consider Advanced Airway

**VF / VT?**

- Shock
- CPR for 2 min
- Amiodarone

**ROSC?**

- Yes
- No

**VF / VT?**

- Yes
- No

**VF / VT?**

- Yes
- No

**ROSC?**

- Yes
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**ROSC?**

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**ROSC?**

- Yes
- No
Unstable Pediatric Bradycardia

Patient Unstable
- Altered level of consciousness
- Hypotension
- SOB/slow breathing/pulmonary congestion
- Signs of shock

Begin MOVIE & treat underlying cause
- Maintain A, B, C’s, assist breathing as needed
- Monitor – continuous ECG, oximetry, blood pressure
- Oxygen - maintain $\text{SpO}_2 > 94\%$
- Vital signs - initial full set including glucose
- IV/IO - ensure vascular access
- ECG – 12 lead ECG

• Monitor & Observe
• Expert consultation

Despite adequate oxygenation/ventilation does patient remain unstable?

Yes

If HR < 60 bpm CPR for 2 min

Does bradycardia persist?

No

• Epinephrine
• Atropine: if increased vagal tone or primary heart block
• Consider transcutaneous/transvenous pacing

Medications (IV/IO)
- Epinephrine 0.01 mg/kg IV/IO q3-5 min, if no IV/IO may give 0.1 mg/kg via endotracheal tube
- Atropine 0.02 mg/kg IV/IO, may repeat x 1, minimum dose 0.1 mg, maximum single dose 0.5 mg

Core Principles
- The most common cause of bradycardias in the pediatric population is a hypoxic insult.
- Oxygenate/ventilate is the treatment of choice
- Pacing may be indicated when other steps/meds have failed, especially for sinus node dysfunction or complete heart block

Quality CPR
- Push Hard (1/3 anterior-posterior chest diameter), Fast (100/min) & allow for Full Recoil on horizontal hard surface
- Compression interruption < 10 sec
- Without advanced airway, 15:2 compressions to ventilations
- Change compressor every 2 min
- Waveform capnography to assess CPR quality - goal $P_{ETCO_2} > 10\text{mmHg}$

Advanced Airway
- Continuous CPR with supraglottic advanced airway or ETT tube and breaths once every 6-8 seconds

For educational purposes only
Unstable Pediatric Tachycardia

Patient is Unstable
- Altered level of consciousness
- Hypotension
- SOB, pulmonary congestion
- Signs of shock

Begin MOVIE & treat underlying cause
- Maintain A, B, C’s, assist breathing as needed
- Monitor – continuous ECG, oximetry, blood pressure
- Oxygen - maintain $\text{SpO}_2 > 94\%$
- Vital signs - initial full set including glucose
- IV/IO - ensure vascular access
- ECG – 12 lead ECG

Narrow QRS? (QRS < 0.09 seconds)

Most likely Ventricular Tachycardia (VT)
- If monomorphic and regular consider Adenosine (If known WPW then do not give, get a expert consult)

Consider:
- Expert Consult
- Amiodarone or Procainamide

If Unsuccessful

Patient is Unstable?

Yes

Immediate Cardioversion

No

Most likely a Supraventricular Tachycardia (SVT)
- Hx of paroxysmal HR change
- P waves absent or abnormal
- Fixed HR over time
- Infants HR ≥ 220
- Children HR ≥ 180

Consider:
- Vagal Maneuvers
- Adenosine IV/IO
- Cardioversion

Most likely Sinus Tachycardia (ST)
- Hx and known cause for ST
- P-waves
- Constant PR interval, variable R-R interval
- Infants HR usually < 200 bpm
- Children HR usually < 180 bpm

Identify and treat underlying cause

Medications (IV/IO)
- Adenosine IV/IO
  - 1st Dose: 0.1 mg/kg to max 6 mg rapid push with rapid flush of 10-20 ml NS
  - 2nd Dose: 0.2 mg/kg to max 12 mg rapid push with rapid flush of 10-20 ml NS
- Amiodarone 5 mg/kg over 20-60 min
- Procainamide 15 mg/kg over 30-60 min

Cardioversion
- Sedation as needed
- First shock: 0.5-1.0 J/kg
- Subsequent shock if unsuccessful at 2.0 J/kg

Vagal Stimulation
- In infants and young children apply crushed ice in bag/glove to face
- In older children valsalva maneuver or carotid sinus massage may be used

For educational purposes only
Defibrillation and Synchronized Cardioversion

Defibrillation is the delivery of significant electrical energy through the heart over about 10 milliseconds with the goal of taking a critical mass of myocardial cells and depolarizing them into a brief moment of asystole. This asystolic pause allows cells with automaticity to again dominate the heart in a normal organized rhythm pattern. Synchronized cardioversion is similar to defibrillation except that the delivery of the energy is timed to the intrinsic rhythm of the patient to avoid shocking during a relative refractory period of the cardiac cycle. Shocks during this period can produce VF.

Waveforms: Monophasic waveforms deliver the energy of the shock in one direction (one polarity). Very few manufactures worldwide make this type of defibrillator anymore but some are still in use. Biphasic waveforms deliver a current that reverses direction during the few milliseconds of the shock as the polarity of the pads/paddles changes. Biphasic waveforms have been shown to be superior to monophasic waveforms in implanted defibrillators and significantly less myocardial current density is required with biphasic waveforms.

Defibrillation Energy Selection: Pediatric: Monophasic and biphasic. First defibrillation 2-4 Joules/kg, subsequent shocks should be at least 4 Joules/kg. Higher energies can be considered but do not exceed 10 Joules/kg or the recommended maximum adult energy for the brand of defibrillator

Synchronized Cardioversion Energy Selection: Same for all energy waveform types unless otherwise indicated;
Pediatric Cardioversion: start at 0.5-1 Joules/kg escalating with subsequent attempts to 2 Joules/kg

Steps to Defibrillation and Synchronized Cardioversion

1. Turn on monitor/defibrillator
2. Set lead switch to pads/paddles or lead I, II, or III if leads have been connected
3. Choose energy (most brands of defibrillators come on set to charge at the first defibrillation energy for an adult) for defibrillation or synchronized cardioversion.
4. Place defib pads/paddles on patient
For pediatric patients, use appropriate pad sizes to age/weight; an anterior-posterior placement is common
Attempt to keep paddles/pads 1-3 inches away from implanted devices such as ICD’s and pacemakers.
5. If performing synchronized cardioversion, ensure standard leads are connected; set synch button to on and ensure that the rhythm is being appropriately flagged on the R wave. Give sedation as appropriate for the situation
6. Announce that you are charging. Press the charge button on the machine or if using manual paddles the button on the apex paddle.
7. Warn three times that you are about to shock and visually check that no one is in electrical contact with the patient (direct contact, through liquids, or through metal)
8. Press shock button on machine or two buttons on paddles simultaneously. Note: for Synchronized cardioversion press shock button(s) down until shock occurs. The defibrillator is calculating when to shock and this can be very quick or may take several seconds. Also be sure to re-synch for any subsequent cardioversion attempts as most machines have the synch button turn off after each attempt.
9. For cardiac arrest situations continue CPR if possible as machine is charged and resume with compressions immediately after the shock to minimize CPR time off chest.
Transcutaneous Pacing (TCP)

Transcutaneous pacing (TCP) is a highly effective emergency method of pacing for severe symptomatic bradycardias. Other methods for increasing heart rate like the use of atropine, dopamine, or epinephrine may also be attempted depending on situational factors and what rhythm the patient is in. This non-targeted method of pacing is unique in that it will also pace skeletal muscle, gut muscle and the diaphragm at the currents needed to capture the myocardium electrically. This can mean significant discomfort for the patient and the need for procedural sedation. The current levels needed to get capture are very high in comparison to other methods of pacing and the aberrancy of the route of conduction from the pads leads to QRS complexes that are very wide and bizarre resembling large PVCs. These observations are all normal and are expected.

Steps to Transcutaneous Pacing

1. Position pads on patient for pacing as indicated by the manufacturer. This is usually an anterior-posterior position. Look for a indicator on the pads to show if one pad is specific to the apical position.
2. Ensure standard leads are also connected to the patient
3. Turn pacer on
4. While most TCP will come on default in demand (synchronous) mode, verify that it is not set in non-demand (asynchronous) mode. This mode is rarely used unless there is a situation where artifact is mistakenly being sensed as intrinsic ECG complexes.
5. Set pacer demand rate to a heart rate appropriate to the child’s age and physiological demands (see typical heart rates on page 10 of this package)
6. Set current by titrating the mA upwards until you have consistent electrical capture as indicated by seeing pacer spikes followed by a new QRS morphology. Buffer the capture current (threshold) by increasing the mA by approximately another 10%.
7. Check for mechanical capture (paced rhythm produces cardiac output) by assessing distal pulses (at sites where skeletal muscles are not contracting surrounding the vessel), level of consciousness, vital signs and other signs/symptoms of improved infusion.
8. Proceed to give analgesia and sedation as needed to keep patient comfortable.
9. Arrange transvenous or permanent pacemaker placement as needed.
### Pediatric Vitals Signs and Equipment Sizes

2010 Guidelines for CPR and Emergency Cardiovascular Care

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<th>Age</th>
<th>HR</th>
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<th>Wt (kg)</th>
<th>ETT (mm)</th>
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Minimum Systolic BP = 70 + (age x 2) (up to age 10)
Cuffed ETT Size = (age/4) + 3
Uncuffed ETT Size = (age/4) + 4

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Abbreviations Glossary
Emergency Cardiovascular Care 2011

abx  antibiotic
ACE  angiotensin converting enzyme
ACLS  advanced cardiac life support
ACS  acute coronary syndrome
AED  automated external defibrillator
AF  atrial fibrillation
AFI  atrial flutter
AHA  American Heart Association
ALS  advanced life support
AMI  acute myocardial infarction
APLS  advanced pediatric life support
ASAP  as soon as possible
BB  beta blocker
BP  blood pressure
°C  degrees Celsius
CAB  chest compressions – airway - breathing
CABG  coronary artery bypass graft
CCB  calcium channel blocker
CCR  cardiocerebral resuscitation
CPAP  continuous positive airway pressure
CPR  cardiopulmonary resuscitation
CVP  central venous pressure
DBP  diastolic blood pressure
DIC  disseminated intravascular coagulation
ECC  emergency cardiovascular care
ED  emergency department
Epi  Epinephrine
ERC  European Resuscitation Council
ETT  endotracheal intubation
FAST  Focused Assessment with Sonography for Trauma
FBAO  foreign body airway obstruction
HR  heart rate
HSFC  Heart and Stroke Foundation of Canada
Hx  history
IABP  intra-aortic balloon pump
ILCOR  International Liaison Committee on Resuscitation
IO  intraosseous
ITH  induced therapeutic hypothermia
IV  intravenous
J  Joules
LLUD  left lateral uterine displacement
LMA  laryngeal mask airway
MAP  mean arterial pressure = (2 DBP + SBP)/3
LLUD  left lateral uterine displacement
MgSO₄  magnesium sulphate
MI  myocardial infarction
mm Hg  millimetres of mercury
MOVIE  Monitor – Oxygen if required – Vital Signs including glucose – IV – 12 lead ECG
MVO₂  mixed venous oxygen saturation
NPO  nothing by mouth
NS  normal 0.9% saline
NSTEMI  non-ST elevation myocardial infarction
NTG  nitroglycerin
PALS  pediatric advanced life support
PCI  percutaneous coronary intervention
PE  pulmonary embolus
PEA  pulseless electrical activity
PₚT-CO₂  end-tidal carbon dioxide
PPV  positive pressure ventilations
Pt  patient
ROSC  return of spontaneous circulation
rt-PA  recombinant tissue plasminogen activator
s+s  signs and symptoms
SBP  systolic blood pressure
SIRS  systemic inflammatory response syndrome
SOB  shortness of breath
SpO₂  oxygen saturation as measured by a pulse-oximeter
STEMI  ST-elevation myocardial infarction
SVT  supraventricular tachycardia
TEE  transesophageal echocardiography
TCP  transcutaneous pacing
TIA  transient ischemic attack
TIMI  Thrombolysis in Myocardial Infarction risk score
UA  unstable angina
VF  ventricular tachycardia
VS  vital signs (TPR, BP, SpO₂, glucose)
VT  ventricular tachycardia
WBC  white blood cell
WPW  Wolff Parkinson White pre-excitation syndrome
References


References


Heart and Stroke Foundation of Canada

Pediatric Advanced Life Support

Written Precourse Self-Assessment

Questions and Answer Key for Students

January 2012

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ECG Rhythm Identification

The PALS ECG Rhythm Identification self-assessment test is designed to test your ability to identify rhythms you may encounter as a PALS provider. The rhythms in the list below are the core PALS rhythms that you should be able to identify during the PALS Provider Course teaching and testing stations. If you have difficulty with pediatric ECG rhythm identification, it is strongly suggested that you spend additional time reviewing basic pediatric arrhythmias before the PALS Provider Course. Sources of information about pediatric ECG rhythm identification are found in the PALS Provider Manual.

This self-assessment test is composed of 13 multiple-choice questions. For all questions, select the single best answer. An answer may be used more than once. There are 3 self-assessment tests: ECG Rhythm Identification, Pharmacology, and Practical Application.

Pediatric Rhythms:

A. Normal sinus rhythm
B. Sinus tachycardia
C. Sinus bradycardia
D. Supraventricular tachycardia (SVT)
E. Wide-complex tachycardia; presumed ventricular tachycardia (monomorphic)
F. Ventricular fibrillation (VF)
G. Asystole
H. Pulseless electrical activity (PEA)

Rhythms 1 to 8: Core PALS Rhythms (select single best answer from rhythms A to H)

Rhythm 1 (clinical clue: heart rate 214/min)

![ECG waveform image]
Rhythm 2 (clinical clues: heart rate 44/min; no detectable pulses)

Rhythm 3 (clinical clues: age 8 years; heart rate 50/min)

Rhythm 4 (clinical clue: no detectable pulses)
Rhythm 5 (clinical clue: no consistent heart rate detected; no detectable pulses)

Rhythm 6 (clinical clues: age 3 years; heart rate 188/min)

Rhythm 7 (clinical clue: heart rate 300/min)
Rhythm 8 (clinical clues: age 8 years; heart rate 75/min)
Pharmacology

The PALS Pharmacology self-assessment test is designed to test your knowledge of core drugs that will be used in the PALS Provider Course.

If this self-assessment shows that your knowledge of the pharmacology and indications for these drugs is deficient, it is strongly suggested that you spend additional time reviewing basic resuscitation drug pharmacology before taking a PALS course. Sources of PALS drug information include the PALS Provider Manual and the 2010 Handbook of Emergency Cardiovascular Care for Healthcare Providers (ECC Handbook).

The Pharmacology self-assessment consists of 11 multiple-choice questions. Select the single best answer. There are 3 self-assessment tests: ECG Rhythm Identification, Pharmacology, and Practical Application.

1. **You are called to help resuscitate an infant with severe symptomatic bradycardia associated with respiratory distress. The bradycardia persists despite establishment of an effective airway, oxygenation, and ventilation. There is no heart block present. Which of the following is the first drug you should administer?**
   
   A. Atropine  
   B. Dopamine  
   C. Adenosine  
   D. Epinephrine

2. **Which of the following statements about the effects of epinephrine during attempted resuscitation is true?**
   
   A. Epinephrine decreases peripheral vascular resistance and reduces myocardial afterload so that ventricular contractions are more effective  
   B. Epinephrine improves coronary artery perfusion pressure and stimulates spontaneous contractions when asystole is present  
   C. Epinephrine is contraindicated in ventricular fibrillation because it increases myocardial irritability  
   D. Epinephrine decreases myocardial oxygen consumption
3. Initial impression of a 2-year-old female reveals her to be alert with mild breathing difficulty during inspiration and pale skin color. On primary assessment, she makes high-pitched inspiratory sounds (mild stridor) when agitated; otherwise her breathing is quiet. Her \( \text{SpO}_2 \) is 92% in room air, and she has mild inspiratory intercostal retractions. Lung auscultation reveals transmitted upper airway sounds with adequate distal breath sounds bilaterally. Which of the following is the most appropriate initial therapeutic intervention for this child?

A. Perform immediate endotracheal intubation
B. Administer an IV dose of dexamethasone
C. Nebulize 2.5 mg of salbutamol
D. Administer humidified supplementary oxygen as tolerated and continue evaluation

4. Which of the following most reliably delivers a high (90% or greater) concentration of inspired oxygen in a toddler or older child?

A. Nasal cannula with 4 L/min oxygen flow
B. Simple oxygen mask with 15 L/min oxygen flow
C. Nonrebreathing face mask with 12 L/min oxygen flow
D. Face tent with 15 L/min oxygen flow

5. Which of the following statements about endotracheal drug administration is true?

A. Endotracheal drug administration is the preferred route of drug administration during resuscitation because it results in predictable drug levels and drug effects
B. Endotracheal doses of resuscitation drugs in children have been well established and are supported by evidence from clinical trials
C. Intravenous drug doses for resuscitation drugs should be used whether you give the drugs by the IV, the intraosseous (IO), or the endotracheal route
D. Endotracheal drug administration is the least desirable route of administration because this route results in unpredictable drug levels and effects

6. Which of the following statements most accurately reflects the PALS recommendations for the use of magnesium sulfate in the treatment of cardiac arrest?

A. Magnesium sulfate is indicated for VF refractory to repeated shocks and amiodarone or lidocaine
B. Routine use of magnesium sulfate is indicated for shock-refractory monomorphic VT
C. Magnesium sulfate is indicated for torsades de pointes and VF/pulseless VT associated with suspected hypomagnesemia
D. Magnesium sulfate is contraindicated in VT associated with an abnormal QT interval during the preceding sinus rhythm
7. You enter a room to perform an initial impression of a previously stable 10-year-old male and find him unresponsive and apneic. A code is called and bag-mask ventilation is performed with 100% oxygen. The cardiac monitor shows a wide-complex tachycardia. The boy has no detectable pulses, so compressions and ventilations are provided. As soon as the defibrillator arrives you deliver an unsynchronized shock with 2 J/kg. The rhythm check after 2 minutes of CPR reveals VF. You then deliver a shock of 4 J/kg and resume immediate CPR beginning with compressions. A team member had established IO access, so you give a dose of epinephrine, 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) IO, when CPR is restarted after the second shock. At the next rhythm check, persistent VF is present. You administer a 4 J/kg shock and resume CPR. Based on the PALS Pediatric Cardiac Arrest Algorithm, what are the next drug and dose to administer when CPR is restarted?

A. Epinephrine 0.1 mg/kg (0.1 mL/kg of 1:1,000 dilution) IO  
B. Atropine 0.02 mg/kg IO  
C. Amiodarone 5 mg/kg IO  
D. Magnesium sulfate 25 to 50 mg/kg IO

8. Parents of a 1-year-old female phoned the Emergency Response System when they picked up their daughter from the babysitter. Paramedics perform an initial impression revealing an obtunded infant with irregular breathing, bruises over the abdomen, abdominal distention, and cyanosis. Assisted bag-mask ventilation with 100% oxygen is initiated. On primary assessment heart rate is 36/min, peripheral pulses cannot be palpated, and central pulses are barely palpable. Cardiac monitor shows sinus bradycardia. Two-rescuer CPR is started with a 15:2 compression-to-ventilation ratio. In the emergency department the infant is intubated and ventilated with 100% oxygen, and IV access is established. The heart rate is now up to 150/min but there are weak central pulses and no distal pulses. Systolic blood pressure is 74 mm Hg. Of the following, which would be most useful in management of this infant?

A. Epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) IV  
B. Rapid bolus of 20 mL/kg of isotonic fluid  
C. Atropine 0.02 mg/kg IV  
D. Synchronized cardioversion

9. Which of the following statements about calcium is true?

A. Routine administration of calcium is not indicated during cardiac arrest  
B. The recommended dose is 1 to 2 mg/kg of calcium chloride  
C. Calcium chloride 10% has the same bioavailability of elemental calcium as calcium gluconate in critically ill children  
D. Indications for administration of calcium include hypercalcemia, hypokalemia, and hypomagnesemia
10. An infant with a history of vomiting and diarrhea arrives by ambulance. During your primary assessment the infant responds only to painful stimulation. The upper airway is patent, the respiratory rate is 40/min with good bilateral breath sounds, and 100% oxygen is being administered. The infant has cool extremities, weak pulses, and a capillary refill time of more than 5 seconds. The infant’s blood pressure is 85/65 mm Hg, and glucose concentration (measured by bedside test) is 1.65 mmol/L (30 mg/dL). Which of the following is the most appropriate treatment to provide for this infant?

A. Establish IV or IO access and administer 20 mL/kg D$_5$0.45% sodium chloride bolus over 15 minutes
B. Establish IV or IO access and administer 20 mL/kg Lactated Ringer's solution over 60 minutes
C. Perform endotracheal intubation and administer epinephrine 0.1 mg/kg 1:1,000 via the endotracheal tube
D. Establish IV or IO access, administer 20 mL/kg isotonic crystalloid over 10 to 20 minutes, and simultaneously administer D$_{25}$W 2 to 4 mL/kg in a separate infusion

11. Initial impression of a 9-year-old male with increased work of breathing reveals the boy to be agitated and leaning forward on the bed with obvious respiratory distress. You administer 100% oxygen by nonrebreathing mask. The patient is speaking in short phrases and tells you that he has asthma but does not carry an inhaler. He has nasal flaring, severe suprasternal and intercostal retractions, and decreased air movement with prolonged expiratory time and wheezing. His SpO$_2$ is 92% (on nonrebreathing mask). What is the next medical therapy to provide to this patient?

A. Adenosine 0.1 mg/kg
B. Amiodarone 5 mg/kg IV/IO
C. Salbutamol by nebulization
D. Procainamide 15 mg/kg IV/IO
Practical Application

The PALS Practical Application self-assessment test is designed to test your knowledge of appropriate treatment selections based on pediatric assessment information provided in case scenarios. This exercise specifically evaluates your ability to identify core PALS rhythms (if presented), knowledge of core drugs, knowledge of the PALS flowcharts and algorithms for respiratory distress/respiratory failure and shock, and knowledge of the PALS algorithms for rhythm disturbances.

If you have difficulty with the practical application questions, it is strongly suggested that you review the core PALS rhythms, core drug information, the PALS flowcharts and algorithms for respiratory distress/failure and shock, and the PALS rhythm disturbances algorithms. Sources of this information include the PALS Provider Manual and the 2010 Handbook of Emergency Cardiovascular Care for Healthcare Providers (ECC Handbook).

This self-assessment consists of 19 multiple-choice questions. Select the single best answer. There are 3 self-assessment tests: ECG Rhythm Identification, Pharmacology, and Practical Application.
1. An 8-month-old male is brought to the emergency department (ED) for evaluation of severe diarrhea and dehydration. In the ED the child becomes unresponsive and pulseless. You shout for help and start CPR at a compression rate of at least 100/min and a compression-to-ventilation ratio of 30:2. Another provider arrives, at which point you switch to 2-rescuer CPR with a compression-to-ventilation ratio of 15:2. The cardiac monitor shows the following rhythm:

![Heart Rhythm](image)

The infant is intubated and ventilated with 100% oxygen. An IO line is rapidly established and a dose of epinephrine is given. Of the following choices for management, which would be most appropriate to give next?

A. Defibrillation 2 J/kg  
B. Normal saline 20 mL/kg IV rapidly  
C. High-dose epinephrine, 0.1 mg/kg (0.1 mL/kg of 1:1,000 dilution), IO  
D. Amiodarone 5 mg/kg IO

2. Initial impression of a 10-month-old male in the emergency department reveals a lethargic pale infant with slow respirations. You begin assisted ventilation with a bag-mask device using 100% oxygen. On primary assessment heart rate is 38/min, central pulses are weak but distal pulses cannot be palpated, blood pressure is 60/40 mm Hg, and capillary refill is 4 seconds. During your assessment a colleague places the child on a cardiac monitor and you observe the following rhythm:

![Heart Rhythm](image)

The rhythm remains unchanged despite ventilation with 100% oxygen. What are your next management steps?
A. Administer adenosine 0.1 mg/kg rapid IV/IO and prepare for synchronized cardioversion
B. Start chest compressions and give epinephrine 0.1 mg/kg (0.1 mL/kg of 1:1,000 dilution) IV/IO
C. Start chest compressions and give epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) IV/IO
D. Administer 20 mL/kg isotonic crystalloid and epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) IV/IO

3. A 3-year-old unresponsive, apneic child is brought to the emergency department. EMS personnel report that the child became unresponsive as they arrived at the hospital. The child is receiving CPR, including bag-mask ventilation with 100% oxygen and chest compressions at a rate of at least 100/min. Compressions and ventilations are being coordinated at a ratio of 15:2. You confirm that apnea is present and that ventilation is producing bilateral breath sounds and chest expansion while a colleague confirms absent pulses. Cardiac monitor shows the following rhythm:

![Cardiac monitor rhythm](image)

A biphasic manual defibrillator is present. You quickly use the crown-heel length of the child on a length-based, color-coded resuscitation tape to estimate the approximate weight as 15 kg. Which of the following therapies is most appropriate for this child at this time?

A. Establish IV/IO access and administer amiodarone 5 mg/kg IV/IO
B. Establish IV/IO access and administer lidocaine 1 mg/kg IV/IO
C. Attempt defibrillation at 30 J, then resume CPR beginning with compressions
D. Establish IV/IO access and administer epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) IV/IO
4. Initial impression of a 10-year-old male shows him to be unresponsive. You shout for help and check for breathing or only gasping. After finding that he is pulseless, you begin cycles of compressions and ventilations with a compression rate of at least 100/min and compression-to-ventilation ratio of 30:2. A colleague arrives and places the child on a cardiac monitor, revealing the following rhythm:

![EKG Image]

The two of you attempt defibrillation at 2 J/kg and give 2 minutes of CPR. The rhythm persists at the second rhythm check, at which point you attempt defibrillation using 4 J/kg. A third colleague establishes IO access and administers one dose of epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) during the compressions following the second shock. If VF or pulseless VT persists after 2 minutes of CPR, what is the next drug/dose to administer?

A. Epinephrine 0.1 mg/kg (0.1 mL/kg of 1:1,000 dilution) IV
B. Adenosine 0.1 mg/kg IV
C. Amiodarone 5 mg/kg IV
D. Atropine 0.02 mg/kg IV
5. A 1-year-old male is brought to the emergency department for evaluation of poor feeding, fussiness, and sweating. On initial impression he is lethargic but arousable and has labored breathing and a dusky color. Primary assessment reveals a respiratory rate of 68/min, heart rate 300/min that does not vary with activity or sleep, blood pressure 70/45 mm Hg, weak brachial pulses and absent radial pulses, capillary refill 6 seconds, \( \text{SpO}_2 \) 85% in room air, and good bilateral breath sounds. You administer high-flow oxygen and place the child on a cardiac monitor. You see the following rhythm with little beat-to-beat variability of the heart rate:

```
[Heart rate trace image]
```

Secondary assessment reveals no history of congenital heart disease. IV access has been established. Which of the following therapies is most appropriate for this infant?

A. Make an appointment with a pediatric cardiologist for later in the week
B. Adenosine 0.1 mg/kg IV rapidly; if adenosine is not immediately available, perform synchronized cardioversion
C. Perform immediate defibrillation without waiting for IV access
D. Establish IV access and administer a fluid bolus of 20 mL/kg isotonic crystalloid

6. A child becomes unresponsive in the emergency department and is not breathing. You provide ventilation with 100% oxygen. You are uncertain if a faint pulse is present with the following rhythm:

```
[Heart rate trace image]
```

What is your next action?
A. Start high-quality CPR beginning with chest compressions
B. Order transcutaneous pacing
C. Start an IV and give atropine 0.01 mg/kg IV
D. Start an IV and give epinephrine 0.01 mg/kg IV (0.1 mL/kg of 1:10,000 dilution)

7. You are preparing to use a manual defibrillator and paddles in the pediatric setting. When would it be most appropriate to use the smaller “pediatric” sized paddles for shock delivery?

A. To attempt synchronized cardioversion but not defibrillation
B. If the patient weighs less than approximately 25 kg or is less than 8 years of age
C. If the patient weighs less than approximately 10 kg or is less than 1 year of age
D. Whenever you can compress the victim’s chest using only the heel of one hand

8. A 7-year-old boy is found unresponsive, apneic, and pulseless. CPR is ongoing. The child is intubated and vascular access is established. The ECG monitor reveals an organized rhythm, but a pulse check reveals no palpable pulses. Effective ventilations and compressions are resumed, and an initial IV dose of epinephrine is administered. Which of the following therapies should you perform next?

A. Attempt to identify and treat reversible causes (using the H's and T's as a memory aid)
B. Attempt defibrillation at 4 J/kg
C. Administer epinephrine 0.1 mg/kg IV (0.1 mL/kg of 1:1,000 dilution)
D. Administer synchronized cardioversion at 1 J/kg

9. You are evaluating an irritable 6-year-old girl with mottled color. On primary assessment she is febrile (temperature 40°C [104°F]), and her extremities are cold (despite a warm ambient temperature in the room) with capillary refill of 5 seconds. Distal pulses are absent and central pulses are weak. Heart rate is 180/min, respiratory rate is 45/min, and blood pressure is 98/56 mm Hg. Which of the following most accurately describes the categorization of this child’s condition using the terminology taught in the PALS Provider Course?

A. Hypotensive shock associated with inadequate tissue perfusion
B. Hypotensive shock associated with inadequate tissue perfusion and significant hypotension
C. Compensated shock requiring no intervention
D. Compensated shock associated with tachycardia and inadequate tissue perfusion
10. An 8-year-old child was struck by a car. He arrives in the emergency department alert, anxious, and in respiratory distress. His cervical spine is immobilized, and he is receiving a 10 L/min flow of 100% oxygen by nonrebreathing face mask. Primary assessment reveals respiratory rate 60/min, heart rate 150/min, systolic blood pressure 70 mm Hg, and \( \text{SpO}_2 \) 84% on supplementary oxygen. Breath sounds are absent over the right chest, and the trachea is deviated to the left. He has weak central pulses and absent distal pulses. Which of the following is the most appropriate immediate intervention for this child?

A. Perform endotracheal intubation and call for a STAT chest x-ray
B. Provide bag-mask ventilation and call for a STAT chest x-ray
C. Establish IV access and administer a 20 mL/kg normal saline fluid bolus
D. Perform needle decompression of the right chest and assist ventilation with a bag and mask if necessary

11. An 18-month-old child presents with a 1-week history of cough and runny nose. You perform an initial impression, which reveals a toddler responsive only to painful stimulation with slow respirations and diffuse cyanosis. You begin a primary assessment and find that the child’s respiratory rate has fallen from 65/min to 10/min, severe inspiratory intercostal retractions are present, heart rate is 160/min, \( \text{SpO}_2 \) is 65% in room air, and capillary refill is less than 2 seconds. Which of the following is the most appropriate immediate treatment for this toddler?

A. Establish vascular access and administer a 20 mL/kg bolus of isotonic crystalloid
B. Open the airway and provide positive-pressure ventilation using 100% oxygen and a bag-mask device
C. Administer 100% oxygen by face mask, establish vascular access, and obtain a STAT chest x-ray
D. Administer 100% oxygen by face mask, obtain an arterial blood gas, and establish vascular access

12. You are supervising another healthcare provider who is inserting an intraosseous (IO) needle into an infant's tibia. Which of the following signs should you tell the provider is the best indication of successful insertion of a needle into the bone marrow cavity?

A. Pulsatile blood flow will be present in the needle hub
B. Fluids can be administered freely without local soft tissue swelling
C. You are unable to aspirate any blood through the needle
D. Once inserted, the needle shaft of the needle moves easily in all directions within the bone
13. A pale and obtunded 3-year-old child with a history of diarrhea is brought to the hospital. Primary assessment reveals respiratory rate of 45/min with good breath sounds bilaterally. Heart rate is 150/min, blood pressure is 90/64 mm Hg, and SpO₂ is 92% in room air. Capillary refill is 5 seconds and peripheral pulses are weak. After placing the child on a nonrebreathing face mask (10 L/min flow) with 100% oxygen and obtaining vascular access, which of the following is the most appropriate immediate treatment for this child?

A. Obtain a chest x-ray  
B. Begin a maintenance crystalloid infusion  
C. Administer a bolus of 20 mL/kg isotonic crystalloid  
D. Administer a dopamine infusion at 2 to 5 mcg/kg per minute

14. You have just assisted with the elective endotracheal intubation of a child with respiratory failure and a perfusing rhythm. Which of the following provides the most reliable, prompt assessment of correct endotracheal tube placement in this child?

A. Absence of audible breath sounds over the abdomen during positive-pressure ventilation  
B. Auscultation of breath sounds over the lateral chest bilaterally plus presence of mist in the endotracheal tube  
C. Confirmation of appropriate oxygen and carbon dioxide tensions on arterial blood gas analysis  
D. Clinical assessment of adequate bilateral breath sounds and chest expansion plus presence of exhaled CO₂ in a colorimetric detection device after delivery of 6 positive-pressure ventilations

15. A 4-year-old male is in pulseless arrest in the pediatric intensive care unit. A code is in progress. As the on-call physician you quickly review his chart and find that his baseline corrected QT interval on a 12-lead ECG is prolonged. A glance at the monitor shows recurrent episodes of the following rhythm:

![ECG Image]

The boy has received one dose of epinephrine 0.01 mg/kg (0.1 mL/kg of 1:10,000 dilution) but continues to demonstrate the rhythm illustrated above. If this rhythm persists at the next rhythm check, which medication would be most appropriate to administer at this time?
16. You are participating in the elective intubation of a 4-year-old child with respiratory failure. You must select the appropriate sized uncuffed endotracheal tube. You do not have a color-coded, length-based tape to use to estimate correct endotracheal tube size. Which of the following is the most appropriate estimated size uncuffed endotracheal tube for an average 4-year-old?

A. 3-mm tube
B. 4-mm tube
C. 5-mm tube
D. 6-mm tube

17. You are caring for a 3-year-old with vomiting and diarrhea. You have established IV access. When you place an orogastric tube, the child begins gagging and continues to gag after the tube is placed. The child’s color has deteriorated; pulses are palpable but faint and the child is now lethargic. The heart rate is variable (range 44/min to 62/min). You begin bag-mask ventilation with 100% oxygen. When the heart rate does not improve, you begin chest compressions.

The cardiac monitor shows

![Cardiac Monitor Image]

Which of the following would be the most appropriate therapy to consider next?

A. Epinephrine 0.1 mg/kg (0.1 mL/kg of 1:1,000 dilution) IV
B. Atropine 0.02 mg/kg IV
C. Attempt synchronized cardioversion at 0.5 J/kg
D. Cardiology consult for transcutaneous pacing
18. You are transporting a 6-year-old endotracheally intubated patient who is receiving positive-pressure mechanical ventilation. The child begins to move his head and suddenly becomes cyanotic and bradycardic. \( \text{SpO}_2 \) is 65% with good pulse signal. You remove the child from the mechanical ventilator circuit and provide manual ventilation with a bag via the endotracheal tube. During manual ventilation with 100% oxygen, the child's color and heart rate improve slightly and his blood pressure remains adequate. Breath sounds and chest expansion are present and adequate on the right side, but they are consistently diminished on the left side. The trachea is not deviated, and the neck veins are not distended. A suction catheter passes easily beyond the tip of the endotracheal tube. Which of the following is the most likely cause of this child's acute deterioration?

A. Tracheal tube displacement into the right main bronchus  
B. Tracheal tube obstruction  
C. Tension pneumothorax on the right side  
D. Equipment failure

19. A 3-year-old boy presents with multiple system trauma. The child was an unrestrained passenger in a motor vehicle crash. On primary assessment he is unresponsive to voice or painful stimulation. His respiratory rate is <6/min, heart rate is 170/min, systolic blood pressure is 60 mm Hg, capillary refill is 5 seconds, and \( \text{SpO}_2 \) is 75% in room air. Which of the following most accurately summarizes the first actions you should take to support this child?

A. Provide 100% oxygen by simple mask, stabilize the cervical spine, establish vascular access, and provide maintenance IV fluids  
B. Provide 100% oxygen by simple mask and perform a head-to-toe survey to identify the extent of all injuries; begin an epinephrine infusion and titrate to maintain a systolic blood pressure of at least 76 mm Hg  
C. Establish immediate vascular access, administer 20 mL/kg isotonic crystalloid, and reassess the patient; if the child's systemic perfusion does not improve, administer 10 to 20 mL/kg packed red blood cells  
D. Open the airway (jaw-thrust technique) while stabilizing the cervical spine, administer positive-pressure ventilation with 100% oxygen, and establish immediate IV/IO access
ECG Rhythm Identification Answer Sheet

Pediatric Rhythms (core PALS rhythms A to H)

A. Normal sinus rhythm  
B. Sinus tachycardia  
C. Sinus bradycardia  
D. Supraventricular tachycardia (SVT)  
E. Wide-complex tachycardia; presumed ventricular tachycardia (monomorphic)  
F. Ventricular fibrillation (VF)  
G. Asystole  
H. Pulseless electrical activity (PEA)

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Pharmacology Answer Sheet

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# Practical Application Answer Sheet

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