

# **Cardiopulmonary Resuscitation Course Guide**

***Environmental Health and Safety Office***  
[www.dal.ca/safety](http://www.dal.ca/safety)

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**DALHOUSIE  
UNIVERSITY**

*Inspiring Minds*

# Introduction

## What is Cardiopulmonary Resuscitation?

**Definition:** **Cardiopulmonary resuscitation** is expired air resuscitation (EAR) used in conjunction with external cardiac compressions (ECC). Expired air resuscitation provides oxygen to the casualty, external cardiac duplicates the heart's pumping the oxygenated blood around the body.

## History

The concept of providing air to an unconscious person by mouth-to-mouth resuscitation has been around for a considerable amount of time. There are even vague references to it in the Bible. However, it was not until 1954 that Dr. James Elam proved that expired air could, in fact, provide adequate oxygenation for casualties who could not breathe on their own. Two years later, Dr. Elam teamed with Dr. Peter Safer to formalize the procedure now known as mouth-to-mouth resuscitation.

Likewise, the concept of external heart massage has been around for a considerable time. However, it was not until the early 1960s that Dr. WD Kowenhoven formalized a standard method for administering chest compressions.

These two concepts formed the basis for what is now cardiopulmonary resuscitation (CPR).

**Terminology:** For the purpose of this course, the more common terms **rescue breathing** or **mouth-to-mouth resuscitation** will be used for expired air resuscitation and **chest compressions** will be used for external cardiac compressions.

## Why is Cardiopulmonary Resuscitation Necessary?

### Statistics

- Approximately 50,000 Canadians die every year from sudden cardiac arrest.
- The survival rate of people who suffer cardiac arrest (outside a hospital) is less than 5%.
- Less than 15% of people who suffer cardiac arrest in front of bystanders receive CPR from those bystanders.
- Casualties receiving CPR from bystanders are two to five times more likely to survive than casualties who don't.

**Definitions:** **Cardiac arrest** is the abrupt loss of the heart's ability to perform its proper function. The heart can either stop beating altogether – **asystole** or quiver - **ventricular fibrillation**.

## Brain Damage and Death

When a person goes into cardiac arrest, there is no longer a flow of oxygenated blood to the body's vital organs, including the brain. As the brain is starved of oxygen, its cells start to die. As the brain cells die, there will be consequences to the casualty.

The following chart shows the consequences of oxygen deprivation:

Minutes Without Oxygen	Effects on a Person
0 to 4	Minimal effects on a person. In some instances there is the possibility of brain damage.
4 to 6	There is the possibility of brain damage.
6 to 10	There is the likelihood of brain damage.
Over 10	There is the likelihood of irreversible brain damage or death.

As the chart indicates, a person in cardiac arrest does not have a lot of time before they could face serious brain injuries, even death. So the sooner CPR can be administered to a casualty, the better their chance of survival. In virtually all cases of cardiac arrest where CPR is administered, the heart does not return to its normal rhythm.

The fundamental purpose of CPR is to provide the casualty with oxygen (rescue breathing) and circulation (chest compressions) until Dalhousie Security or EMS arrives on scene with an automated external defibrillator.

**Definition:** **Defibrillation** is an electronic shock administered to momentarily stop the heart and allow the brain to "reset" it to its natural rhythm.

## Chain of Survival

A person's chance of survival can be correlated into a series of four events that must be taken in a timely manner.

- Early access
- Early CPR
- Early defibrillation
- Early medical care

## Early Access

Once it has been established that a person has a medical condition that requires more advanced care, the call must be made to Dalhousie Security (**4109**). The faster that care can arrive on scene, the better the casualty's chance of survival.

## Early CPR

Once the call has been made to Dalhousie Security, start CPR. As seen in the chart on the previous page, a person can start losing brain function in about four minutes. The earlier that CPR can be started, the better the casualty's chance of survival.

## Early Defibrillation

As previously mentioned, the heart needs to be shocked in order to return to its normal rhythm. CPR provides a bridge between the on-set of cardiac arrest and defibrillation but the longer a person goes without it, the less their chance of survival.

**Note:** If a person's heart has stopped – asystole, defibrillation will not work.

## Early Medical Care

It is important that paramedics get to the scene as soon as possible. Paramedics in Nova Scotia are extremely well trained and are able to properly assess a casualty. They will also be able to deal with a patient in cardiac arrest due to asystole by administering certain drugs. Paramedics will also have direct access to hospital emergency personnel.

## What Causes Cardiac Arrest?

The most common cause of cardiac arrest is a heart attack. There are a number of factors that can contribute to a person having a heart attack:

- Smoking
- Obesity
- Stress
- Age
- Physiology
- Poor Diet

Other events that can lead to cardiac arrest include drowning, poisoning, electrocution, drug overdose, blood loss, other traumatic injuries, or allergic reactions. Any life threatening situation can lead to cardiac arrest.

**Note:** If a person is in cardiac arrest, they are clinically dead. The number one concern is CPR. It may help emergency responders to know the cause of the injuries, but the immediate concern is to get oxygenated blood circulating throughout the body.

## Universal Precautions

When dealing with a casualty, all reasonable precautions must be taken to avoid the transmission of disease or other illness from either the rescuer to the casualty or vice versa. Bodily fluids, particularly blood, may contain viruses such as human immunodeficiency virus (HIV) or hepatitis. Both are life-threatening.

There are two pieces of personal protection that should be used whenever possible while performing CPR; 1) disposable gloves and 2) disposable plastic masks.

### Disposable Gloves

The first aid kits around the University are equipped with disposable gloves. Where a casualty is bleeding, the extra time should be taken to put on the gloves. When there is no bleeding, chest compressions should commence immediately. There has never been a documented case of a rescuer (or casualty) transmitting an illness by doing chest compressions without protective gloves.

### Disposable Plastic Masks

The first aid kits around the University are in the process of all being equipped with disposable plastic masks. Masks should be used when doing rescue breathing, especially if there is bleeding around the mouth of the either the casualty or rescuer.

# ***Steps in the Management of an Emergency***

## **1. Survey the Area for Potential Safety Hazards**

The most important consideration at any emergency scene is your own safety. If providing help to an injured person could put you or someone else (including the casualty) at further risk to injury or illness, wait for the arrival of emergency responders. They are trained to deal with the potential hazards.

**Definition:** A **hazard** is an object or situation that has the potential to cause injury or property damage.

Because of the size of Dalhousie University and diverse nature of the activities performed at the university, there the potential for any number of hazardous situations that could put people at risk. Some of the hazards to be aware of include:

- Electricity
- Chemical spills
- Debris
- Hazardous atmospheres
- Animals
- Unruly people

### **Electricity**

Some common electrical hazards include power lines, exposed wires, electrical panels, and objects or substances that act as conductors. Even items not considered good conductors, such as wood, could be wet or contain a substance that is conductive.

**Definition:** A **conductor** is an object or substance that permits the transmission of electricity.

Caution should be used when encountering an accident that was not witnessed, especially if the injured person is a utility worker or electrician.

If a person is in a vehicle that has come into contact with power lines, leave them there. **DO NOT** approach the vehicle. If the casualty is conscious, tell them to stay in the vehicle. The vehicle is grounded by the tires so staying put is the safest option.

If a person has to exit a burning vehicle, they should jump with both feet together and not hold onto any part of the vehicle as they jump. They should then hop away from the vehicle.

## Chemical spills

There are a number of potential dangers with chemical spills. Chemicals can be toxic (poisonous), cause respiratory failure (asphyxiation), or cause burns.

In many cases the type of chemical spill cannot be readily identified before hazardous materials teams arrive at the scene.

NEVER take chances around chemicals.

## Debris

Many accidents, particularly motor vehicle collisions, will produce twisted metal, broken glass, and shards of plastic. If possible, remove as much debris as safely possible to allow better access to casualties.

## Hazardous Atmospheres

Hazardous atmospheres fall into a number of categories including:

- Oxygen deficient
- Oxygen enriched
- Toxic gases
- Explosive gases (substances)

**Definition:** Oxygen deficient atmospheres contain less than 19.5% oxygen in the air.

**Definition:** Oxygen enriched atmospheres contain greater than 23.5% oxygen in the air.

Although rare, hazardous atmospheres have the potential to be devastating. The number one problem with hazardous atmospheres is the lack of clues or evidence as to why a person(s) is incoherent, unconscious, or otherwise incapacitated.

**Domino Effect:** When a person is overcome by a toxic atmosphere or oxygen deficiency, the automatic assumption by witnesses or people that come across the scene is that the person has had a heart attack, choked, or fainted. The first potential rescuer will enter the area and become a second casualty. This will continue until someone finally makes the connection that the atmosphere is the problem and gets the proper help.

There are a number of areas around the University that have the potential to contain toxic atmospheres:

- Laboratories (chemistry, biology)
- Tunnels
- Confined spaces
- Below grade areas (temporary trenches)

**Definition:** A **confined space** is an area that meets three specific criteria; 1) it is not designed or intended for regular human occupancy, 2) it has restricted access or exit and 3) it is or may become hazardous to a person entering it because of its design, construction, location, atmosphere or the materials or substances in it or other conditions.

If a person is unconscious in one of these areas, call Dalhousie Security (**4109**) immediately. Do not enter the space if you are not 100% sure why a person has been injured.

## **Animals**

There are a number of experiments involving animals at Dalhousie University. Be very careful with these animals if they are present at an emergency scene. Many of them will not have predictable behavior.

A dog belonging to an injured person will also have the potential to act erratically or in a defensive manner. Never try and get between a casualty and their dog if the dog has the potential to cause harm. Even specially-trained seeing-eye dogs are generally not prepared to handle an emergency situation with their owner.

## **Unruly People**

Emergency scenes at the University have the potential to involve unruly people. There are a number of reasons that a person becomes disruptive or agitated when another person is injured:

- Stress
- Alcohol Intoxication
- Drug impairment
- Guilt (that they were the cause)

It is important to stay calm. Stress that you can help the casualty and do not say or do anything that could further provoke a disruptive person.

There is always a reason why a person has become sick, injured, or otherwise incapacitated. The overall scene of an incident can provide clues to help determine the cause (and possible treatment) for a casualty. It can also identify potential hazards for rescuers and bystanders.

## 2. Establish the Level of Consciousness (LOC) of the Casualty

Approach the casualty slowly and, if possible, within their line of vision. They may have a head or neck injury and their natural reaction will be to try and turn toward you. This could aggravate their condition. Calmly, but in a firm voice, ask them some simple questions and identify yourself.

Examples:      *What is your name?*  
                    *What happened to you?*  
                    *Where do you feel pain?*

Their answers to these questions can provide valuable information to the first responders or paramedics when they arrive, especially if the casualty goes unconscious.

If there is no initial response, kneel down next to the casualty and firmly, but without yelling, ask them the same questions and give a small pinch on the shoulder. Watch for a reaction from the casualty. A flinch or other facial movement could mean the casualty is somewhat aware of their surroundings.

## 3. Call Dalhousie Security

Send someone to call (or call yourself) Dalhousie Security **4109** and provide them with the following information:

- Who you are
- Where you're at (as specific as possible)
- The condition of the casualty (LOC, what happened to them, etc.)

Upon receiving the call Dalhousie Security will immediately dispatch staff to the scene and call (911) to summon emergency medical services (EMS). The staff is trained in emergency first aid and each vehicle carries an automated external defibrillator (AED). Dalhousie Security will also be better able to get to the scene as they are more familiar with the campuses and the layout of the various buildings. The staff will then be on scene help direct arriving EMS to the scene.

## 4. Start the ABC's

A primary survey is done to determine (and control) life-threatening injuries. They are sequentially checked in their importance of sustaining life.

- A: Airway**
- B: Breathing**
- C: Circulation & Severe Bleeding**

If a casualty verbally answers the questions posed to them, check for severe bleeding and proceed to the secondary survey (Step 5). If a person can talk it means they have an airway, the ability to breath, and circulation.

If a casualty is responsive to touch, they probably have at an airway and the ability to breath.

**Note:** A person can have a pulse but not be breathing.

If a casualty is unresponsive, perform the ABC's.

### **A (Airway)**

Create an airway using the head tilt, chin lift method or, if necessary, the jaw thrust method.

### **B (Breathing)**

Determine if the casualty can breathe on their own. If they can't, perform rescue breathing.

### **C (Circulation)**

After an airway has been established and the casualty is getting oxygen (rescue breathing), check for a pulse. If there is no pulse, perform chest compressions.

**Note:** The proper technique for these procedures will be described in the following chapter.

# ***Cardiopulmonary Resuscitation Techniques***

## **Introduction**

Cardiopulmonary Resuscitation (CPR) is applied to casualties who have gone into cardiac arrest. It is important to understand that a person who is in cardiac arrest is clinically dead. Performing CPR is the only thing that will stop the progression from clinical death to brain death. Once a person is brain dead, they are medically dead.

The heart is well protected by ribs and muscle so considerable force is required to “artificially” pump blood to the rest of the body. This force while delivering compressions on a person’s chest can produce bruising and other injuries including broken ribs.

It is also important to perform CPR on a firm surface with the casualty on their back. To properly perform CPR may require the movement of the casualty. Any casualty that is breathing and has a pulse should only be moved if there is an immediate danger to them, otherwise wait until well-trained EMS response teams get to the scene. If a casualty does have to be moved, make sure the head and neck move as little as possible while transporting them.

## **Respiration**

Respiration is the process of exchange between oxygen (from the air) and carbon dioxide, (a waste product from the body). Under normal circumstances, the air contains approximately 21% oxygen. Thus, when a person inhales, they bring in air that is 21% oxygen. When a person exhales, they breathe out approximately 16% oxygen. Therefore, during rescue breathing, the casualty will receive approximately 16% oxygen.

A person exposed to such low oxygen levels under normal circumstances would experience increased breathing, increased pulse rate, and impaired judgment and coordination. However, it has been proven that expired air will provide adequate ventilation.

## **Creating an Airway**

The first step in performing CPR is to create an airway. An airway is the passageway from the mouth or nose to the lungs. Without an airway, the casualty will be unable to get oxygen to the lungs. The most common, and effective, means of creating an airway is the head tilt, chin lift method. This method is used when a head or spinal injury is not suspected.

Steps in determining if a casualty has an airway:

1. Put your ear over the casualty's mouth and watch their chest to see if it rises.
2. Listen and watch for signs that the casualty is breathing.
3. Do this for no more than 10 seconds.
4. If the casualty shows no signs of breathing, they may have an obstructed airway.

### **Head Tilt; Chin Lift Method**

Steps in creating an airway using the head tilt, chin lift method:

1. Put the palm of one hand over the casualty's forehead and tilt it back.
2. Take the other hand and lift the chin to open the casualty's mouth. This will move the tongue from the back of the throat allowing air to get to the lungs.
3. Pinch the nose with your thumb and index finger on the hand tilting the forehead.
4. Give two breaths into the mouth and watch for the chest to rise. If the chest rises the airway is clear. If the air does not go in, there is an obstruction in the airway.
5. Reposition the head and try again.
6. If there is still an obstruction, commence with chest compressions (sets of 15), checking the mouth for any objects that may have become dislodged after each set.
7. A ventilation attempt should be tried after each set of 15 compressions.
8. Continue with chest compressions (sets of 15) until the airway is clear or until more highly trained help arrives.

## Jaw Thrust Method

If there is a possibility that the casualty has a head or spinal injury, the **jaw thrust** method should be used. Some incidents that may inflict head or spinal injuries include:

- Falls
- Sports injuries (hockey, diving, football)
- Vehicle collisions
- Motorcycle or bicycle crashes

Steps in creating an airway using the jaw thrust method:

1. Grab each side of the jaw with each hand.
2. Use your fingers and pull the jaw forward.
3. Use your cheek or have another person cover the nose and give two breaths.
4. Repeat the same steps as when using the head tilt, chin lift method.

**Stoma:** In rare instances a person may have a stoma. Although stomas are normally associated with colostomies, people who have had cancer or injuries to their pharynx, epiglottis, or other area of the throat may require one. If a casualty has a stoma, breath into the stoma as you would the mouth.

## Rescue Breathing

Once it has been established that the casualty has an airway or if an airway has been created, determine if they can breathe on their own. If they cannot breathe on their own, commence rescue breathing.

**Note:** It is quite possible for a casualty not to be able to breathe on their own but still have a pulse; therefore, DO NOT start chest compressions until it is established that there is no pulse.

Steps to be followed in rescue breathing if the casualty has a pulse:

1. Take a deep breath to fill your lungs with air.
2. Slowly breathe into the casualty. Refer to the steps in creating an airway.

3. Continue for one minute giving approximately 12 breathes – one every five seconds.
4. Reassess the casualty for no more than ten seconds, checking for signs of breathing and a pulse. If there is no pulse, proceed with chest compressions.

### **Chest Compressions**

Chest compressions are used to simulate, as closely as possible, the pumping of the heart. Even the very best external heart massage is inferior to a properly functioning heart muscle; therefore, CPR cannot prolong a person's life for a great deal of time, but will act as an effective bridge until defibrillation.

Steps to be taken when giving chest compressions:

1. Find the casualty's xiphoid process – the spot where the bottom ribs come together at the sternum.
2. Place the heel of one hand one to two inches above the xiphoid process in the center of the chest.
3. Place the other hand on top.
4. Position yourself so that you're over the casualty with your arms locked.
5. Give 15 compressions. Each compression should compress the chest 4 to 5 cm (1.5 to 2 inches).

**Frequency:** The 15 compressions should be done no less than one second apart,

1. After each set of 15 compressions, give a breath to the casualty.
2. After four sets of 15 compressions, check for signs of circulation and breathing.
3. Repeat the sequence as needed.

### **Automated External Defibrillator (AED)**

Dalhousie Security has two AED machines that are located in their vehicles. There is a third AED machine located at the Dalplex. The security staff and the Dalplex staff are all trained in the proper use of the AEDs.