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INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) occurs more commonly than in-hospital cardiac arrest. In Canada, the estimated incidence of treated OHCA is 55 per 100,000 people, 85% of which occur in the home, and half are witnessed by a family member.[1] Approximately 8.5% of EMS-treated cardiac arrests survive to hospital discharge.[2] The American Heart Association Cardiac Arrest Guideline (2020) indicates that variability in outcomes is linked to the strength of the Chain of Survival (Figure 1).[3] In the prehospital setting, early recognition and activation of emergency response, early high quality continuous chest compressions, and early defibrillation favorably impact survival. Timely advanced resuscitation and post-arrest care are also important. The emphasis continues to be on circulation as a priority, ahead of airway and breathing. Efforts are ongoing in the realm of continuous quality improvement (CQI) to continually strive to improve clinical outcomes after cardiac arrest.

Figure 1. Chain of Survival for Adult OHCA

SAFETY

Be aware of environmental hazards when approaching cardiac arrest patients. Consider possible causes for cardiac arrests that could pose a risk to the clinician (e.g. drowning, electrocution, violent scenes, confined spaces, etc.).

Apply personal protective equipment to reduce exposure to bodily fluids and aerosolized particles.

For patients with possible or confirmed COVID-19 infection, aerosol level precautions are indicated for provider safety. Resuscitation should only begin once appropriate PPE is donned by all clinicians in the room or vehicle compartment.

Observe safety precautions when delivering electrical therapy.

Clinician safety also involves being aware of the risk of occupational stress injury when attending cardiac arrests (or any other call). Occupational stress injuries can be acute (witnessing or experiencing one event) or cumulative (response to multiple events). Much like physical injury, preventative measures prior to the precipitating event and early interventions post-event will help to reduce the risk of PTSD. Resources are available to assist clinicians who are involved with any difficult call. These include the Peer Support Team (which can be activated through the Medical Communications Centre), a confidential employee and family assistance program and a Health and Wellness team who can provide assistance.

Bystanders Involved in Resuscitation

Research keeps reminding us that bystander CPR and AED use is associated with high rates of survival if performed timely and effectively. As a result, more of the general public is being trained and more AEDs are being distributed throughout the world. But while paramedics, nurses, and other first responders are used to resuscitation attempts, we also need to be aware of the psychological impact this has on bystanders. Emerging research is looking into how bystanders or lay-rescuers are affected by resuscitation attempts before first responders arrive. This could include someone who called 9-1-1, performed CPR, or was on scene and saw the whole event. It is important for EHS clinicians to realize that there may be more patients aside from the cardiac arrest patient. If resources allow (e.g. other responding crew, supervisor, etc.), make initial contact and offer some reassurance on the importance of their level of care prior to our arrival. Acknowledging that bystanders have done a great job may increase the chance that they perform CPR again as well as may have emotional benefits for the bystander.[4] A Lay Responder Support Model may be used in the future.[5]

ASSESSMENT

Clinicians should aim to quickly determine if the cardiac arrest is likely due to a medical or traumatic etiology, most arrests will be secondary to an underlying medical cause.

In the setting of a medical cardiac arrest, or if unsure, clinicians should provide immediate chest compressions upon recognizing a patient who is unresponsive, has absent or agonal respirations, and no palpable pulse for 10 seconds. The traumatic cardiac arrest bundle of care differs and will be

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detailed in a separate EHS CPG specific for this context.

Decision Not to Start Resuscitation

If the following conditions are present, clinicians should collaboratively consider not starting resuscitative efforts:

- ✓ Signs of prolonged death:
  - Rigor mortis
  - Decomposition
  - Dependent lividity
- ✓ Valid written personal healthcare directive indicating do not resuscitate/allow natural death (DNR/AND)
- ✓ The patient's Substitute Decision Maker (SDM) confirms the patient would not want resuscitation
- ✓ Asystole on arrival with no CPR for 10 minutes prior to EMS arrival

Etiology of the Cardiac Arrest

During the initial and ongoing assessment, always consider the possible etiologies for cardiac arrest (H's and T's). This may lead the clinician to alter interventions in order to provide better care, and may prompt early consultation with the Medical Communications Centre Physician (MCCP) to discuss specific therapy. See Table 1 for various cardiac arrest etiologies and potential interventions. Opioid-associated cardiac arrest is also becoming more common and should be considered (history of drug abuse disorder, opioid use, overdose, or track marks).

MANAGEMENT FOR PRESUMED MEDICAL ETIOLOGY CARDIAC ARREST

Management of the patient with a medical cause of cardiac arrest differs from management of the patient with a traumatic cause. If the cause of arrest is unclear, resuscitation should occur as if the etiology is medical in nature.

The approach to resuscitation should be a choreographed approach emphasizing early defibrillation, high quality CPR, limited interruptions, basic airway management, controlled ventilation, and rescuer fatigue management (**PEP 2 supportive**).

Resuscitation Sequence: Task Prioritization

Resuscitation guidelines emphasize the importance of early and high quality chest compressions. Therefore the priority of interventions should be chest compressions, early defibrillation then airway and breathing management (C-A-B). Figure 2 illustrates the BLS triangle and can be used to visualize where clinicians should be situated, and highlight what should be prioritized during resuscitation. Priorities 1-3 are the main focus. 4-5-6 can be done as additional resources become available. This is also referred to as the "pit crew" approach to resuscitation.

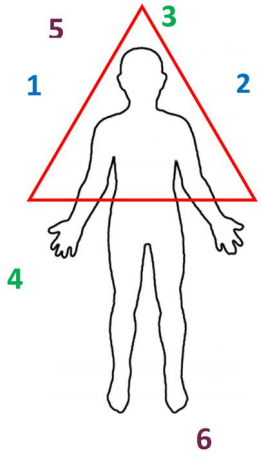

Figure 2: The BLS Triangle

Priority #1: Chest Compressions (**PEP 1 supportive**)

The first person should position themselves on the right side of the patient, perform an initial assessment and pulse check then begin high quality CPR as soon as cardiac arrest is recognized.

High Quality CPR includes:

- ✓ **Rate** between 100 and 120/min
- ✓ **Depth** 5-6 cm
- ✓ Allow complete **recoil**
- ✓ **Minimize pauses** in compressions
  - Less than 10 seconds for pulse and rhythm checks, compressor change, or moving the patient.
  - Compressions should occur right up until a shock is delivered and start immediately after shock is delivered without an intervening pulse or rhythm check (**PEP 1 neutral**).
- ✓ **Rotate** compressors every two minutes

The use of CPR feedback devices will help to ensure CPR is of high quality (**PEP 1 neutral**). The ZOLL X Series is equipped with a CPR feedback device which is best utilized when the compressor can visualize the CPR dashboard (Figure 3). Without the dashboard visible the device will give an audible prompt to "push harder" if compressions are too shallow and state "good CPR" once the depth has been corrected; however, there are no voice prompts for other CPR parameters (e.g. recoil or rate). If the dashboard doesn't appear on the display screen you may need to ensure a channel is available.

Figure 3: ZOLL X Series CPR Dashboard

Occasionally personnel from other agencies (e.g. fire, law enforcement) may be assigned the role of compressor. It is critical that EHS clinicians provide the required coaching to ensure the compressor is comfortable utilizing the dashboard and are providing high quality CPR.

Priority #2: Defibrillation (**PEP 1 supportive**)
The second person should position themselves on the left side of the patient, apply the defibrillator, analyze the rhythm and deliver a shock (if applicable) as soon as possible. Chest compressions should be performed while the defibrillator is charging and immediately after the shock is delivered (with no pulse check) in order to minimize interruptions in compressions. Initial defibrillation energy level is 120 J (with ZOLL X Series). The energy for subsequent shocks should be escalated to 150 J then 200 J (ZOLL X Series; done automatically in AED mode) if the patient has not responded to the initial shock. Subsequent rhythm and pulse checks (if not a shockable rhythm) occur at the end of every 2 minute cycle of compressions (putting the defibrillator in AED mode during resuscitation will keep time and prompt for pulse checks and/or defibrillation). This person should alternate compressions with the other individual every two minutes.

Priority #3: Airway and Breathing Management
The person managing airway and breathing should be located at the patient's head and will make all airway decisions, including whether they need to have another clinician take over for advanced airway management. If there are only 2 clinicians on scene, the one not doing compressions should also manage airway and breathing while maintaining the priority of early and timely defibrillation. Placing an i-gel may be done as quickly as the insertion of an OPA and application of a non-rebreather, so this may be considered as an initial option. Focus on effective oxygenation rather than specific airway intervention. ETI may even be deferred until after arrival at the receiving center. ETI (**PEP 1 neutral**), EGD (**PEP 1 supportive** for i-gel), or BMV (**PEP 1 supportive**) are all viable options depending on the circumstances. If an i-gel has been inserted and the patient is being adequately oxygenated and ventilated it is not recommended to remove the i-gel in favor of ETI in the pre-hospital setting. A few things to consider before electing to attempt ETI initially over inserting an i-gel are:

- is there a low risk of influenza like illness?
- are higher priorities such as high quality chest compressions and defibrillation managed?
- is adequate personnel available to perform and aid in the procedure without taking away from higher priorities?
- is ETI expected to be performed efficiently and without difficulty based on a CAT analysis?
- It is within the your personal scope of practice and do you have a high degree of comfort performing the skill?

Pause compressions while inserting an advanced airway. A viral filter must be attached to all airway devices to help protect the clinicians from exhaled air. An MDI adapter should be placed in the circuit if there is an anticipated need. Avoid disconnecting the circuit during the resuscitation for clinician safety.

It is important to avoid hyperventilation, including both rate and volume. Hyperventilation can lead to gastric insufflation, decreased cardiac output, and decreased coronary and cerebral perfusion. Overventilation and excessive airway pressures exceeding 20cm H_20 may also cause air and potentially viral particles to leak around the i-gel or cuffed endotracheal tube. **End-tidal CO_2 monitoring** should occur in all cardiac arrest settings in order to observe trends and changes. Normal $EtCO_2$ is between 35-45 mmHg; however, in the setting of cardiac arrest, clinicians should attempt to maintain the $EtCO_2$ above 20 mmHg, indicating that compressions are effective

(**PEP 2 supportive**). A sudden increase in the $EtCO_2$ may indicate the presence of ROSC (**PEP 1 supportive**); however, DO NOT stop CPR to assess for a pulse until the end of your 2 minute cycle.

Prior to advanced airway placement and once resources allow, compressions and ventilations may be provided either synchronously at a ratio of 30:2, or asynchronously with a ventilation rate of 10 per minute (approximately 1 breath every 6 seconds). Evidence suggests there is no difference in patient outcomes between the two strategies.[6] Ventilations should be delivered over a 1 second period until chest rise is observed (approximately 500-600 mL of tidal volume). Asynchronous compressions and ventilation are employed after advanced airway placement. If an influenza like illness is suspected, compressions and ventilations should remain synchronous at a ratio of 30:2 in an effort to decrease potential cuff leak.

Priority #4: Vascular Access & Drug Administration

This person should position themselves on either side of the patient for easier access to vasculature. Quality chest compressions should not be delayed or interrupted in order to obtain vascular access. The decision to obtain IV (**PEP 1 neutral**) or intraosseous (IO) (**PEP 1 neutral**) access will depend on scope of practice, patient vasculature, and the environment. It is recommended to attempt IV access first, based on evidence suggesting this route may be more efficacious than IO in this context.[7] Avoid prolonged attempts at IV insertion (i.e. after 1-2 attempts for IV then quickly shift to IO access if scope allows). Vascular access is not sought until the first three priorities are established, particularly if the clinicians are BLS providers without endorsement for pharmacologic intervention. Epinephrine administration should, however, occur as soon as possible after the first three priorities are maintained (**PEP 2 supportive**).

Pharmacological options for cardiac arrest management include:

Shockable Rhythms (VF and VT):

- ✓ Epinephrine (**PEP 1 neutral**)
- ✓ Amiodarone (**PEP 1 neutral**)
- ✓ Magnesium (only if polymorphic VT) (**PEP 1 neutral**)

Non-Shockable Rhythms (Asystole and PEA):

- ✓ Epinephrine (**PEP 1 neutral**)

Priority #5 and #6: Team Support

As resources become available, **priority #5** is for someone to position themselves between positions 1 and 3 and assist with airway and breathing management and cycle through CPR when possible. Finally, **priority #6** is for someone to position themselves near the patient's feet and begin recording and directing others as required, including ensuring the compressors are rotating, and assisting with other tasks as required. Review of potentially reversible causes, overall scene management, and consideration of indications for rapid extrication and transport should be reconsidered. Table 1 outlines some potentially reversible causes of cardiac arrest (H's and T's), as well as possible interventions.

Special Circumstances

Opioid-associated cardiac arrest is becoming more prevalent in recent years. The role of naloxone in cardiac arrest patients receiving CPR and ventilation is unclear. Even if opioid-associated cardiac arrest is suspected, the priorities remain early and uninterrupted chest compressions, timely defibrillation, ventilation, and cardiac arrest medication administration. In addition to this, it is reasonable to consider naloxone administration with repeat dosing every 3 minutes if opioid-associated cardiac arrest is suspected.[8]

Prehospital cardiac arrest in pregnancy is managed in keeping with the overarching principles outlined here. Continuous manual left lateral uterine displacement (as opposed to tilting a backboard with the right side elevated) is indicated when the fundal height is at or above the umbilicus. The uterus should be lifted up and leftward off the maternal vessels (Figure 4). It is important to not inadvertently push down, which will increase inferior vena cava compression.

Figure 4: Left lateral uterine displacement[9]

This relieves aortocaval compression, and manual displacement allows for more effective chest compressions, as compared to previous recommendations to elevate the entire right side of the patient. This displacement should continue throughout post arrest care as well. Good maternal care is the priority, which in turn equates to good care for the fetus.

There may be rare instances in which a patient may become agitated during cardiac arrest while compressions are occurring. If clinician safety is at risk or if it is compromising the ability to provide care, a low dose of midazolam IV may be administered.

Indications for Transport During Ongoing Resuscitation

Cardiac arrest care should occur where the patient is found, and transport occur if/when ROSC is achieved. This allows the best opportunity for immediate and quality chest compressions and timely defibrillation (when indicated). After 3 cycles of CPR, EHS clinicians may independently decide to transport without ROSC if there are predictors of survivability, or other special circumstances. **ANY** of the following may be considered an indication for transport without ROSC:

- Young patient age
- Close proximity to hospital
- Arrest witnessed by EHS or MFR providers
- Shockable rhythm at any time during the resuscitation
- ROSC detected (even transiently) at any time
- Possible reversible causes
- Complex social or environmental factors on scene

Presence of Family During Resuscitation

There is evidence to suggest that the presence of family during resuscitation may be of benefit (**PEP 2 supportive**). Family members should be given the option to remain present during resuscitative efforts. Family presence should be considered on a case by case basis in keeping with the family's wishes while maintaining scene safety.

Remember that this is likely a psychologically traumatic event for family. It is important to check in with them and offer support as required. If resources allow, a clinician may be assigned the role of staying with the family to answer questions and provide support during and after cardiac arrest care.

PREHOSPITAL POST ARREST CARE

As per the 2020 ILCOR guidelines, post–cardiac arrest care is a critical component of the Chain of Survival and demands a comprehensive, structured, multidisciplinary system that requires consistent implementation for optimal patient outcomes. One of the first things that should be done on obtaining a ROSC is to communicate and make a plan with the team. Have a shared mental model so everyone knows what the priorities are and what tasks need to be done.

The impact of the ischemia-reperfusion injury caused by cardiac arrest and subsequent resuscitation requires post–cardiac arrest care to simultaneously support the multiple organ systems that are affected. Prehospital care of post-arrest patients hinges on hemodynamic support, mechanical ventilation, temperature management, diagnosis and treatment of underlying causes and treatment of seizures.

Many cardiac arrest patients who survive the initial event will eventually die because of withdrawal of life-sustaining treatment in the setting of neurological injury. This cause of death is especially prominent in those with OOHCA. Thus, much of post-arrest care focuses on mitigating injury to the brain.

We can think of a ROSC checklist in terms of an "ABCDE" approach during this busy phase of care.

AIRWAY AND BREATHING

Optimize Ventilation and Oxygenation (**PEP 1 neutral**)

After ROSC, avoiding hyperventilation continues to be important. 10 ventilations per minute is typically adequate. Oxygen should also be titrated in order to achieve a SpO_2 between 92 and 98% while attempting to maintain an $EtCO_2$ between 35-40 mmHg. $EtCO_2$ will often spike upon ROSC but will trend downward. Do not hyperventilate the patient in an attempt to decrease the $EtCO_2$.

CIRCULATION

Treat hypotension

Clinicians should aim to keep the systolic blood pressure above 90 mmHg and/or MAP above 65

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mmHg. Intravenous fluid (**PEP White**) in combination with vasopressors (**PEP 1 supportive**) such as dopamine can be used to maintain a patient's blood pressure at an acceptable level.

Electrical therapy and dysrhythmias
A post-arrest patient is inherently unstable and will need to be monitored closely for rhythm disorders. Unstable tachyarrhythmias may need to be electrically cardioverted, and conversely, unstable bradycardic patients may require pacing. There is no role for routine use of antidysrhythmic medication infusion during ROSC care. Amiodarone is indicated for persistent VT in hemodynamically stable ROSC patients with a pulse.

12 Lead (**PEP 2 supportive**)
A large proportion of cardiac arrests are due to myocardial infarction. A 12-lead obtained during post-arrest care could demonstrate ST elevation at which time the patient should be considered for reperfusion therapy (direct-to-PCI or pre-hospital fibrinolysis). Follow the guideline for STEMI care in these cases. If it was determined that the patient was having a STEMI prior to arrest, contact the MCCP early to discuss possible intra-arrest fibrinolytics as prolonged CPR is a contraindication.

DISABILITY

Neurological
Monitor for and treat seizures.

ENDOCRINE & ENVIRONMENT

Blood glucose
This should be checked for all ROSC patients.

Passive cooling methods (**PEP 1 neutral**)
After cardiac arrest it is important to avoid hyperthermia. Passively cooling the patient by cooling the environment and removing the patient's clothing will help avoid this. Targeted temperature management will ensue in patients who are persistently comatose after arrival at the receiving centre.

TRIP DESTINATION

Optimal Trip Destination (**PEP 2 supportive**)
Post cardiac arrest patients should be taken to the nearest Level I or II facility that is able to continue appropriate ROSC care and admit the patient. Patients may be taken to the nearest smaller centre if immediate assistance is required. Ideally, the PCI Centre (Halifax Infirmary) should be the trip destination when this is either the closest centre or equidistant with other options. The clinician should notify receiving staff as soon as possible so they are able to appropriately prepare to receive the patient.

TRANSFER OF CARE

For patients **with ROSC** it is important to provide all relevant details to the receiving facility in terms of the resuscitation up to that time. It is expected that the emergency department will continue the post-arrest care of the patient which may include: targeted temperature management, neurologic, cardiorespiratory, and metabolic support, as well as potential transfer to the PCI lab. The clinician should state what measures have been (or have not been) taken in the pre-hospital setting. For example, stating 'no cooling has been started' may cue the staff to begin this process as soon as possible.

For patients **without ROSC** despite ongoing resuscitation, it is critical to ensure quality chest compressions and timely defibrillation during the transfer of care and to provide support as needed to the hospital team.

ON-SCENE TERMINATION OF RESUSCITATION

Termination of Resuscitation (TOR) guidelines are an important tool to ensure consistent decision-making when further efforts are medically futile and should be ceased (PEP **2 supportive**). The principles outlined here only apply to adult non-traumatic out-of-hospital cardiac arrests presumed to be of cardiac origin. The TOR rule below excludes death from other causes (asphyxia/hanging, drug overdose, hemorrhage). Guidance around traumatic cardiac arrest will be addressed separately. **A decision about whether to continue resuscitation efforts should be made after 15 minutes of resuscitation.** See the section above on indications for transport during ongoing resuscitation for cases where transport after 3 cycles of CPR may be appropriate.

Apply the following TOR Rule independent of CSP or MCCP contact. EHS clinicians should terminate resuscitation independently when **ALL** of the following are present:

- Age over 65
- Arrest not witnessed by EHS or MFR providers

- No shocks delivered at any time
- No return of spontaneous circulation (ROSC) at any time

All other adult non-traumatic cardiac arrests require consultation after 15 min of CPR:

- If age over 65, consult CSP
- If 65 and younger, consult MCCP

Transport may be advised if there are special indications that this is appropriate. Alternatively, advice may be given to either cease efforts if ongoing resuscitation is considered futile, or continue for an additional 10-20 minutes then terminate if ROSC is not achieved (follow up consult is not required). If the EHS clinicians on scene feel that the cardiac arrest is from a reversible cause requiring an MCCP consult for treatment discussion (see Table 1), make this call early in the resuscitation; as soon as the main priorities of resuscitation have been established.

Ensure you state your $EtCO_2$ value to CSP or the MCCP when you call to discuss termination of resuscitation.

For circumstances where MFRs have provided CPR for 15 min for an unwitnessed non-traumatic cardiac arrest where the above TOR rule is applicable and has been met, EHS crews should do a rhythm check prior to any consideration of termination. If the TOR rule has been met after 15 min of high-quality CPR by MFRs and the EHS rhythm check shows a persistent non-shockable rhythm, then EHS crew can consider termination as per the TOR rule and discussion above.

TISSUE DONATION

If resuscitative efforts are not initiated or are terminated on scene, the clinician should ensure the Medical Examiner is notified that the patient may be a tissue donor and/or if there are any contraindications to tissue donation. The list of contraindications include:

- Age greater than 70 years
- Weight less than 2.7 kg or greater than 136 kg
- Lab diagnosed infections (e.g. MRSA)
- Blood cancers (e.g. lymphoma, leukemia)
- Neurological diseases (e.g. ALS, MS, Alzheimer's)
- HIV, Hepatitis B, Hepatitis C, Human T-cell Lymphotropic virus (HTLV), active TB
- Severe sepsis (positive blood cultures, WBC > 20, 000 x 24 hours and temperature > 38.3C x 24 hours) [findings must be concurrent]

CHARTING

When documenting a cardiac arrest in ePCR, there are a number of important details to include, such as:

- ✓ Patient identifiers, including age and gender, where possible
- ✓ Scene findings
- ✓ Estimated time of arrest
- ✓ If the arrest was witnessed and by whom
- ✓ If resuscitation was attempted prior to EMS arrival and by whom
- ✓ Suspected etiology of the arrest
- ✓ Time of first shock given
- ✓ Type of AED, if used (Public or Non-Public (e.g. MFR))
- ✓ The initial cardiac arrest rhythm. This may be AED Shockable or AED Non-Shockable if an AED is used prior to EHS arrival.
- ✓ The rhythm on arrival at destination (if the patient is transported)
- ✓ If there was a ROSC provide the time and if it was sustained
- ✓ What interventions were done (including accurate times)
- ✓ Reversible causes that may have been considered
- ✓ A complete set of vitals including a blood glucose if ROSC was achieved and sustained long enough to acquire them
- ✓ 12 lead interpretation; 12 leads should also be attached to the PCR. If an ECG was transmitted for consultation, clearly indicate which ECG(s) were transmitted.
- ✓ Any communication with clinical support
- ✓ Reason(s) why resuscitation was terminated or not initiated
- ✓ Presence of a DNR/AND and/or identification of the Substitute Decision Maker and the patient's goals of care
- ✓ Pronouncement of death time

It is critical that data such as vitals and time stamps are imported into Siren and 12 leads imported and attached. Additionally, **all data must be uploaded from the ZOLL X Series to the online server.**

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Key Points - Resuscitation

Early chest compressions and defibrillation are the top priorities

Adequate rate, depth, recoil and minimal pauses in compressions are critical

C-A-B sequencing & choreography is critical - teamwork!

Always consider possible underlying causes (H's & T's)

Actively manage the post-arrest patient

KNOWLEDGE GAPS

Published evidence on the universal approach to cardiac arrests does not necessarily reflect the phases of prehospital care. For example, the scene survey/management, assessment, extrication, and transport are not reflected in the 2020 Resuscitation Guidelines. Prehospital practitioners need to translate this published knowledge into practice.

There are several other knowledge gaps surrounding OOHCA, including:

- Determining the optimal approach to airway management. There may in fact be no difference in specific devices used assuming oxygenation and ventilation are achieved via any means.
- The impact of ALS medication (such as epinephrine). Use of certain medications remains in question, particularly with regards to the impact on survival with favourable neurologic outcome. More recent evidence has suggested it may improve survival outcomes when given in a timely fashion.
- The role of chest compression devices.
- The role of dual sequence defibrillation and/or vector change in the treatment of shockable cardiac arrest.
- Which populations may benefit from ECPR/ECMO.

There is clear evidence regarding the role of cardiac arrest centres; however, the evidence suggests the main benefit is in the inter-facility transfer of ROSC patients to these centres, and not necessarily primary transport directly from the field. Future work of Nova Scotia Health will include exploring the possible role of the Halifax Infirmary as a cardiac arrest centre.

It is not always possible to update all local resuscitation documents at the same rate at which international guidelines are changed. Please refer to current AHA guidelines for the most up-to-date information on resuscitation practices.

EDUCATION

Formal certification in CPR, ACLS, PALS, PEARS and NRP will enable improved care in the resuscitation of patients. Practitioners are encouraged to maintain certification in these courses. Ongoing practice in scenario management can improve the care that you provide in resuscitation.

QUALITY IMPROVEMENT

Quality of CPR has been clearly associated with improved outcomes of patients. Reviewing resuscitation data and providing feedback to clinicians can help improve subsequent resuscitation efforts. The availability of cardiac monitor data through case push to the server is essential for quality improvement and is a key component of the Patient Care Record.

Complete and concise clinical documentation is important for communicating the care that was or was not delivered. All cardiac arrests where resuscitation was provided by EHS clinicians are reviewed for clinical performance. Performance measures are used to inform areas for system improvement and to identify where there may be gaps in education.

It is encouraged that clinicians report technological issues and patient safety concerns through occurrence reporting.

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https://emspep.cdha.nshealth.ca/

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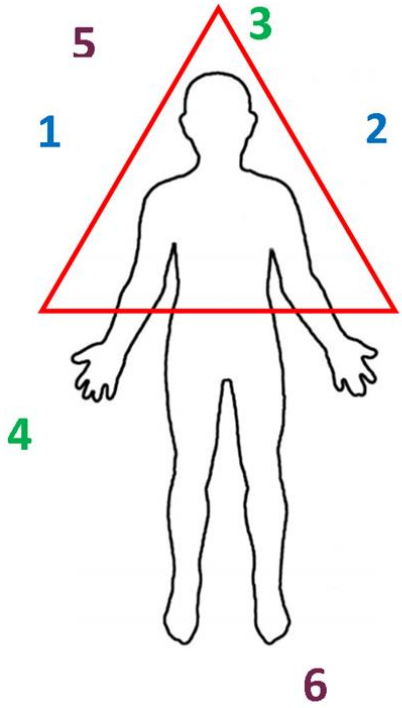
Table 1. Possible etiologies of cardiac arrest

Cause	Situation in which to suspect	Physical Findings	Interventions/adaptations to standard resuscitation
Hypovolemia	Trauma, internal hemorrhage, severe dehydration	Flat neck veins ECG: narrow complex, rapid rate	Stop the hemorrhage Volume infusion
Hypoxia	Suffocation, drowning	Cyanosis, airway obstruction ECG: Slow rate	Increased focus on oxygenation and ventilation
Hydrogen ion (acidosis)	History of diabetes or renal failure	ECG: Small amplitude QRS complexes	Ventilation, sodium bicarbonate
Hyperkalemia	History of diabetes, renal failure, or recent dialysis	Dialysis fistulas, medication ECG: Tall peaked T waves, small P wave, wide QRS	Calcium chloride, sodium bicarbonate
Hypokalemia	Diuretic use	ECG: Flat T waves, prominent U waves, wide QRS, long QT	Magnesium
Hypothermia	Exposure to the cold	Cold central body temperature ECG: Osborne waves	1 shock only, no meds
Tension pneumothorax	Blunt chest trauma	No pulse with CPR, neck vein distension, tracheal deviation, difficult to ventilate ECG: Narrow, initially rapid progressing to slow	Needle decompression
Tamponade (Cardiac)	Blunt or penetrating chest or upper abdominal trauma	No pulse with CPR, vein distension ECG: Narrow and fast	Fluid infusion
Toxins (OD)	Opioids, tricyclic antidepressants, digoxin, β blocker, or calcium channel blockers.	Pupils ECG: Bradycardia, long QT (depends on drug)	Antidote*
Thrombosis (Pulmonary)	Immobility (recent surgery, travel, cast), active cancer, history of DVT/PE	No pulse with CPR, distended neck veins ECG: Narrow and rapid	Thrombolysis*
Thrombosis (Cardiac)	Acute coronary symptoms prior to arrest	ECG: Q waves, ST segment changes, T wave inversion	Reperfusion after ROSC • If STEMI identified on 12 lead prior to arrest, contact MCCP early for possible fibrinolysis*
Trauma	Blunt or Penetrating Trauma Electrocution	Varies	Traumatic cardiac arrest management will be addressed in another CPG If electrocution, defibrillate immediately
Terminal disease	Current palliative patient	Palliative care plan, DNR or advance directive	N/A

Adapted from American Heart Association (2015). *Advanced Cardiovascular Life Support Provider Manual.*

* These interventions require on-line medical control consult

Figure 2: Prioritization of Resuscitation Tasks (Pit Crew Approach)



Priority 1 - RIGHT side

1. Perform an initial assessment and pulse check
2. Begin 200 continuous chest compressions (100 per minute)

Priority 2 - LEFT side

1. Bring in the monitor and apply pads.
2. ANALYZE rhythm and shocks if indicated.
3. Activate metronome on monitor if in manual mode
4. Alternate compressors every 200 compressions

Priority 3 - At patient's HEAD

1. Open/clear airway and place OPA/NPA and NRB (or i-gel)
2. If resources allow, initiate ventilation with BVM or SGD or ETT

Priority 4 - Either side

1. Initiate vascular access.
2. ALS – Administer epinephrine and amiodarone as per guidelines

Priority 5 - Between position 1 and 3

1. Assist in advanced airway maneuvers
2. Cycle through CPR when possible

Priority 6 - At patient's feet

1. Assume "code lead" and begin recording and directing others.
2. Ensure rotation of compressors/rhythm check every 200 compressions.
3. Assist with remaining tasks as needed.

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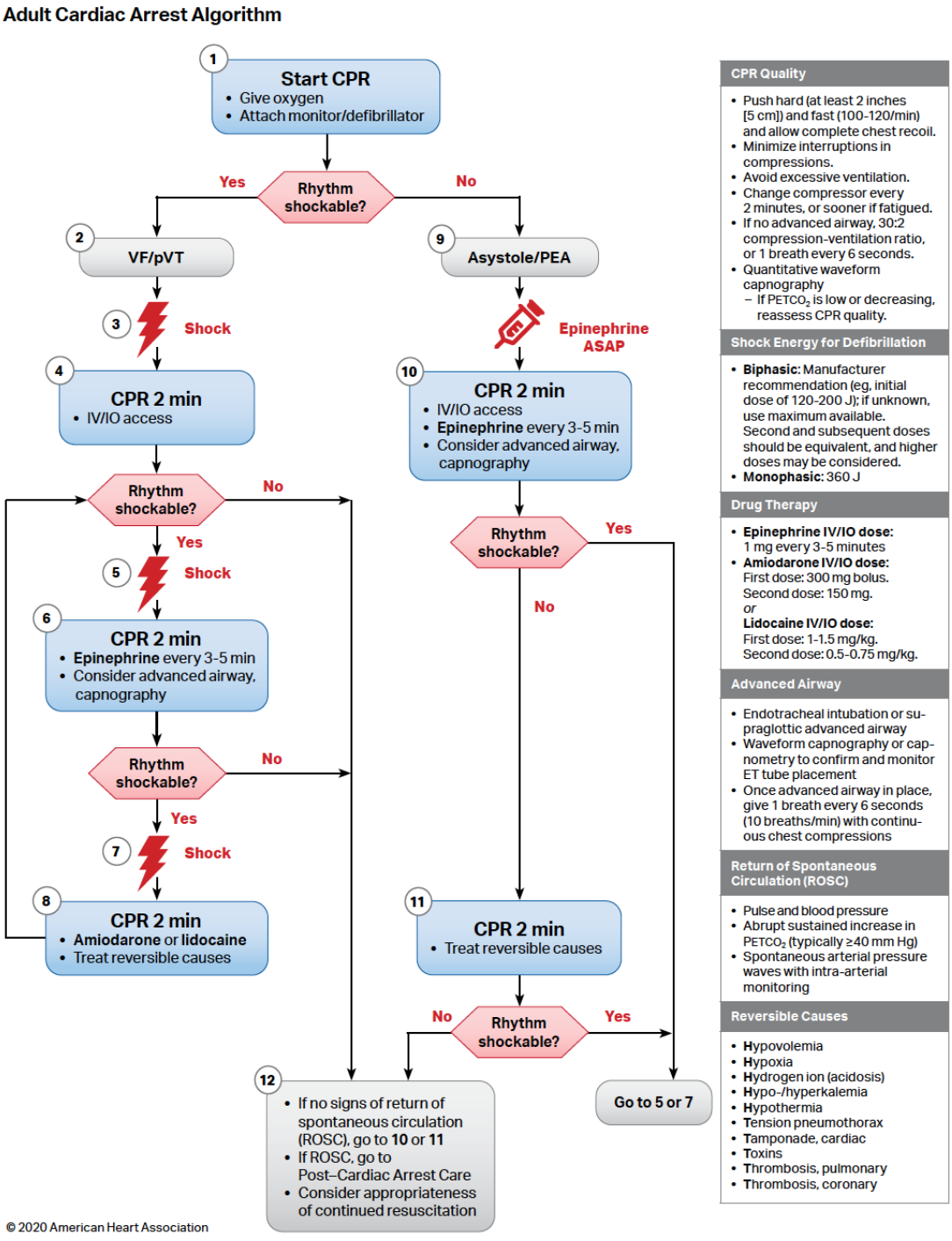
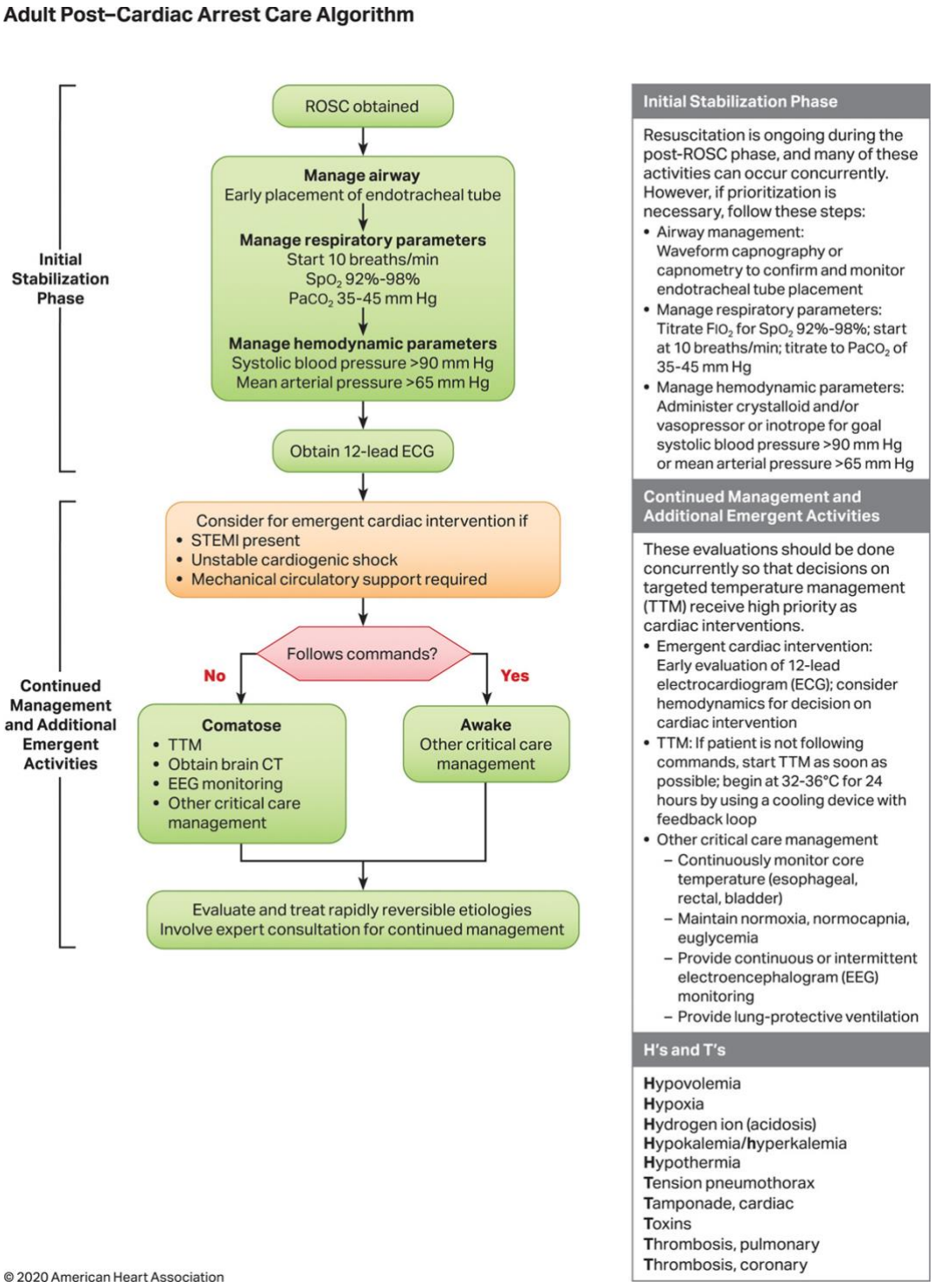
Figure 5:



American Heart Association (AHA) CPR and First Aid Emergency Cardiovascular Care. 2020 American Heart Association Guidelines for CPR and ECC: Algorithms. https://cpr.heart.org/en/resuscitation-science/cpr-and-ecc-guidelines/algorithms#

Figure 6:



American Heart Association (AHA) CPR and First Aid Emergency Cardiovascular Care. 2020 American Heart Association Guidelines for CPR and ECC: Algorithms. https://cpr.heart.org/en/resuscitation-science/cpr-and-ecc-guidelines/algorithms#

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PEP 3x3 TABLES for Adult OOHCA

Throughout the EHS Guidelines, you will see notations after clinical interventions (e.g.: **PEP 2 neutral**). PEP stands for: the Canadian **P**rehospital **E**vidence-based **P**ractice Program.

The number indicates the Strength of cumulative evidence for the intervention:
1 = strong evidence exists, usually from randomized controlled trials;
2 = fair evidence exists, usually from non-randomized studies with a comparison group; and
3 = weak evidence exists, usually from studies without a comparison group, or from simulation or animal studies.

The coloured word indicates the direction of the evidence for the intervention:
Green = the evidence is supportive for the use of the intervention; **Yellow = the evidence is neutral**; **Red = the evidence opposes** use of the intervention;
White = there is no evidence available for the intervention, or located evidence is currently under review.

PEP Recommendations for Adult OOHCA Interventions, as of 2022/04/29. PEP is continuously updated. See: https://emspep.cdha.nshealth.ca/ for latest recommendations, and for individual appraised articles.

General Cardiac Arrest Care

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• ACDC • ACLS • BCLS • Bystander CCC • Dispatch assisted CCC • EMS provided CCC • ETCO2 to determine ROSC • Impedance Threshold Device • ITD and ACDC • NaHCO3-after long arrest • Standard CPR • Transport to an ECMO capable facility	• Chest Compression devices • Compressions directly after Defib • CPR feedback device • Epinephrine • Fibrinolysis • High Dose Epi. • Hypertonic Saline • Intra-Arrest Cooling • IV access • Mechanical Intraosseous Insertion • NaHCO3 • PAI-CPR/Defib • Passive leg raise • Vasopressin		• Calcium (suspected hyper K) • NaHCO3 in special cases • Opiate overdose descision tool • Temperature Monitoring
	2 (fair evidence exists)	• Bystander CPR • Continuous Oxymetry Monitoring • Critical care life support • Early epinephrine • ETCO2 evaluation of ventilation • ETCO2 for compression evaluation • Family Involvement in Resuscitation • Passive Oxygen Administration • POCUS • Team based resuscitation • Termination Resuscitation ALS • Termination Resuscitation BLS	• Intra-arrest transport (load and go) • Prehospital Lactate	• ETT Drug Admin. • Manual Intraosseous Insertion	
	3 (weak evidence exists)	• Dispatcher video assistance • Fluid Resuscitation	• ECG • Precordial Thump		

*PEP is the **Canadian Prehospital Evidence-based Practice** Program. Every clinical intervention is given a recommendation based on the strength of available research evidence (1 = randomized controlled trials and systematic reviews of RCTs; 2 = studies with a comparison group; 3 studies without a comparison group or simulation) and direction of the compiled evidence: **supportive** of intervention; **neutral** evidence for intervention; or **opposing** evidence for intervention). See: **https://emspep.cdha.nshealth.ca***

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PEA / Asystole

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)		• Aminophylline • Fibrinolysis		
	2 (fair evidence exists)		• Anticholinergic • Transcutaneous Pacing		
	3 (weak evidence exists)				

VF/VT-Pulseless (Shock Advised)

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Biphasic Defibrillation • Defibrillation	• Antiarrhythmic - Class I (Na+ channel blockers) • Antiarrhythmic - Class III (K+ channel blockers) • CPR before defibrillation • Double Sequential Defibrillation • Magnesium		
	2 (fair evidence exists)	• Beta Blockers • Hands-on defib			
	3 (weak evidence exists)				

Post-Cardiac Arrest Care

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Inotrope	• Oxygen • Oxygen-titrated • Post-arrest cooling • Post-Arrest Cooling (CCT)		• Fluid Resuscitation
	2 (fair evidence exists)	• 12-Lead ECG • Antiarrhythmic - Class I (Na+ channel blockers) • Optimal Trip Destination			
	3 (weak evidence exists)				

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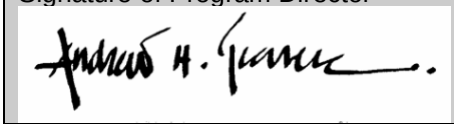
Signature of Program Director 		Signature of program Document Coordinator *Electronically Signed* *Tanya Fraser*