6220.04: CARDIAC ARREST ADULT

INTRODUCTION

Cardiac arrest is a common occurrence out-of-hospital. In the United States, as many as 65% of all cardiac arrests are sudden.[i,ii] In Canada, the estimated incidence of treated out-of-hospital cardiac arrest (OOHCA) is 55 per 100,000 population, 85% of which occur in the home, and half are witnessed by a family member.[iii] Approximately 8.5% of EMS-treated cardiac arrests survive to hospital discharge.[iv] Certain interventions are associated with improved survival, and should be top of mind for paramedics when managing a cardiac arrest.

Interventions Known to Improve Survival from OOHCA:

- Early recognition of cardiac arrest
- Early bystander CPR
- High quality CPR
- Early defibrillation
- Therapeutic hypothermia

CPR is essential for survival. Although all components of CPR are important (airway management, ventilations, compressions), provision of high quality chest compressions is most important. Paramedics are required to pay attention to their own CPR proficiency, compressions delivered by others, and the response of the patient.

Systems of care must be well integrated to optimize the chances of recovery from cardiac arrests, which include: Community (e.g., early 911 access, effective chest compressions, public access defibrillation programs), EMS (e.g., CPR and defibrillation), ED (e.g., therapeutic hypothermia); and In-hospital system (e.g., post-arrest care).

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.

Observe safety precautions when delivering electrical therapy.

ASSESSMENT

Paramedics should provide immediate chest compressions upon recognizing a patient who is unresponsive, has absent or agonal respirations, and no palpable pulse for 10 seconds.

Decision to Not Start Resuscitation

When the following conditions are present, the paramedic crew should collaboratively consider not starting resuscitative efforts:

- ✓ Signs of prolonged death
  - o Rigor mortis
  - o Decomposition
  - o Dependent lividity
- ✓ Traumatic cardiac arrest prior to EMS arrival
- ✓ Valid directive indicating no resuscitation
- ✓ Asystole on arrival with no CPR for 10 minutes prior to EMS arrival

Etiology

During assessment, consider the possible causes for cardiac arrest. This may lead the clinician to alter interventions to provide better care for the patient. See Table 1 for various cardiac arrest etiologies and potential interventions.

MANAGEMENT

CPR Sequence

The most recent 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).

Chest Compressions (PEP 2 supportive)

The person most likely to provide the highest quality of chest compressions should be delegated to this task for the initial 2 minutes.

High Quality CPR includes:

- ✓ **Rate** at least 100/min
- ✓ **Depth** at least 5 cm
- ✓ Allow complete **recoil**
- ✓ **Minimize pauses** in compressions
  - o Less than 10 seconds for pulse and rhythm checks, compressor change, or moving the patient.
- ✓ **Rotate** compressors every two minutes

Defibrillation (PEP 1 supportive)

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6220.04: CARDIAC ARREST ADULT

The defibrillator should be applied, the rhythm analyzed and a shock delivered (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 200J. You may consider escalating the energy for subsequent shocks if the patient has not responded to the initial 200J. Subsequent rhythm and pulse checks (if organized rhythm on monitor) occur at the end of every 2 minute cycle of compressions.

Airway and Breathing Management
To meet the priority of effective chest compressions and early defibrillation, initial airway management may consist of an airway adjunct (OPA / NPA) and non-rebreather mask. Defer advanced airway management unless multiple providers allow coordinated care.

Focus on effective oxygenation rather than the specific intervention. ETI (**PEP 2 neutral**), EGD (**PEP 2 neutral**), or BMV are all considered acceptable methods of airway management.

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. Optimal compression to ventilation ratio with an adult cardiac arrest is 30:2. Once an advanced airway is in place, compressions and ventilations are provided asynchronously with a ventilation rate of 8-10 per minute (approximately 1 breath every 6-8 seconds). Ventilations should be delivered over a 1 second period until chest rise is observed (approximately 500-600mL).

Vascular Access & Drug Administration
Quality chest compressions should not be delayed or interrupted in order to obtain vascular access. After 2 failed attempts at obtaining IV access, consider obtaining tibial intraosseous (IO) access.

Pharmacological options for cardiac arrest management include:

Shockable Rhythms (VF and VT):
- ✓ Epinephrine (**PEP 2 neutral**)
- ✓ Lidocaine (**PEP 2 neutral**)
- ✓ Amiodarone (**PEP 1 neutral**)
- ✓ Magnesium (**PEP 2 neutral**)

Non-Shockable Rhythms (Asystole and PEA):
- ✓ Epinephrine (**PEP 2 neutral**)

Special Management Considerations
There are certain circumstances which may require adaptations to normal interventions. Refer to Table 1 for special cases and possible interventions.

PREHOSPITAL POST ARREST CARE

Titrated Oxygen (**PEP 1 neutral**)
After a return of spontaneous circulation (ROSC), it is still important to avoid hyperventilating the patient. 10 ventilations per minute is most often adequate. Oxygen should also be titrated in order to achieve an SpO_2 between 94 and 99%.

Treat hypotension
Clinicians should aim to keep the systolic blood pressure above 90mmHg. Intravenous fluid **(PEP white)** in combination with vasopressors such as dopamine **(PEP white)** can be used to maintain a patient's blood pressure at an acceptable level.

Electrical therapy
A post-arrest patient is typically unstable and will need to be monitored closely. Unstable tachyarrhythmias may need to be cardioverted, and conversely, unstable bradycardic patients may need to be paced.

12 Lead
A large number 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 guidelines for STEMI care in these cases.

Passive cooling methods (**PEP 1 supportive**)
If a patient is unable to respond to verbal commands in the post-arrest setting, therapeutic hypothermia can be induced. Therapeutic hypothermia has been shown to improve neurological recovery after cardiac arrest and should be continued in the hospital setting. Pre-hospital cooling is most often passive and can include:
- ✓ Removing clothing
- ✓ Cooling the environment
- ✓ Applying ice packs to the groin/axillary areas

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Optimal Trip Destination (**PEP 1 supportive**)
Post cardiac arrest patients should be taken to a facility that is able to continue appropriate ROSC care, such as a hospital that can reliably provide therapeutic hypothermia and/or PCI. Whatever facility is chosen, the clinician should notify the 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 including: therapeutic hypothermia, neurological, cardiovascular, 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 during the transfer of care and to provide support as needed to the hospital team.

ON-SCENE TERMINATION OF RESUSCITATION

Guidelines for Termination of Resuscitation (**PEP 2 supportive**)
Research has demonstrated that the following factors are predictors of survivability:

- Witnessed arrest by EMS
- Shockable rhythm present
- ROSC prior to transport

A termination of resuscitation rule has been studied and validated which states:
It is appropriate to terminate resuscitation if all of the following factors are present[v]:

- The arrest is not witnessed by an EMS provider
- There is no shockable rhythm identified by an AED or other monitor
- There is no ROSC prior to transport

When patients do not meet the above termination of resuscitation rule, other factors should be considered when deciding whether to transport. These include clinical (e.g. age of patient), social (e.g. expectations of others on scene), or geographical (e.g. distance to hospital) factors.

TISSUE DONATION

If resuscitative efforts are not initiated or are terminated on scene, the clinician is encouraged to approach the patient's next-of-kin regarding tissue donation. Any patient less than 80 years of age except those with HIV, Hepatitis B or C, leukemia or lymphoma, ALS, Alzheimer's, MS, CJD or severe sepsis are potentially suitable donors. Patients who have been dead for more than 24 hours are not suitable donors. If a suitable tissue donor is identified and the next-of-kin is agreeable, the ME can then be contacted with the pertinent information.

CHARTING

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

- ✓ If the arrest was witnessed
- ✓ If resuscitation was attempted prior to EMS arrival and by whom
- ✓ Suspected etiology of the arrest
- ✓ Time of first shock given
- ✓ The initial cardiac rhythm
- ✓ The rhythm on arrival at destination (if the patient is transported)
- ✓ If there was a ROSC and if it was sustained
- ✓ What interventions were done (including accurate times)
- ✓ If tissue donation was discussed
- ✓ Any communication with on-line medical support

RESEARCH OPPORTUNITIES

Research in resuscitation can be extremely diverse including both quantitative and qualitative methods. While large groups such as the Resuscitation Outcomes Consortium (https://roc.uwctc.org/tiki/tiki-index.php) will continue to focus on the various interventions in resuscitation, other research networks in Canada and elsewhere will focus on how to implement guidelines into practice. Any interest in resuscitation research can be directed to EHS via the following link: http://www.gov.ns.ca/health/ehs/

Key Points - Resuscitation

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6220.04: CARDIAC ARREST ADULT

Early chest compressions and defibrillation are priorities

Adequate rate, recoil and minimal pauses in compressions are critical

C-A-B sequencing for all

CPR choreography of care is critical

Teamwork, Teamwork, Teamwork

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 2010 Resuscitation Guidelines. Practitioners need to translate this published knowledge into practice.

Also many of the interventions in resuscitation such as ALS medications, and airway management remain in question. This does not mean that there is no role for these interventions but rather that EMS systems need to validate their roles in contemporary research. Lack of evidence of a difference does not mean the same as evidence of a lack of difference.

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 IMPLICATIONS

Formal certification in CPR, ACLS, PALS, 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 IMPLICATIONS

Quality of CPR has been clearly associated with improved outcomes of patients.

Key Challenges to Improving CPR Quality

CPR Component	Key Challenges to Improving Quality
Recognition	• Failure to recognize gasping as a sign of cardiac arrest • Unreliable pulse detection
Initiation of CPR	• Low bystander CPR response rates • Incorrect dispatch instructions
Compression rate	• Slow compression rate
Compression depth	• Shallow compression depth
Chest wall recoil	• Rescuer leaning on the chest
Compression interruptions	• Excessive interruptions for: - rhythm/pulse checks - ventilations - defibrillation - intubation - intravenous (IV) access - other
Ventilation	• Ineffective ventilations • Prolonged interruptions in compressions to deliver breaths • Excessive ventilation (especially with advanced airway)
Defibrillation	• Prolonged time to defibrillator availability • Prolonged interruptions in chest compressions pre-and post-shocks
Team Performance	• Delayed rotation, leading to rescuer fatigue and decay in compression quality • Poor communication among rescuers, leading to unnecessary interruptions in compressions

Travers et al. Circulation 2010. 122: s676-S684

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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	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)	Empty tricyclic, digoxin, β blocker, or calcium channel blocker pill bottles	Pupils ECG: Bradycardia, long QT (depends on drug)	Antidote*
Thrombosis (Pulmonary)	Extended period of stasis (e.g. long flight or bed ridden)	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
Trauma	Commotio cordis (blunt chest trauma), electrocution	Varies	Defibrillate ASAP even though 'traumatic'
Terminal disease	Current palliative patient	Palliative care plan, DNR or advance directive	N/A

Adapted from American Heart Association (2011). *Advanced Cardiovascular Life Support Provider Manual.*

* These interventions require on-line medical control consult

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6220.04: CARDIAC ARREST ADULT

Timeline Reference Chart

	Two Responders			Multiple EMS Rescuers				Goals of Resuscitation	
Min	Rescuer 1	Rescuer 2		Rescuer 1	Rescuer 2	Rescuer 3		Resuscitation Team Organization	
0	Starts CC	Prepares defib		Starts CC	Prepares BVM	Prepares defib			
1	CC	Inserts OPA & NRB		CC	BVM	DF			
2	CC	DF at 2 minutes		CC	BVM	IV, DF			
	2 MIN: Defibrillation, Crew Rotation								
3	IV, Rx	CC		BVM	CC	DF, Rx			Medication
4	IV, Rx, DF	CC		BVM	CC	DF, Rx			
	4 MIN: Defibrillation, Crew Rotation								
5	CC	BVM, Prep AW		BVM	Prep AW	CC			
6	CC	BVM, Prep AW		BVM	Prep AW, Defib	CC		Effective CC and DF	
	6 MIN: Defibrillation, Crew Rotation								
7	AW, Rx	CC		CC	AW	Rx			Medication / Airway
8	AW, Rx	CC		CC	AW	Rx, DF			
	8 MIN: Defibrillation, Crew Rotation								
9	CC	BV-AW		BV-AW	CC	Rx			Disposition/Prognostication
10	CC	BV-AW		BV-AW	CC	DF, Other			
	10 MIN: Defibrillation, Crew Rotation								
11	BV-AW, Other	CC		BV-AW	Rx	CC			Medication / Extrication
12	BV-AW, Other	CC		BV-AW	DF, Other	CC			

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6220.04: CARDIAC ARREST ADULT

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**rotocols Project.

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 2013/05/09. PEP is continuously updated. See: http://emergency.medicine.dal.ca/ehsprotocols/protocols/toc.cfm 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 RECOMMENDATION FOR INTERVENTION	1 (strong evidence exists)		• ACDC • High Dose Epi. • NaHCO3 • Passive Oxygen Administration • Thrombolysis • Vasopressin	• Chest compression devices	• Compression-only CPR • ETT Drug Admin. • Impedence Threshold Device • NaHCO3 in special cases • NaHCO3/ROSC after long arrest • Precordial Thump
	2 (fair evidence exists)	• CPR • CPR feedback device • Intraosseous Infusion • Termination Resuscitation ALS • Termination Resuscitation BLS	• ACLS • Epinephrine		
	3 (weak evidence exists)		• Pre-Arrival Instructions		

PEA / Asystole

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF RECOMMENDATION FOR INTERVENTION	1 (strong evidence exists)		• Aminophylline		• Anticholinergic • Transcutaneous Pacing
	2 (fair evidence exists)				
	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 RECOMMENDATION FOR INTERVENTION	1 (strong evidence exists)	• Biphasic Defibrillation	• Antiarrythmic - Class III (K+ channel blockers) • CPR before defibrillation • Magnesium		• Antiarrythmic - Class I (Na+ channel blockers)
	2 (fair evidence exists)	• Defibrillation			
	3 (weak evidence exists)				

Post-Cardiac Arrest Care

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF RECOMMENDATION FOR INTERVENTION	1 (strong evidence exists)	• Hypothermia	• Oxygen • Titrated oxygen		• Fluid Resuscitation • Inotrope
	2 (fair evidence exists)	• Optimal Trip Destination			
	3 (weak evidence exists)				

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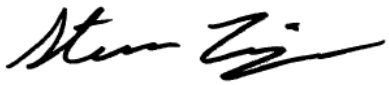
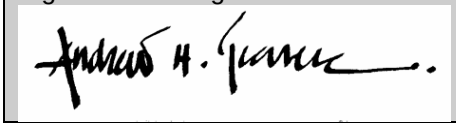
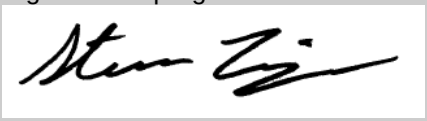
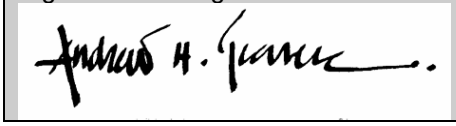
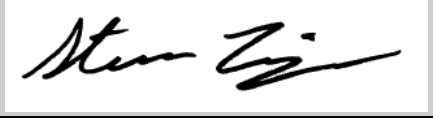
Program Document Number Management System

PDN: 6220.04	**Title:** Cardiac Arrest Adult	**Type:** CPG
Effective Date: February 22 2013	**Revision Date:**	
Approval Date: February 15 2013	**Revision Date:**	
Review Date: November 11 2012	**Revision Date:**	
Replaces: 6220.03	**Revision Date:**	
Signature of Program Director 	Signature of Program Document Coordinator 	

PDN: 6220.99.01.01	**Title:** Cardiac Arrest Adult	**Type:** Field Guide
Effective Date: February 22 2013	Revision Date:	
Approval Date: February 15, 2013	Revision Date:	
Review Date: November 11, 2012	Revision Date:	
Replaces: 6220.03	Revision Date:	
Signature of Program Director 	Signature of program Document Coordinator 	

PDN: 6220.99.02.01	**Title:** Post Cardiac Arrest Care	**Type:** Field Guide
Effective Date: February 27 2014	Revision Date:	
Approval Date: February 15, 2014	Revision Date:	
Review Date: November 11, 2012	Revision Date:	
Replaces: 6220.03	Revision Date:	
Signature of Program Director 	Signature of program Document Coordinator 	

EHS has made every effort to ensure that the information, tables, drawings and diagrams contained in the Clinical Practice Guidelines issued Q1 DHW2013 is accurate at the time of publication. However, the EHS guidance is advisory and has been developed to assist healthcare professionals, together with patients, to make decisions about the management of the patient's health, including treatments. It is intended to support the decision making process and is not a substitute for sound clinical judgment. Guidelines cannot always contain all the information necessary for determining appropriate care and cannot address all individual situations; therefore individuals using these guidelines must ensure they have the appropriate knowledge and skills to enable appropriate interpretation.

*PEP is the **Canadian Prehospital Evidence-based Protocols Project.** 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: **http://emergency.medicine.dal.ca/ehsprotocols/protocols/toc.cfm***