# ACLS Precourse Package 2015

<table>
<thead>
<tr>
<th>Component</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACLS General Prerequisites</td>
<td>2</td>
</tr>
<tr>
<td>Knowledge Prerequisites</td>
<td>2</td>
</tr>
<tr>
<td>Course Description</td>
<td>3</td>
</tr>
<tr>
<td>Course Evaluation</td>
<td>3</td>
</tr>
<tr>
<td>Course Resources (print and online)</td>
<td>4</td>
</tr>
<tr>
<td>Remediation</td>
<td>4</td>
</tr>
<tr>
<td>Preparing for the Course</td>
<td>4</td>
</tr>
<tr>
<td>CME Mainpro Credits</td>
<td>5</td>
</tr>
<tr>
<td>Cancellation, Refund and Transfer</td>
<td>5</td>
</tr>
<tr>
<td>ECC Essentials 2011 – Learning</td>
<td>6-30</td>
</tr>
<tr>
<td>Algorithms for ACLS</td>
<td></td>
</tr>
<tr>
<td>HSFC Precourse Self-Assessment</td>
<td>31-40</td>
</tr>
</tbody>
</table>
Thank you for choosing SkillStat Learning Inc. for your Advanced Life Support 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 ACLS course. It includes relevant information needed to help you successfully prepare and succeed in your ACLS training.

**ACLS 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 ACLS course (every ACLS course through SkillStat includes an optional BLS-HCP course concurrently) or register for a BLS-HCP course before an ACLS 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 ACLS pharmacology
- Knowledge of the ACLS algorithms (cardiac arrest, stroke management, acute coronary syndromes, post-cardiac arrest, unstable tachycardias, unstable bradycardias)
- Basic Life Support procedures and protocols
COURSE DESCRIPTION:

The **ACLS Provider** and **ACLS Renewal** courses address therapeutic interventions for cardiopulmonary arrest, acute arrhythmias, stroke, and acute coronary syndromes (ACS) through didactic instruction, case-based learning scenarios and active simulations.

The **Advanced Cardiovascular Life Support (ACLS) Provider Course** is for health care practitioners who have not taken ACLS within the last two years. The **ACLS Renewal Course** is for those who have successfully completed an ACLS 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 ACLS algorithms
- Practical evaluation of team leadership and airway management within active simulations
- Written evaluation

COURSE EVALUATION:

To successfully complete an ACLS 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 ACLS Algorithms Learning Document, links to online resources and a pre-course written self-evaluation – a practice quiz prepared by the HSFC)
- The ACLS 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
- Student resources found at www.heart.org/eccstudent (use code “compression” for access to AHA student website)

REMEDIATION:

- 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 entre ACLS 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 ACLS course delivery are laid out by Heart and Stroke Foundation of Canada. You are welcome to attend another ACLS course though at no cost (see our Complete Success Policy)
- **SkillStat’s Complete Success Policy**: if you are either unsuccessful in an ACLS course OR sense that additional practice in another course would be beneficial, you are invited to attend another ACLS 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 an ACLS 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 ACLS 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 ACLS course are available upon course completion. Please request a CME letter for Mainpro credits via email or at the ACLS course. The ACLS Provider course offers MAINPRO-M1 credits=14, MAINPRO-C=8 credits. The ACLS 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.
### Adult Care

<table>
<thead>
<tr>
<th>Inside</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Overview of Emergency Cardiovascular Care 2011</td>
<td>3</td>
</tr>
</tbody>
</table>

#### 2011 Adult BLS & ACLS Algorithms

- Basic Life Support for Healthcare Providers                           | 5    |
- Ventricular Fibrillation/VT Arrest                                    | 7    |
- Pulseless Electrical Activity                                          | 8    |
- Asystole                                                              | 9    |
- Post-Cardiac Arrest Care                                              | 11   |
- Unstable Bradycardia                                                  | 13   |
- Adult Tachycardia                                                     | 14   |
- Atrial Fibrillation / Atrial Flutter                                  | 15   |
- Acute Coronary Syndromes                                              | 17   |
- Stroke                                                                | 19   |

#### Rapid Reference

- Electrical Therapies                                                 | 21   |
- Adult ACLS Medications                                                | 23   |
- Therapeutic Hypothermia Overview                                      | 24   |
- Abbreviation Dictionary                                               | 25   |
- References                                                            | 27   |

### Authors:

- Tracy Barill RN  
  SkillStat Learning Inc.
- Michael Dare RN, ALS Paramedic  
  Dare Consulting Services

### Reviewed by:

- Darin Abbey RN  
- Allan Holmes MD
- Thora Barnes RN  
- Jamie Renwick MD
- Aaron Davison MD  
- Angela Robson RN
- Sheila Finamore RN  
- Ron Straight ALS Paramedic

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Emergency Cardiovascular Care 2011: Essentials for Health Professionals in Hospital was developed for education purposes. It is available at [www.skillstat.com/ecc2011](http://www.skillstat.com/ecc2011). Feedback is welcome (ecc2011@skillstat.com). This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. To view a copy of this license, visit [http://creativecommons.org/licenses/by-nc-nd/3.0/](http://creativecommons.org/licenses/by-nc-nd/3.0/).
On October 18, 2010 the International Liaison Committee On Resuscitation (ILCOR) released a major 5 year update to the CPR and Emergency Cardiovascular Care (ECC) Guidelines. The American Heart Association (AHA) and the European Resuscitation Council (ERC) in turn released similar interpretations of this release.

These guidelines provide core algorithms to outline key actions and decisions for the immediate care of common cardiovascular emergencies:

- cardiac arrest
- post-cardiac arrest
- hemodynamically unstable bradycardia and tachycardia
- acute coronary syndromes
- stroke

These algorithms are central to advanced cardiac life support and pediatric advanced life support courses.

Considerable material included in the major release documents is not included in these core algorithms. This makes sense. Most health providers focus their attention on the more likely core subset of possible cardiovascular emergencies.

For advanced care health professionals in hospital, though, their required skills encompass a broader scope of practice - a full complement of therapeutic interventions and a complex array of morbidities. Support documents and courses specific to this setting harness added content to supplement the core algorithms. This ‘best fit’ approach builds on the ‘one-size-fits-all’ core algorithms to ensure optimal care and improved patient outcomes.

**ACLS & ECC 2011 Essentials** is an education supplement for healthcare professionals tasked with the emergency cardiac care of adults in hospital. This summary of 2010/2011 emergency cardiovascular care guidelines combines recent resuscitation science, suggested procedures and guiding principles into an organized approach to in-hospital emergency cardiovascular care. Canadian Stroke Strategy guidelines and Canadian Cardiovascular Society Atrial Fibrillation protocols round out this document. We hope that a solid understanding and long term adoption of the latest in hospital emergency cardiovascular care science is enhanced with this supplement.

Much thanks go to the advanced care practitioners who reviewed this document. Their significant investments in time and their many suggestions have added to this publication. Despite great efforts placed in the creation of these documents, error free results rarely occur despite several reviews and edits. Please direct any suggestions or questions to ecc2011@skillstat.com.

Both the AHA and the ERC are careful to point out that not all recommendations will apply to all rescuers or all situations. 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 official ECC 2010 guidelines, executive summaries and updates online. Links are included below for your convenience.

International Liaison Committee for Resuscitation (http://www.ilcor.org/en/home/)
American Heart Association (http://guidelines.ecc.org)
Canadian Cardiovascular Society Atrial Fibrillation Guidelines (http://www.ccs.ca/consensus_conferences/cc_library_e.aspx)
European Resuscitation Council (http://www.cprguidelines.eu/2010/)
Overview of Emergency Cardiovascular Care 2011

For 36-months, evidence evaluation by 356 resuscitation experts from 29 countries was coordinated through the International Liaison Committee on Resuscitation (ILCOR). This 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.

The Canadian Stroke Strategy is a comprehensive initiative designed to optimize stroke care in Canada. The Canadian Cardiovascular Society released the 2010-2011 Atrial Fibrillation Guidelines incorporating the latest science into practical protocols. Included algorithms and support information for atrial fibrillation and stroke care is based on their work.

Resuscitation care strives to preserve life and restore health while limiting disability. In Canada and the US, over 50,000 people were discharged from hospital in 2009 following a cardiac arrest. Recent data show that 75% were discharged with a favorable neurological outcome. Many more averted a cardiac arrest. In the last ten years, mortality from acute coronary syndromes was reduced by 47% and deaths from stroke reduced by 14%. The adoption of the prior 2005 CPR and ECC Guidelines is associated with increased survival to discharge. When used, resuscitation science works.

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 ‘gasp’ 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 – PETCO2) to continuously monitor tracheal tube placement, to assess the quality of CPR, and indicate the return of spontaneous circulation
- 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
- Safety of using cricoid pressure routinely during resuscitation is questioned; do not use cricoid pressure if it impedes ventilation or negatively impacts the speed/ease of intubation
- The delivery of medications via the endotracheal tube is no longer recommended
- Strong emphasis on coordinated post-cardiac arrest care with the inclusion of a comprehensive post resuscitation protocol

(continued on next page)
Continued emphasis on effective resuscitation team dynamics and team leadership

There is little evidence to support or refute the routine application of supplemental oxygen for ACS in the absence of hypoxemia; there is evidence that suggests hyperoxemia may lead to harmful effects; encourage the maintenance of oxygen saturation (SpO₂) to 94-98% in all patients not in cardiac arrest; (note that newborns are particularly at risk for harm due to hyperoxaemia; assess a baby’s need for oxygen with pulse oximetry attached to the right upper extremity; for babies born at term, begin resuscitation at room air)

New recommendations for first line medications in tachycardias and atrial fibrillation/flutter

Several initiatives outlined to reduce time to effective acute coronary syndromes (ACS) treatment

Routine use of glycoprotein IIb/IIIa inhibitors is no longer recommended in the treatment of ACS

IV beta blockers should be only used selectively in the pre-hospital and emergency department settings

Increased timeline for use of fibrinolytics in stroke from 3 to 4.5 hours for selected patients

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:

- For every minute into a cardiac arrest, opportunity for successful resuscitation is reduced by about 10% - 1% for every 6 seconds.
- Brain damage can occur after only 3 minutes of a patient being in 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.

Time-sensitive interventions are key.

To help ensure a rapid effective response, summary algorithms are provided to highlight relevant concepts and actions of the most likely cardiovascular 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 essential knowledge presented in algorithms for the resuscitation of adults. Note the adult universal cardiac arrest algorithm of the AHA Guidelines is expanded to three algorithms for clarification and further direction: Ventricular Fibrillation / Ventricular Tachycardia Arrest, Pulseless Electrical Activity (PEA) and Asystole. Direction is also expanded to include emergency atrial fibrillation/flutter management.

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, the delivery of ACLS medications, an induced therapeutic hypothermia overview, 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.
Activate Emergency Response
Get AED / Defibrillator

Check pulse
Max 10 seconds

Definite pulse

No pulse or unsure?

Begin CPR (CAB)
30 compressions : 2 breaths

Access to AED

Give 1 shock
Resume CPR immediately
for 2 min; follow prompts of AED to reassess rhythm. Continue until ALS arrives or signs of life occur

Shockable rhythm?

Resume CPR immediately
for 2 min; follow prompts of AED to reassess rhythm. Continue until ALS arrives or signs of life occur

Shockable

Not Shockable

Give 1 breath
every 5-6 seconds
Continue to frequently monitor pulse and signs of life while giving rescue breaths

Quality CPR
- After assessing no pulse or unsure begin with compressions then open airway and give 2 breaths (CAB)
- Push Hard (5-6 cm), Fast (100-120/min) & allow for Full Recoil on horizontal hard surface
- Compression interruption < 10 sec
- With 2 person CPR but without advanced airway, deliver 30:2 compressions to ventilations – change compressor every 5 cycles
- 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 compressor every 2 minutes

Core Principles
- Minimize time to first shock
- Maximize time on chest (CPR)
- Deliver quality CPR
- Do not over ventilate – rate or volume

Electrical Therapy
- Automated external defibrillator (AED) should be applied as soon as available
- Adult pads (8-12 cm diameter)
<table>
<thead>
<tr>
<th>Healthcare Provider CPR Skills Summary</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><strong>Recognition</strong></td>
<td>Unresponsive</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No breathing or only gasping</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No definite pulse palpated within 10 seconds</td>
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<td></td>
</tr>
<tr>
<td><strong>CPR Sequence</strong></td>
<td>C – A - B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Compressions Landmark**            | Heel of hand placed on centre of the chest on lower half of sternum; second hand placed over first | Heel of hand placed on centre of the chest on lower half of sternum Optional: second hand placed over first | Lone Rescuer: 2 fingers placed just below the nipple line  
Two Rescuers: 2 thumbs placed just below the nipple line with hands encircling chest |
| **Compression Rate**                 | At least 100/minute         |                             |                     |
|                                      | Change compressors every 2 minutes |                             |                     |
| **Compression Depth**                | At least 5 cm (2 inches)    |                             | At least 1/3 the anterior-posterior diameter |
| **Chest Wall Recoil**                |                             | Allow full recoil between compressions |                     |
| **Airway**                           |                             | Head tilt – chin lift (jaw thrust if trauma is suspected) |                     |
| **Compression to Ventilation Ratio** | 30:2                        | 30:2 for single rescuer     | 15:2 for two rescuers |
| (without advanced airway)            | 1 or 2 rescuers             |                             |                     |
| **Rescue Breaths**                   | 1 breath every 5-6 seconds  | 1 breath every 3 seconds    |                     |
| **Rescue Breaths with advanced airway** | 1 breath every 6-8 seconds (8-10 breaths/minute)  
Breaths delivered asynchronously with chest compressions  
About 1 second per breath with visible chest rise |                     | 5 back blows followed by 5 chest compressions until effective or infant becomes unresponsive |
| **FBAO - Responsive**                | 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) |                     | 5 back blows followed by 5 chest compressions until effective or infant becomes unresponsive |
| **FBAO - Unresponsive**              | 30 compressions – open airway – remove foreign body only if seen - 2 attempts to ventilate – Repeat until ventilation is successful |                     |                     |
| **AED**                              | Use AED as soon as possible Use adult pads (8-12 cm in diameter) | 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.
Ventricular Fibrillation / Ventricular Tachycardia Arrest

Activate Emergency Response
Begin Quality CPR
Attach Monitor-Defibrillator

VF / VT?

Shock CPR for 2 min

VF / VT?

Yes

Shock CPR for 2 min
Epinephrine 1mg IV/IO

ROSC

PEA / Asystole Algorithms

No

Yes

Post-Cardiac Arrest Algorithm

VF / VT?

Yes

Shock CPR for 2 min
Amiodarone 300mg IV/IO

Treat Reversible Causes
Consider Advanced Airway
Repeat Epinephrine q3-5 min
Repeat Amiodarone once (150 mg)

Core Principles
- Minimize time to first shock
- Maximize time on chest (CPR)
- Deliver quality CPR
- Do not over ventilate (rate or volume)

Advanced Airway
- Continuous CPR with supraglottic advanced airway or ETT tube and breaths once every 6-8 seconds
- Waveform capnography to confirm advanced airway placement

Return of Spontaneous Circulation (ROSC)
- Sustained breathing
- Skeletal muscle movement
- Pulse & BP
- \( P_{ETCO_2} > 35 \text{ mm Hg} \)

Reversible Causes
- Hypovolemia
- Hypoxia
- Hyper/Hypo K+ / H+ (acidosis)
- Hypothermia
- Tension pneumothorax
- Tamponade, Cardiac
- Toxins
- Thrombosis – PE / MI

ACLS Medications (IV/IO)
- In VF/VT, no medications are proven to improve survivability to discharge; consider arrest context pre-admin.
- Epinephrine 1 mg IV push (IVP) q3-5 min - 1st dose after 2nd shock
- Vasopressin 40 u IVP; can replace first or second dose of Epinephrine
- Amiodarone 300mg IVP after 3rd shock; optional 2nd dose 150 mg IVP

Quality CPR
- Push Hard (5-6 cm), Fast (100'/min) & allow for Full Recoil on horizontal hard surface
- Compression interruption < 10 sec
- Without advanced airway, 30:2 compressions to ventilations
- Change compressor every 2 min
- With advanced airway, waveform capnography can assess CPR quality - goal \( P_{ETCO_2} > 10 \text{ mmHg} \)

Electrical Therapy
- Biphasic at default energy of 120J-200J as per manufacturer; consider escalating energy
- Monophasic or unknown – deliver max Joules

For educational purposes only
Activate Emergency Response
Begin Quality CPR x 2 min
Attach Monitor-Defibrillator

IV/IO Access x 2 (large bore)
Consider Epinephrine 1 mg
Advanced Airway

Rapid Identification and Treatment of most likely Cause
History, Physical Exam & Investigations
REFER TO CORE PRINCIPLES BELOW

- Hypovolemia
- Hypoxia
- Hyper/Hypo K+ / H+ (acidosis)
- Hyperthermia
- Tension pneumothorax
- Tamponade, Cardiac
- Toxins
- Thrombosis - PE / MI

Resume CPR
Epi every 3-5 min
(if cardiac rhythm changes to VF/VT or Asystole, proceed to appropriate algorithm)

ROSC
Yes
Post-Cardiac Arrest Algorithm

No

Core Principles
- PEA combines an organized ECG rhythm with no cardiac output; treat early and quickly
- Causes of PEA include the 4Hs and 4Ts; other less common causes are possible i.e. anaphylaxis, septic shock, cardiac valve disease, and a cascade of events involving 2 or more causes
- Investigations must provide near immediate results to be of value i.e. FAST echocardiography
- With evidence of heart wall motion and/or narrow QRS complex: exhaust all treatable causes
- A focused head to toe physical exam is crucial. Within context, look for: jugular venous distention, engorged facial vasculature, skin color changes, tracheal deviation, air entry, asymmetrical chest wall motion, abdominal distension, shunts, medical alert items, and needle marks
- Treat any extreme tachy/brady arrhythmias if suspected of contributing to low cardiac output (exception: sinus tachycardia)
- If cause not obvious, treat for best guess i.e. volume challenge, pericardiocentesis, needle decompression...
- Many traditional treatment contraindications do not apply in the unique setting of PEA

Quality CPR
- Push Hard (5-6 cm), Fast (100'/min) & Allow Full Recoil on horizontal hard surface
- Minimal compression interruption < 10 sec
- Without advanced airway, 30:2 compressions to ventilations
- Change compressor every 2 min
- With advanced airway, waveform capnography can assess CPR quality - goal P_{ET}CO_{2} > 10 mmHg
- Do not over ventilate (rate or volume)

ACLS Medications (IV/IO)
- Epinephrine (Epi) 1 mg q 3-5 min
- Vasopressin 40 u can replace 1st or 2nd dose of Epinephrine

Return of Spontaneous Circulation (ROSC)
- Sustained breathing
- skeletal muscle movement
- Pulse & BP
- P_{ET}CO_{2} > 35 mmHg

For educational purposes only
Asystole

Activate Emergency Response
Begin CPR for 2 min
Attach Monitor-Defibrillator

IV/IO Access
Consider Epinephrine 1 mg
Consider advanced airway

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

CPR 2 min
Epi every 3-5 min
(if an organized cardiac rhythm or VF/VT, proceed to appropriate algorithm)

ROSC

Yes
Post-Cardiac Arrest Algorithm

No

Core Principles
- Asystole: absence of ventricular activity (p waves may still be present) confirmed by ensuring electrode leads are attached correctly
- Severe vagal reflex is a temporary cause of asystole i.e. with blow to eye or solar plexus
- If asystole is witnessed - patient was just in a perfusing rhythm - or if P waves are present, consider transcutaneous pacing (TCP)
- Survival to discharge of in-hospital asystole (11%) is 10 times that of pre-hospital asystole (<1%)
- If in doubt whether asystole or fine VF, treat as asystole (fine VF unlikely to be successfully shocked)

Quality CPR
- Push Hard (5-6 cm), Fast (100+/min)
  & Allow Full Recoil on flat hard surface
- Minimal compression interruption < 10 sec
- Without advanced airway, 30:2 compression : ventilation ratio
- Change compressor every 2 min
- With advanced airway, waveform capnography can assess CPR quality - goal PetCO₂ > 10 mmHg
- Do not over ventilate (rate or volume)

ACLS Medications (IV/IO)
- Epinephrine (Epi) 1 mg every 3-5 min
- Vasopressin 40 u can replace 1st or 2nd dose of Epinephrine

Return of Spontaneous Circulation (ROSC)
- Sustained breathing / skeletal muscle movement
- Pulse & BP and/or PetCO₂ > 35 mmHg

For educational purposes only
Manage Airway and Breathing
- maintain oxygen saturation 94-98%
- chest x-ray
- consider advanced airway & waveform capnography
- ventilate 10-12/minute; titrate to $P_{ET\text{CO}_2}$ 35-45 mm Hg

Manage Hemodynamics
- frequent BP monitoring/arterial line;
- continuous ECG monitoring; 12 lead ECG/troponin levels
- avoid prophylactic antiarrhythmics
- treat hypotension; IV/IO bolus; vasopressor infusion; lactate levels
- treat STEMI/suspected AMI with emergent reperfusion

Minimize Neurological Injury
- monitor core temperature
- do not rewarm if temperature > 32°C
- perform serial neurological exams; if unable to follow commands after 10 minutes, induce therapeutic hypothermia if not contraindicated
- continuous EEG monitoring if comatose to detect and treat seizure activity

Optimize Metabolic Status
- monitor and manage serum glucose
- monitor and manage serum electrolytes
- monitor urine output; creatinine levels

Ventilation/Oxygenation
- Avoid excessive ventilation
- Begin at 10-12 breaths/minute – titrate to $P_{ET\text{CO}_2}$ 35-40 mm Hg
- Adjust inspired oxygen to minimum required to keep oxygen saturations 94-98%

Hemodynamic Support
- Fluids: normal saline or lactated Ringer’s 1-2 L (4°C fluid if inducing hypothermia)
- Norepinephrine IV Infusion: 2-10 mcg per minute
- Dopamine IV Infusion: 5-10 mcg/kg per minute
- Epinephrine IV Infusion: 2-10 mcg per minute

Core Principles
- Optimize cardiopulmonary function and the perfusion of vital organs
- Transport to advanced critical care unit capable of specialized post-cardiac arrest interventions
- Identify and treat causes of arrest / prevent re-arrest
- Prevent hyperthermia and consider induction of hypothermia to optimize survivability / neurological recovery
- Identify and treat acute coronary syndromes (and suspected acute myocardial infarction (AMI))
- Optimize ventilation and oxygenation without hyperventilation

Treatable Causes
- Hypovolemia
- Hypoxia
- Hyper/Hypo K+ / H+ (acidosis)
- Hypothermia
- Tension pneumothorax
- Tamponade, Cardiac
- Toxins
- Thrombosis – PE / MI

Return of Spontaneous Circulation (ROSC)
- Sustained breathing
- Skeletal muscle movement
- Pulse & BP
- $P_{ET\text{CO}_2} > 35$ mm Hg

For educational purposes only
Prolonged whole-body ischemia during cardiac arrest triggers a cascade of pathophysiological processes that persist after return of spontaneous circulation. The pathologies of this post-cardiac arrest syndrome (PCAS) include:

1. Post-cardiac arrest brain injury
2. Post-cardiac arrest myocardial dysfunction
3. Systemic ischemia/reperfusion response
4. Persistent precipitating cause of cardiac arrest

A time-sensitive, multiple system approach to post-cardiac arrest care positively impacts survivability to discharge and neurological outcomes.

**Therapeutic Strategies**

- **Transfer to intensive care unit** that specializes in this comprehensive clinical pathway
- General intensive care monitoring, advanced hemodynamic monitoring and cerebral monitoring
- Early hemodynamic and circulatory optimization (fluid bolus, inotropes, vaspressors and blood transfusions and possible mechanical circulatory assistance devices if required)
  - Central venous pressure of 8-12 mm Hg
  - Mean arterial pressure of 65-90 mm Hg
  - Hematocrit > 30%
  - Hemoglobin > 80 g/L
  - Urine output at least 0.5ml/kg per hour
  - Lactate levels 2 mmol/l or less
- Oxygenation and Ventilation
  - Immediate adjustment of oxygen delivery post-arrest to produce arterial oxygen saturations of 94-98%
  - Intubation and mechanical ventilation for those requiring therapeutic hypothermia – caution against hyperventilation – titrate to \( P_{v}CO_2 \) of 35-40 mm Hg or PaCO\(_2\) of 40-45 mm Hg
- Management of Acute Coronary Syndromes
  - **Early primary percutaneous coronary intervention** (PCI) with ST elevation myocardial infarction (STEMI) or suspected acute MI
  - Use of fibrinolytics if PCI not readily available for STEMI
  - Use of PCI or fibrinolytics can (and should) be concurrent with therapeutic hypothermia efforts if warranted
- Treat the precipitating cause of the cardiac arrest – cardiac, electrolyte, toxicological, pulmonary and neurological)
- Therapeutic Hypothermia
  - **Therapeutic hypothermia** – induction of core body temperature at 32-34 °C for 12-24 hours beginning minutes to hours after the cardiac arrest; is standard treatment for comatose survivors of a cardiac arrest;
  - Hypothermia is considered to be neuroprotective; hypothermia decreases: 1) energy utilization; 2) the consumption of oxygen and glucose; 3) cerebral edema; 4) and the release of neurotoxic mediators
- Monitor blood glucose levels and treat blood glucose levels above 8 mmol/L
- Seizure activity is not uncommon post cardiac arrest, causing a 3-fold increase in cerebral metabolic rates

Online Resources: 1) [ilcor.org/data/Post-cardiac_arrest_syndrome.pdf](http://ilcor.org/data/Post-cardiac_arrest_syndrome.pdf)
2) [circ.ahajournals.org/cgi/content/full/122/18_suppl_3/S768](http://circ.ahajournals.org/cgi/content/full/122/18_suppl_3/S768)
If HR is atypical, begin MOVIE & treat underlying cause
- Monitor – continuous ECG, oximetry, blood pressure
- Oxygen - maintain \( \text{SpO}_2 \geq 94\% \)
- Vital signs - initial full set including glucose
- IV/IO - ensure vascular access
- ECG – 12 lead ECG

Patient Unstable?
- Acute altered level of consciousness
- Hypotension
- Acute heart failure
- Signs of shock
- Ischemic chest discomfort

Give Atropine

Effective?

Consider:
- Transcutaneous Pacing (TCP)
- or Dopamine infusion
- or Epinephrine infusion

Medications (IV/IO)
- Atropine 0.5 mg bolus, repeat q 3-5 min
  Total maximum: 3 mg
- Dopamine infusion: 2-10 mcg/kg per min
- Epinephrine infusion: 2-10 mcg/min
- Isoproterenol infusion: 2-10 mcg/min

Alternatives:
- Aminophylline may be effective if the bradycardia is caused by an inferior MI, cardiac transplant or spinal cord injury
- Glucagon if beta-blocker or calcium channel blocker overdose
- Glycopyrrolate can be chosen as an alternative to Atropine

Core Principles
- An atypically slow heart rate (HR) is less than 50/min and markedly slower than usual (may have resting HR less than 50/min)
- In the presence of significant hemodynamic compromise, immediately treat to increase heart rate (HR) while identifying / treating causes
- Bradycardia is caused by several treatable causes: cardiac (i.e. acute coronary syndromes, sick sinus syndrome), and non-cardiac (i.e. hypoxia, vasovagal response, hypothermia, hypoglycemia)

Electrical Therapy
- Transcutaneous Pacing (TCP): initiate immediately if Atropine is ineffective or is unlikely to be effective (Mobitz type II block, complete heart block and cardiac transplant)
- Ensure mechanical capture and SBP>90 before using analgesia and sedation to control pain
If HR is atypical, begin MOVIE & treat underlying cause

- Monitor – continuous ECG, oximetry, blood pressure
- Oxygen - maintain SpO₂ ≥ 94 %, airway, breathe prn
- Vital signs - initial full set including glucose
- IV/IO - ensure vascular access
- ECG – 12 lead ECG

Regular Rhythm
If stable ventricular tachycardia consider:
- Procainamide
- Amiodarone
- Synchronized Cardioversion

(For regular rhythm and a confirmed SVT with bundle branch block, may consider: Adenosine, Beta Blockers and Calcium Channel Blockers; note that with extremely rapid heart rates it is increasingly difficult to identify rhythm pattern irregularity; consider expert help)

Irregular Rhythm
- Seek expert help
- If torsades de pointes suspected consider MgSO₄
- May be atrial fibrillation with bundle branch block and WPW (see AF/Fl algorithm)

Patient Unstable?
- Hypotension?
- Acute altered level of consciousness
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

Synchronized Cardioversion
- Consider sedation
- For regular rhythm & narrow QRS complex, consider Adenosine

Regular Rhythm
- Vagal Maneuvers
- Adenosine (watch for atrial flutter – if likely seek expert help)
- Beta-blocker (BB)
- Calcium Channel Blocker (CCB)

Irregular Rhythm
- Probable atrial fibrillation (refer to atrial fibrillation/flutter algorithm)

ACLS Medications (IV/IO)
- Adenosine 6mg IV rapid push; follow with 20 ml NS flush; second dose 12 mg
- Amiodarone 150 mg IV over 10 minutes; repeat if needed; follow with infusion of 1mg/min for 6 hr
- Diltiazem 15-20 mg over 2 min
- Metoprolol 5mg over 1-2 min q5min to max 15mg
- MgSO₄ 1-2 g over 10 min
- Procainamide 20-30 mg/min as an infusion until the rhythm is converted, the QRS is widened by 50%, or total of 17 mg/kg has been given. Do not use if patient has heart failure
- Verapamil 2.5-5 mg IV over 2 minutes; may repeat to a max of 20 mg

Core Principles
- This algorithm does not apply to sinus tachycardia (ST) which is rarely faster than 150/min (for ST treat the cause not the rhythm – i.e. pain, hypovolemia, sepsis, cocaine... )
- In the presence of hemodynamic compromise, immediately treat to slow heart rate while identifying / treating causes
- In general electrical cardioversion is safer than antiarrhythmic drug conversion
- Refer to Electrical Therapies for details on synchronized cardioversion

For educational purposes only
Atrial Fibrillation/Flutter

Begin MOVIE; focused Hx; CHADS2 score; identify possible causes
- Monitor – continuous ECG, oximetry, blood pressure
- Oxygen - maintain SpO2 ≥ 94 %
- Vital signs - initial full set including glucose
- IV/IO - ensure vascular access
- ECG – 12 lead ECG

Patient Unstable?
- Hypotension
- Acute altered level of consciousness
- Signs of shock
- Ischemic chest discomfort
- Acute heart failure

Yes

Cardioversion at 120-200J
(if AF is chronic consider rate control to stabilize pt.)

No

Rate Control
- Beta blockers
- Diltiazem
(Digoxin – delayed onset slowing only resting HR)

Rhythm Control
- Electrical cardioversion and/or:
  - Procainamide
  - Ibutilide
  - Propafenone

Greater than 48 hrs onset?
(or < 48 hrs with hx of a mechanical valve, rheumatic valve disease, recent TIA/ stroke with non-therapeutic INR)

No

Yes

Rate control if needed:
- Beta blockers
- Diltiazem
(Digoxin – delayed onset slowing only resting HR)

Avoid conversion Anticoagulation x 3 wks

ACLS Medications (IV/IO)
- Procainamide 15-17mg/kg infused over 60 minutes; 60% conversion rate for rapid onset AF/AFl; 5% incidence of hypotension
- Ibutilide: 1-2 mg IV over 10-20 minutes; may pre-treat with MgSO4 to help reduce incidence of torsades de pointes (2-3% incidence); post conversion monitoring x 4 hrs or until QT interval resolution;
- Propafenone give 450-600 mg PO; monitor for hypotension, bradycardia
- Amiodarone is not recommended for recent onset AF/Fl
- Metoprolol give 2.5-5 mg IV q5min over 2 min max 3 doses; relatively contraindicated in patients with CHF, COPD, asthma and with BP in the low range of normal
- Diltiazem Give 0.25mg/kg IV over 10 min; may repeat with 0.35 mg/kg IV in 15 minutes if first dose is ineffective; decrease dose in elderly patients or those with low BP
- Verapamil 0.075-0.15mg/kg over 2 min; monitor for hypotension and bradycardia

Core Principles
- If doubt as to AF/Fl onset, treat as > 48 hrs.; anticoagulate with Warfarin (INR 2-3) or Dabigatran for 3 weeks before conversion: continue for at least 4 weeks after conversion;
- Risk for ischemic stroke for patients with nonvalvular AF/AFl - persistent or paroxysmal - is 5% annually
- Evidence supports beta blockers as being superior to diltiazem for first line rate control
- If an accessory pathway is suspected (i.e. Wolff-Parkinson-White - irregular wide QRS complexes with HR >240/min), avoid AV nodal drugs (ABCD – adenosine, beta blockers, calcium channel blockers and digoxin); consider electrical cardioversion or antiarrhythmics (Procainamide or Ibutilide)
- Transesophageal echocardiography (TEE) can be used to rule out a embolus in the left atrium
- A CHADS2 score – CHF, Hypertension, Age, Diabetes, Stroke/TIA - evaluates the risk of stroke


For educational purposes only
Acute Coronary Syndromes (ACS)

Signs and Symptoms of ACS?

Assess - Stabilize – MOVIE
- Monitor – continuous ECG, oximetry
- Oxygen – give O₂ if O₂ Saturation < 94 %
- Vital signs - TPR/BP & glucose, blood work, chest x-ray
- IV - ensure vascular access
- ECG – 12 lead ECG

Patient Hx (include symptom duration, allergies, meds) - Physical exam
Aspirin 160-325 mg
Nitroglycerin² if SBP>90 mmHg; Morphine IV if discomfort persists

ECG Interpretation³

ST Elevation MI (STEMI)
ST elevation or new Left Bundle Branch Block
Start Supplemental Therapies⁴
Perform Fibrinolytic Checklist

Symptom Duration?
>12 hr

Candidate for Fibrinolysis & Inappropriate Delay to PCI?
Yes (both conditions)
Fibrinolysis
(Door to needle <30 min)
Consider: Rescue PCI² or delayed PCI

<12 hr

No (to either condition)

Percutaneous Coronary Intervention (PCI)
(Door to Balloon <90 min)

High Risk UA/NSTEMI
Unstable Angina / non-ST Elevation MI
ST depression or dynamic T wave inversion
Consider PCI with:
a. positive troponins or b. high TIMI risk score or c. unstable clinical features (i.e. recurrent or persistent ST deviation, compromised hemodynamic status – poor perfusion, V-tach, heart failure, PCI < 6 months, prior CABG)
Start Supplemental Therapies⁴

Low/Intermediate Risk ACS
Normal or Non-Diagnostic ECG changes
Serial troponin levels & 12 lead ECGs (q6h)
Consider admission &/or non-invasive diagnostics

New UA/NSTEMI sign?
Yes

- unstable clinical features
- dynamic ECG changes
- elevated troponins

No

Abnormal findings from non-invasive diagnostic test?
Yes

Consider discharge & follow-up

No
1 – **Signs and symptoms of acute coronary syndromes (ACS)** include chest discomfort possibly radiating to the upper body/arms/neck/jaw, shortness of breath, sweating, indigestion, nausea, vomiting and dizziness. Atypical presenters – ACS in the absence of chest discomfort are more common with women, the elderly and diabetic patients.

2 – **Nitroglycerin**: nitroglycerin (NTG) produces arterial and venous vasodilation. NTG is often effective in the treatment of angina. In contrast, evidence is inconclusive for the routine use of NTG during an acute myocardial infarction (AMI). NTG should be given cautiously for AMI patients if an expected blood pressure drop would prevent the use of proven beneficial medications (i.e. ACE inhibitors and beta-blockers). NTG is contraindicated with:

- patients with systolic BP (SBP) < 90 mm Hg or more than 30 mm Hg below baseline
- bradycardia < 50/minute or tachycardia > 100/minute in the absence of heart failure
- patients with right ventricular infarction (RVI) - caution with inferior MI - approximately 50% of inferior MI are RVI
- recent use of medications for erectile dysfunction - within 24 hours of Sildenafil (Viagra) - 48 hours of Tadalafil (Cialis)

NTG can relieve chest discomfort produced by gastrointestinal causes. The relief of chest discomfort by NTG does not rule out ACS.

3 – **ECG Interpretation**: the first 12 lead ECG may or may not present with immediate findings of a STEMI or NSTEMI. At least two repeat 12 lead ECGs are advised every 15-20 minutes with persistent symptoms typical for cardiac ischemia. Threshold values of ST deviation are provided in the table below for STEMI, UA/NSTEMI, and low to medium risk ACS.

### 12 Lead ECG Threshold Values (2 contiguous leads – standardized to 1 mV=10 mm)

<table>
<thead>
<tr>
<th>GENDER &amp; AGE</th>
<th>STEMI (elevated at J Point)</th>
<th>UA/NSTEMI</th>
<th>NON-DIAGNOSTIC ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women</strong></td>
<td>1.5 mm in leads V2/V3 &amp; 1 mm in all other leads</td>
<td>ST depression &gt;0.5 mm in leads V2/V3 &amp; 1 mm in all other leads</td>
<td>ST deviation &lt;0.5 mm</td>
</tr>
<tr>
<td><strong>Men 40 or older</strong></td>
<td>2 mm in V2/V3 &amp; 1 mm in all other leads</td>
<td>ST depression &gt;0.5 mm in leads V2/V3 &amp; 1 mm in all other leads</td>
<td>ST deviation &lt;0.5 mm</td>
</tr>
<tr>
<td><strong>Men under 40</strong></td>
<td>2.5 mm in leads V2/V3 &amp; 1 mm in all other leads</td>
<td>ST depression &gt;0.5 mm in leads V2/V3 &amp; 1 mm in all other leads</td>
<td>ST deviation &lt;0.5 mm</td>
</tr>
</tbody>
</table>

American Heart Association Guidelines for CPR and ECC. *Circulation*: 2010;122; Supplement p S791.

4 – **Supplemental Therapies**: these include Enoxaparin or heparin, Clopidogrel 75-600 mg according to patient history and strategy chosen (fibrinolytic or PCI), oral beta blockers (IV for select cases), ACE inhibitors or ARBs and statin therapy.

5 – **Inappropriate Delay to PCI**: goal for percutaneous coronary intervention balloon inflation is ideally 90 minutes from first medical contact (advanced life support paramedic or emergency department). Additional direction is now available for emergency physicians that potentially shortens or lengthens this timeline based on onset of symptoms, age of patient and whether the MI is anterior or not.

### Acceptable Delay Time for PCI (balloon inflated) – If greater time needed, Fibrinolysis May be Preferable

<table>
<thead>
<tr>
<th>Onset of Symptoms</th>
<th>Anterior STEMI &amp; &lt;65 years</th>
<th>Anterior STEMI and &gt;65 years</th>
<th>Non-Anterior STEMI and age&lt;65 years</th>
<th>Non-Anterior STEMI and age&gt;65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 2 hours</td>
<td>40 minutes</td>
<td>107 minutes</td>
<td>58 minutes</td>
<td>168 minutes</td>
</tr>
<tr>
<td>Beyond 2 hours</td>
<td>43 minutes</td>
<td>148 minutes</td>
<td>103 minutes</td>
<td>179 minutes</td>
</tr>
</tbody>
</table>


The figures included are to be interpreted not as an exact science but as general indicators. For example, younger patients presenting with anterior STEMI may well benefit from fibrinolysis if transfer to a PCI is needed – delay is inappropriate. The older patient presenting to the hospital after 2-3 hours of symptoms may well benefit from a transfer to a centre capable of PCI.

6 – **Rescue PCI**: a 12/15 lead ECG is advised 75 minutes after fibrinolysis to evaluate fibrinolytic success. If the ST-elevation deviation has not resolved by 50%, the patient should be transferred for rescue PCI as soon as possible; there is support (possible benefit) for post-fibrinolytic delayed PCI (6 hours or more after fibrinolysis).
**Adult Suspected Stroke**

1. **Activate Emergency Response**

   **Assess and Stabilize - Begin MOVIE**
   - Monitor - airway, blood pressure, ECG if available
   - Oxygen - maintain SpO₂ 94-98%, provide breaths prn
   - Vital signs - full set & glucose (treat low glucose stat)
   - IV - ensure vascular access
   - ECG – 12 lead ECG if available – do not delay therapy

   Perform Neurological Screening Assessment

   **Activate Stroke Team or Designee**

   **Immediate Neurological Assessment**
   - Patient History
   - Establish time of symptom onset
   - Perform Canadian Neurological Scale
   - CT Scan completed

   **CT Scan shows Hemorrhage?**

   - **No Hemorrhage**
     - **Probable Acute Ischemic Stroke: Consider Fibrinolytics**
       - Check for fibrinolytic exclusions
       - Repeat neurological exam (if deficits recovering rapidly, avoid fibrinolytics)
     - **Candidate for fibrinolytic therapy?**
       - Review risks/benefits with patient and Family. If acceptable:
         - Give rt-PA – No antiplatelets/anticoagulants for 24 hours
         - Begin Post rt-PA Stroke Pathway
         - Monitor BP, glucose, temperature, neuro status (treat if indicated)
         - Admit to Stroke Unit if available or ICU

   - **Hemorrhage**
     - **Probable Acute Hemorrhagic Stroke: Neuro Consult**
       - (consider transfer if neurologist or neurosurgeon unavailable)
         - Begin Hemorrhagic Stroke Pathway
         - Admit to stroke unit or ICU

   - **Candidate for fibrinolytic therapy?**
     - **Not a candidate**
     - **Give Aspirin**

   - **Begin Stroke Pathway**
     - Admit to Stroke Unit or ICU

Support notes included on reverse page.

For educational purposes only
1 - **Adult Suspected Stroke:** Signs and symptoms of stroke include “sudden weakness or numbness of the face, arm or leg, especially on one side of the body; sudden confusion; trouble speaking or understanding; sudden trouble walking, dizziness, loss of balance or coordination; or severe sudden headache with no known cause.” 2010 American Heart Association Guidelines for CPR and ECC. *Circulation:* 2010;122: Supplement p S820.

2 - **Activate Emergency Response:** Time is brain. Alteplase (tPA) must be given within 4.5 hours of symptom onset to eligible patients with ischemic stroke. The earlier the stroke is treated, the greater the benefit. “Pre-hospital stroke assessment and rapid transport to the most appropriate hospital is critical to improving outcomes” BC Stroke Strategy Provincial Stroke Action Plan: November 2010

3 - **Check for fibrinolytics exclusions:** Symptomatic intracranial hemorrhage occurs in about 5% of patients who receive tPA for stroke. Before administering fibrinolytics, the ordering physician must verify that there are no exclusion criteria (additional criteria for 3-4.5 hours from symptom onset) and be prepared to treat any potential complications.

4 - **Stroke Pathway:** When compared to admissions to general medical units, patients who are admitted to dedicated interdisciplinary stroke units with established stroke care pathways are discharged from hospital 20% sooner and are 20% less likely to be discharged from symptom onset and be prepared to treat any potential complications.

5 – **Aspirin:** Note that aspirin use for the patient having an acute stroke is recommended only for those who are not experiencing a hemorrhagic stroke and who are not candidates for fibrinolytics.

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### Core Principles

- Survivability to discharge with good neurological function is optimized with time-sensitive stroke care
- Minimize delays to definitive stroke diagnosis and treatment. Major steps in stroke care are also the key delay points (D’s of stroke care):
  - **Pre-Hospital** (less than 3.5 hours from symptom onset – defined as last time patient seen as normal)
    - Detection: rapid recognition of stroke symptoms
    - Dispatch: activate emergency response
    - Delivery: rapid stroke screening assessment, management, and transport to stroke centre
    - Door: triage to appropriate stroke center
  - **Hospital** (60 minutes)
    - Data: rapid triage, evaluation (CT scan), stroke management in the emergency department (ED - first 25 min)
    - Decision: stroke expertise and therapy selection (45 minutes from arrival in ED)
    - Drug: fibrinolytic therapy (rt-PA or Alteplase) or intra-arterial strategies (60 minutes from ED arrival and max 4.5 hours from symptom onset)
    - Disposition: rapid admission to stroke unit or ICU (within 3 hours of arrival to ED)
- Monitor and treat co-morbidities; minimize risks associated with stroke and stroke treatments (i.e. head of bed at 30°; fluctuations in BP, temperature, glucose; airway compromise; oxygenation and ventilation; neurological deterioration; bleeding; NPO until dysphagia assessment);
- For transient ischemic attack (TIA)-a brief reduction of blood flow to the brain typically lasting less than 10 minutes without permanent damage- or minor stroke; as many as 10% will progress to major stroke within the next week in left untreated. With prompt treatment (ideally within 48 hours), long term risk of stroke is reduced by 80%. Management includes brain imaging to rule out hemorrhage, antiplatelet agents, anticoagulation for atrial fibrillation, blood pressure and glycemic control, and possible carotid endarterectomy.

### Additional Online Resources

- Canadian Neurological Scale ([www.neurosurvival.ca/ClinicalAssistant/scales/CNS.html](http://www.neurosurvival.ca/ClinicalAssistant/scales/CNS.html))
- Canadian Best Practice Recommendations for Stroke Care ([www.strokebestpractices.ca/](http://www.strokebestpractices.ca/))
- 2010 AHA Guidelines for CPR and ECC: Adult Stroke ([circ.ahajournals.org/cgi/reprint/122/18_suppl_3/S818](http://circ.ahajournals.org/cgi/reprint/122/18_suppl_3/S818))
Defibrillation and Synchronized Cardioversion

Defibrillation is the delivery of a large electrical current through the heart over a few milliseconds with the goal of depolarizing a critical mass of myocardial cells into a brief moment of asystole. This asystolic pause hopefully allows pacemaker cells (i.e. SA node) to regain control of the heart in a normal organized pattern. Synchronized cardioversion is similar to defibrillation except that the electrical energy is synchronized to deliver during ventricular depolarization (QRS complex) to avoid shocking during the relative refractory period of the cardiac cycle (T wave). Shocks placed during the refractory 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 many 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 less myocardial current density is required with biphasic waveforms.

- **Defibrillation Energy Selection:**
  - Adult Monophasic: 360 Joules all defibrillations
  - Adult biphasic: Follow manufactures recommendations (between 120-200 Joules); subsequent shocks can be at the same energy level or escalating energies can be considered. If the recommended starting energy is unknown then using the maximum energy setting can considered.
  - Pediatric: (monophasic or 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**
  - Adult Atrial Fibrillation: start at 120-200 Joules escalating with subsequent attempts. Monophasic use 200J initially.
  - Adult Atrial Flutter: start at 50-100 Joules escalating with subsequent attempts.
  - Adult SVT: start at 50-100 Joules escalating with subsequent attempts.
  - VT with pulse: start at 100 Joules escalating with subsequent attempts.
  - 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 patients in cardiac arrest most often an anterior-anterior approach is used as it is quickest for pad application. Follow pictures on pads. Generally one pad is placed on the right upper anterior chest. Try to keep pad off larger bones such as the clavicle and the sternum and off the patient’s areola. Place the second pad in the left axillary position.
   - If the pads are being used in an anterior-posterior position the anterior pad is placed in an apical position and the posterior pad placed beside the spine and below the scapula on the left side. This placement is most common for transcutaneous pacing and is also often used in elective synchronized cardioversion.
   - If paddles are used apply an appropriate conductive medium (gel pads, conductive paste). Apply hard pressure (15-25 lbs.) and ensure that you are not in any electrical contact with the patient.
   - For pediatric patients if pads are too large consider anterior-posterior placement.
   - Attempt to keep paddles/pads 1-3 inches away from implanted devices such as AICD’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.

(continued on reverse page)
8. 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 achieve capture are very high in comparison to other methods of pacing. The abnormal 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. Most TCP will come on default in demand (synchronous) mode, verify 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 60-80 per minute
6. Set current by titrating the mA dial upwards until you have consistent electrical capture as indicated by seeing pacer spikes followed by a new QRS morphology which is very wide with a broad T wave. Buffer the capture current (threshold) by increasing the mA by approximately 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.
## Rapid Reference: Adult ACLS Medications

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage (all doses are IV/IO unless otherwise noted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine</td>
<td>6mg rapid push over 1-3 sec followed by a 20 ml syringe flush. If not successful a 12 mg dose can be given also with flush. Use most proximal IV/IO access and most proximal port.</td>
</tr>
<tr>
<td>Amiodarone</td>
<td><strong>VF/Pulseless VT:</strong> 300 mg push, a second dose of 150 mg can be given</td>
</tr>
<tr>
<td></td>
<td><strong>Life-Threatening Arrhythmias:</strong> Max cumulative dose: 2.2 g over 24 hrs. May be administered as:</td>
</tr>
<tr>
<td></td>
<td>Rapid infusion: 150 mg over 10 min, may repeat every 10 min as needed (15 mg/min)</td>
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<tr>
<td></td>
<td>Slow infusion: 360 mg over 6 hrs (1 mg/min)</td>
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<tr>
<td></td>
<td>Maintenance infusion: 540 mg over 18 hrs (0.5 mg/min)</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.5 mg q3-5 min. Max dose: 0.04 mg/kg (total 3 mg). Consider higher doses and shorter dosing interval with severe compromise</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>500-1000mg (5-10 ml of the 10% solution) for hyperkalemia or calcium channel blocker overdose. May be repeated as needed</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Loading dose 4-6 ug/kg, followed by 2-3 ug/kg doses at 4 hr intervals. Maximum dosing total 1 mg</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>15-20 mg (0.25 mg/kg) over 2 min. May repeat in 15 min at 20-25 mg (0.35 mg/kg) over 2 min. Maintenance infusion for rate control 5-15 mg/hr</td>
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<tr>
<td>Dobutamine</td>
<td>2-20 ug/kg/min. Titrate so heart rate does not increase &gt; 10% baseline</td>
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<tr>
<td>Dopamine</td>
<td>2-10 ug/kg/min for symptomatic bradycardia (up to 20 ug/kg/min for hypotension)</td>
</tr>
<tr>
<td>Epinephrine</td>
<td><strong>Cardiac arrest:</strong> 1mg q3-5min</td>
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<tr>
<td></td>
<td><strong>Severe bradycardia:</strong> 2-10 ug/min</td>
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<td></td>
<td><strong>Anaphylaxis:</strong> 0.5 mg IM (ideal to lateral thigh)</td>
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<tr>
<td>Ibutilide</td>
<td>1-2 mg IV over 10-20 minutes</td>
</tr>
<tr>
<td>Isoproterenol</td>
<td>2-10 ug/min titrated to adequate heart rate</td>
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<tr>
<td>Magnesium Sulfate</td>
<td><strong>Cardiac Arrest:</strong> 1-2 g as a bolus</td>
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<td></td>
<td><strong>With pulse:</strong> 1-2 g mixed in 50-100 ml D5W over 5-60 min, then infusion of 0.5-1.0 g/hr as needed</td>
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<tr>
<td>Metroprolol</td>
<td>5 mg IV q5min to a total of 15 mg</td>
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<tr>
<td>Norepinephrine</td>
<td>Start at 0.1-0.5 ug/kg/min then titrate to response</td>
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<tr>
<td>Procainamide</td>
<td>20 mg/min infusion to max total dose of 17 mg/kg</td>
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<tr>
<td>Propafenone</td>
<td>300-600 mg po</td>
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<tr>
<td>Sodium Bicarbonate</td>
<td>1-2 mEq/kg bolus (44 mEq per preloaded syringe)</td>
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<tr>
<td>Sotalol</td>
<td>1-1.5 mg/kg over 5 min</td>
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<tr>
<td>Vasopressin</td>
<td><strong>Cardiac arrest:</strong> 40 units push</td>
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<td></td>
<td><strong>Vasodilatory shock:</strong> 0.02-0.04 units/min</td>
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<tr>
<td>Verapamil</td>
<td>2.5-5 mg over 2-3 min, repeat dose 5-10 mg every 15-30 min as needed. Max total dose 30 mg</td>
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</table>
Brain injury and hemodynamic instability are the main causes of death for survivors of a cardiac arrest. Induced therapeutic hypothermia (ITH) - active cooling to 32-34°C Celsius for 24 hours - is shown to improve neurological recovery for those who experience a prolonged cardiac arrest.

**ITH is recommended for:** survivors of out-of-hospital VF arrests who are unable to follow verbal commands.

**ITH should be considered for:**
- survivors of out-of-hospital cardiac arrest from PEA or Asystole who are unable to follow verbal commands
- survivors of in-hospital cardiac arrest of any initial rhythm who are unable to follow verbal commands 10 minutes after the arrest

Active rewarming is discouraged for unresponsive cardiac arrest survivors who spontaneously become mildly hypothermic (core temperature >32°C) for the first 48 hours post-arrest.

At the time of writing no universally accepted induced therapeutic hypothermia algorithm has been published by AHA, ERC, or ILCOR. Many regions in Canada have adopted and/or modified the 2005 ITH guidelines of the Canadian Association of Emergency Physicians (CAEP).

**Three Phases: Induction, Maintenance and Rewarming**

**Induction:** a combination of external and internal cooling methods are implemented early post-arrest; interventions include rapid infusion (30 ml/kg) of 4°C 0.9% saline, ice packs, cooling blankets, intravascular heat exchangers, ice water gastric/bladder lavage and evaporative cooling techniques

**Maintenance:** a cooling method is used along with continuous temperature feedback monitoring to keep the core body temperature between 32-34°C

**Rewarming:** typically after 24 hours of cooling, rewarming should begin and progress slowly (i.e. 0.25-0.5°C/hour); manage fluctuations in electrolyte concentrations, intravascular volume and metabolic rate that occur with changes in body temperature; prevent hyperthermia by maintaining core temperatures at 36-37.5°C

**Considerations**

- ITH is an important component of a multisystem approach to post-cardiac arrest care; advanced airway management, hemodynamic stabilization, treatment of acute coronary syndromes and metabolic monitoring (serial lactate, electrolyte, glucose testing) are performed simultaneously
- Cooling suppresses several physiologic pathways that cause delayed (post-arrest) cell death; cooling also reduces cerebral metabolic rate by 6-10% for every 1°C reduction in cerebral temperature
- Shivering is an expected physiologic response to mild hypothermia; shivering increases heat production, thus slowing or preventing cooling; shivering should be treated; the threshold temperature for shivering can be decreased with IV sedation; IV boluses of neuromuscular blocking agents (NMBA) may be warranted; note that NMBA can eliminate skeletal muscle movement - the primary indicator of seizures activity (a seizure can triple cerebral metabolic rate); a continuous NMBA infusion requires ongoing EEG monitoring
- Physiologic effects and associated complications of hypothermia include:
  - increased systemic vascular resistance; continuous ECG monitoring for dysrhythmias;
  - diuresis; manage hemodynamic status and electrolyte levels
  - reduced insulin sensitivity and production; monitor for hyperglycemia
  - possible impaired coagulation; monitor for increased bleeding
  - impaired immune response; monitor for an increased incidence of infection
  - impaired medication elimination (one study showed a 30% reduction in medication clearance); re-evaluate medication dosing as temperature is reduced
- Target ITH temperatures are often maintained with simple interventions such as ongoing sedation, keeping the patient uncovered and the occasional use of evaporative cooling (a fan directed over wetted skin)
- Prognosis of post-cardiac arrest patients treated with ITH can not be reliably predicted for at least 72 hours
Abbreviations Glossary
ACLS and 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
IM  intramuscular injection
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
P₂CO₂  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


1. Ten minutes after an 85-year-old woman collapses, paramedics arrive and start CPR for the first time. The monitor shows fine (low-amplitude) VF. Which actions should they take next?
   a. Performing at least 5 minutes of vigorous CPR before attempting defibrillation
   b. Inserting an ET tube and then attempting defibrillation
   c. Delivering up to 3 precordial thumps while observing the patient’s response on the monitor
   d. Beginning cycles of CPR while preparing the defibrillator to use as soon as possible

2. A cardiac arrest patient arrives in the ED with PEA and a heart rate of 30/min. CPR continues, proper ET tube placement is confirmed, and IV access is established. Which medication is most appropriate to give next?
   a. Calcium chloride 5 mL of 10% solution IV
   b. Epinephrine 1 mg IV
   c. Atropine 1 mg IV
   d. Sodium bicarbonate 1 mEq/kg IV

3. What is an advantage of using hands-free defibrillation pads instead of defibrillation paddles?
   a. Hands-free pads deliver more energy than paddles.
   b. Hands-free pads increase electrical arc.
   c. Hands-free pads allow for a more rapid defibrillation.
   d. Hands-free pads have universal adaptors that can work with any machine.

4. Which action is performed as you prepare for defibrillator discharge?
   a. Asking the person managing the airway to quickly intubate the patient before attempting defibrillation
   b. Disconnecting monitor leads to prevent shock damage to monitor
   c. Continuing compressions while charging the defibrillator
   d. Checking the pulse while charging the defibrillator

5. A woman with a history of narrow-complex SVT arrives in the ED. She is alert and oriented but pale. Heart rate is 165/min, and the ECG shows SVT. Blood pressure is 105/70 mm Hg. IV access has been established. Which is the most appropriate initial treatment?
   a. Adenosine 6 mg rapid IV push
   b. Vagal maneuver
   c. Synchronized cardioversion
   d. Atropine 1 mg IV push
6. What is a common but sometimes fatal mistake in cardiac arrest management?
   A. Failure to obtain vascular access
   B. Prolonged periods of no ventilations
   C. Failure to perform endotracheal intubation
   D. Prolonged interruptions in chest compressions

7. You have attempted endotracheal intubation for a patient in respiratory arrest. When you attempt positive-pressure ventilation, you hear stomach gurgling over the epigastrium but no breath sounds. Waveform capnography is zero or flat. Which of the following is the most likely explanation for these findings?
   a. Intubation of the esophagus
   b. Intubation of the left main bronchus
   c. Intubation of the right main bronchus
   d. Bilateral tension pneumothorax

8. Which statement about IV administration of medications during attempted resuscitation is true?
   a. Give epinephrine via the intracardiac route if IV access is not obtained within 3 minutes.
   b. Follow IV medications via peripheral veins with a fluid bolus.
   c. Do not follow IV medications via central veins with a fluid bolus.
   d. Infuse normal saline mixed with sodium bicarbonate intravenously during continuous CPR.

9. A 60-year-old man with recurrent VF now has a wide-complex rhythm with no pulse after administration of epinephrine 1 mg IV and a third shock. Which drug is most appropriate to give next?
   a. Amiodarone 300 mg IV push
   b. Lidocaine 150 mg IV push
   c. Magnesium 3 g IV push diluted in 10 mL of D5W
   d. Procainamide 20 mg/min IV infusion, up to a maximum dose of 17 mg/kg

10. While treating a patient in persistent VF arrest after 2 shocks, you consider using IV vasopressin. Which guideline for use of vasopressin is true?
    a. Give vasopressin 40 units every 3 to 5 minutes.
    b. Vasopressin has a shorter half-life than epinephrine.
    c. Vasopressin is an alternative to a first or second dose of epinephrine in pulseless arrest.
    d. Give vasopressin as the first-line pressor agent for clinical shock caused by hypovolemia.

11. Which cause of PEA is most likely to respond to immediate treatment?
    a. Massive pulmonary embolism
    b. Hypovolemia
    c. Massive acute myocardial infarction
    d. Myocardial rupture
12. Which drug-dose is recommended as the initial medication for a patient in asystole?
   a. Atropine 0.5 mg IV
   b. Atropine 3 mg IV
   c. Epinephrine 1 mg IV
   d. Epinephrine 3 mg IV

13. A patient with a heart rate of 40/min reports chest pain. He is confused, and the pulse oximeter shows oxygen saturation is 91% on room air. After oxygen administration, what is the first drug you should administer to this patient?
   a. Atropine 0.5 mg IV bolus
   b. Epinephrine 1 mg IV push
   c. Isoproterenol IV infusion 2 to 10 mcg/min
   d. Adenosine 6 mg rapid IV push

14. Which statement correctly describes the ventilations that should be provided after ET tube insertion, cuff inflation, and verification of tube position?
   a. Deliver 1 ventilation every 6 to 8 seconds (8 to 10 ventilations per minute) without pauses in chest compressions.
   b. Deliver ventilations as rapidly as possible as long as visible chest rise occurs with each breath.
   c. Deliver ventilations with a tidal volume of 3 to 5 mL/kg.
   d. Deliver ventilations with room air until COPD is ruled out.

15. A patient in the ED reports 30 minutes of severe, crushing, substernal chest pain. Blood pressure is 110/70 mm Hg, heart rate is 58/min, and the monitor shows regular sinus bradycardia. The patient has received aspirin 325 mg orally, oxygen 4 L/min via nasal cannula, and 3 sublingual nitroglycerin tablets 5 minutes apart, but he continues to have severe pain. Which agent should be given next if there are no contraindications?
   a. Atropine 0.5 to 1 mg IV
   b. Furosemide 20 to 40 mg IV
   c. Lidocaine 1 to 1.5 mg/kg IV
   d. Morphine 2 to 4 mg IV

16. Which agent is used frequently in the early management of acute coronary ischemia?
   a. Lidocaine IV bolus
   b. Chewable aspirin
   c. Oral ACE inhibitor
   d. Calcium channel blocker given orally
17. A 50-year-old man who is profusely diaphoretic and hypertensive reports crushing substernal chest pain and severe shortness of breath. He has a history of hypertension. He chewed 2 low-dose aspirins at home and is now receiving oxygen. Which treatment sequences is **most** appropriate at this time?

   a. Morphine and then nitroglycerin, but only if morphine fails to relieve the pain
   b. Nitroglycerin and then morphine, but only if ST elevation is >3 mm and no contraindications exist
   c. Nitroglycerin and then morphine, but only if nitroglycerin fails to relieve the pain and no contraindications exist
   d. Nitroglycerin only because chronic hypertension is a contraindication for morphine

18. A 50-year-old man has a 3-mm ST elevation in leads V₂ to V₄. Chest pain has been relieved with sublingual nitroglycerin. Blood pressure is 130/80 mm Hg, and heart rate is 65/min. Which treatment is **most** appropriate for this patient at this time?

   a. Calcium channel blocker IV
   b. Transcutaneous pacing at 85/min
   c. Percutaneous coronary intervention (PCI)
   d. Fibrinolytics

19. A 70-year-old woman reports a moderate headache and trouble walking. She has a facial droop, slurred speech, and difficulty raising her right arm. She says that she takes “several medications” for high blood pressure. Which action is **most** appropriate at this time?

   a. Activate the emergency response system; tell the dispatcher you need assistance for a woman who is displaying signs and symptoms of an acute subarachnoid hemorrhage.
   b. Activate the emergency response system; tell the dispatcher you need assistance for a woman who is displaying signs and symptoms of a stroke.
   c. Activate the emergency response system; have the woman take aspirin 325 mg.
   d. Drive the woman to the nearby ED in your car.

20. Within 45 minutes of her arrival in the ED, which evaluation sequence should be performed for a 70-year-old woman with rapid onset of headache, garbled speech, and weakness of the right arm and leg? History, physical examination, neurologic assessments, and then a

   a. **noncontrast** head CT with interpretation by a radiologist
   b. **noncontrast** head CT. Start fibrinolytic treatment if CT scan is positive for stroke
   c. lumbar puncture (LP) and **contrast** head CT if LP is negative for blood
   d. **contrast** head CT. Start fibrinolytic treatment when improvement in neurologic signs is noted

21. Which rhythm is a proper indication for transcutaneous pacing if atropine fails to work?

   a. Sinus bradycardia with no symptoms
   b. Normal sinus rhythm with hypotension and shock
   c. Complete AV block with shortness of breath
   d. Asystole that follows 6 or more defibrillation shocks
22. Which cause of out-of-hospital asystole is most likely to respond to treatment?

a. Prolonged cardiac arrest  
b. Prolonged submersion in warm water  
c. Drug overdose  
d. Blunt multisystem trauma

23. A 34-year-old woman with a history of mitral valve prolapse presents to the ED with palpitations. Her vital signs are as follows: heart rate is 165/min, respiratory rate is 14/min, blood pressure is 118/92 mm Hg, and oxygen saturation is 98% on room air. Her lungs sound clear, and she reports no shortness of breath or dyspnea on exertion. The ECG and monitor display a regular narrow-complex tachycardia. Which term best describes her condition?

a. Stable SVT  
b. Unstable SVT  
c. Heart rate appropriate for clinical condition  
d. Tachycardia secondary to poor cardiovascular function

24. A 75-year-old man presents to the ED with a history of light-headedness, palpitations, and mild exercise intolerance lasting 1 week. The initial 12-lead ECG displays atrial fibrillation, which continues to show on the monitor at an irregular heart rate of 120 to 150/min and a blood pressure of 100/70 mm Hg. Which therapy is the most appropriate next intervention?

a. Sedation, analgesia, and then immediate cardioversion  
b. Lidocaine 1 to 1.5 mg/kg IV bolus  
c. Amiodarone 300 mg IV bolus  
d. Seeking expert consultation

25. You prepare to cardiovert a 48-year-old woman with unstable tachycardia. The monitor/defibrillator is in sync mode. The patient suddenly becomes unresponsive and pulseless as the rhythm changes to an irregular, chaotic, VF-like pattern. You charge to 200 J and press the SHOCK button, but the defibrillator does not deliver a shock. Why?

a. The defibrillator/monitor battery failed.  
b. The sync switch failed.  
c. You cannot shock VF in sync mode.  
d. A monitor lead has lost contact, producing the pseudo-VF rhythm.

26. Vasopressin can be recommended for which of the following rhythms?

a. SVT  
b. Second-degree AV block  
c. PEA  
d. Monomorphic wide-complex tachycardia with a pulse
27. Chest compressions and effective bag-mask ventilations are ongoing in a patient with no pulse. The ECG shows sinus bradycardia at a rate of 30/min. Which action should be done next?
   a. Administering atropine 1 mg IV
   b. Initiating transcutaneous pacing at a rate of 60/min
   c. Starting a dopamine IV infusion at 15 to 20 mcg/kg per minute
   d. Giving 1 mg epinephrine IV

28. The following patients were diagnosed with acute ischemic stroke. Which of these patients might be a candidate for IV fibrinolytic therapy?
   a. A 73-year-old woman who lives alone and was found unresponsive by a neighbor
   b. A 65-year-old man presenting approximately 5 hours after onset of symptoms
   c. A 62-year-old woman presenting 1 hour after onset of symptoms
   d. A 58-year-old man diagnosed with bleeding ulcers 1 week before onset of symptoms

29. A 25-year-old woman presents to the ED and says she is having another episode of SVT. Her medical history includes an electrophysiologic stimulation study (EPS) that confirmed a reentry tachycardia, no Wolff-Parkinson-White syndrome, and no pre-excitation. Heart rate is 180/min. The patient reports palpitations and mild shortness of breath. Vagal maneuvers with carotid sinus massage have no effect on heart rate or rhythm. Which is the most appropriate next intervention?
   a. DC cardioversion
   b. IV diltiazem
   c. IV propranolol
   d. IV adenosine

30. A patient with a heart rate of 30 to 40/min reports dizziness, cool and clammy extremities, and dyspnea. All treatment modalities are present. What would you do first?
   a. Give atropine 0.5 mg IV bolus.
   b. Give epinephrine 1 mg IV bolus.
   c. Start dopamine IV infusion 2 to 10 mcg/min.
   d. Begin immediate transcutaneous pacing, sedating the patient if possible.
# ACLS WRITTEN PRECOURSE SELF-ASSESSMENT
## Answer Sheet
### Advanced Cardiovascular Life Support

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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2011 ACLS Written Precourse Self-Assessment
Answer Key

1. d [see ACLS Provider Manual, pages 57 and 62, “Shock First vs CPR First” and “Minimal Interruption of Chest Compressions”]

2. b [see ACLS Provider Manual, page 65, “Shock and Vasopressors (Box 6)”]


5. b [see ACLS Provider Manual, page 129, “Narrow QRS, Regular Rhythm (Box 7)”]


7. a [see ACLS Student Website, Supplementary Material, “Advanced Airway Management”]

8. b [see ACLS Student Website, Supplementary Material, “General IV Principles”]

9. a [see ACLS Provider Manual, pages 65-66, “Shock and Antiarrhythmics (Box 8)”]

10. c [see ACLS Provider Manual, page 65, “Shock and Vasopressors (Box 6)”]

11. b [see ACLS Provider Manual, pages 83-84, Table 3 and “Hypovolemia”]

12. c [see ACLS Provider Manual, page 88, “Administer Vasopressors (Box 10)”]

13. a [see ACLS Provider Manual, page 111, “Treatment Sequence: Atropine”]


15. d [see ACLS Provider Manual, pages 97-98, “Administer Oxygen and Drugs”]

16. b [see ACLS Provider Manual, pages 96-97, “Starting With Dispatch” and “Administer Oxygen and Drugs”]

17. c [see ACLS Provider Manual, pages 97-98, “Administer Oxygen and Drugs”]

18. c [see ACLS Provider Manual, pages 101-103, “Early Reperfusion Therapy” and “Use of PCI”]

19. b [see ACLS Provider Manual, pages 135-136, “Warning Signs and Symptoms” and “Activate EMS System Immediately”]

20. a [see ACLS Provider Manual, pages 141-145, “CT Scan: Hemorrhage or No Hemorrhage (Box 5)”]


22. c [see ACLS Provider Manual, pages 87 and 90, “Asystole as an End Point” and “Duration of Resuscitative Efforts”]

23. a [see ACLS Provider Manual, page 128, “Decision Point: Stable or Unstable (Box 3)”]
24. d [see ACLS Provider Manual, pages 128, “Wide (Broad)-Complex Tachycardias (Box 6)"

25. c [see ACLS Provider Manual, page 123, “Technique"

26. c [see ACLS Provider Manual, pages 78 and 81, “Drugs for PEA” and “Administer Vasopressors (Box 10)”

27. d [see ACLS Provider Manual, page 81, “Administer Vasopressors (Box 10)”

28. c [see ACLS Provider Manual, pages 133 and 135, “Goals of Stroke Care” and “Critical Time Periods”

29. d [see ACLS Provider Manual, page 129, “Narrow QRS, Regular Rhythm (Box 7)”

30. a [see ACLS Provider Manual, pages 110-111, “Treatment Sequence Summary (Box 4)”]