DAN CPR and First Aid (BLS)

Student Handbook

DAN
DIVERS ALERT NETWORK

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This program meets the current (as of December 2020) consensus on Guidelines for Resuscitation from the International Liaison Council on Resuscitation (ILCOR) and as issued by its member organizations including the American Heart Association (AHA), the European Council on Resuscitation (ERC), the Heart and Stroke Foundation of Canada (including the course requirements for CPR-C in Canada), Australia New Zealand Council on Resuscitation (ANZCOR), the Resuscitation Council of South Africa, the InterAmerican Heart Foundation, and the Resuscitation Council of Asia.

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Table of Contents

According to the World Health Organization, cardiovascular diseases are the most common cause of death worldwide and account for about one-third of deaths.[2] As our population ages, the prevalence of these diseases is expected to increase. This program will help prepare participants to handle these events and other life-threatening incidents. The Basic Life Support (BLS): CPR and First Aid provider program is designed to provide course participants with foundational knowledge and teach skills needed to perform cardiopulmonary resuscitation (CPR) and other lifesaving skills.

During this course, participants will become familiar with the signs and symptoms associated with cardiovascular diseases such as heart attack as well as with other diseases and conditions that may also pose an immediate threat to life. Those conditions — such as shock, choking and external bleeding — are included in this course.

The first-aid component of this course addresses additional circumstances and diseases that may require intervention and assistance from emergency medical services (EMS). Successful completion of the BLS: CPR and First Aid course includes demonstration of skill competency and passing a knowledge assessment. Upon completion, you will receive a provider card indicating that you have been trained in basic life support (including CPR) and first-aid measures.

Reading this handbook without instruction and skill practice will not make someone competent to provide CPR or first aid assistance.

First Responder Roles and Responsibility

First aid is providing initial care for an injury or illness. The three key aims of first aid are to (1) preserve life, (2) prevent the condition from worsening and (3) promote recovery.

Since emergency-response skills deteriorate with time, retraining is required every two years to maintain BLS: CPR and First Aid provider certification. In addition, regular practice is encouraged, when possible, to retain skill proficiency. All skills performed in an emergency should be within the scope of one's training.

Course Prerequisites

There are no course prerequisites for participation in the BLS: CPR and First Aid course.

Continuing Education

Continuing education is encouraged in the form of additional training courses, supervised practice sessions, reading current literature and refresher training. Your Instructor can provide information about these programs.

How To Use this Handbook

Each chapter in this student handbook contains two distinct features.

- The beginning of each chapter has a list of questions to assist with learning. This is the information you should look for as you read the material, complete the knowledge development sections, and participate in class discussions.

- Boxes labeled "Note" provide explanations that are important for understanding the material just presented.

This handbook is divided up into two sections. Section 1 is dedicated to CPR, AED and Foreign Body Airway Obstruction (FBAO). Section 2 is dedicated to First Aid and related topics.

Terminology

The BLS: CPR and First Aid student handbook introduces medical terms that may be unfamiliar to some readers. Familiarity with basic medical terminology will enhance the quality of communication with emergency and health-care workers. A glossary of terms is provided in the back of this handbook.

SECTION 1: Basic Life Support

Introduction

The first section of this handbook covers Cardiopulmonary Resuscitation, (CPR), Automatic External Defibrillator, (AED), and Foreign Body Airway Obstruction, (FBAO).

It is designed to be used as the first part of the DAN Basic Life Support and First Aid (BLS) course, or as the material for the DAN CPR course which covers only what is included in this section.

This section covers one- and two-rescuer CPR for Adults, Children and Infants. It also includes use of an AED on adults, children and infants as well as three techniques for assisting with FBAOs.

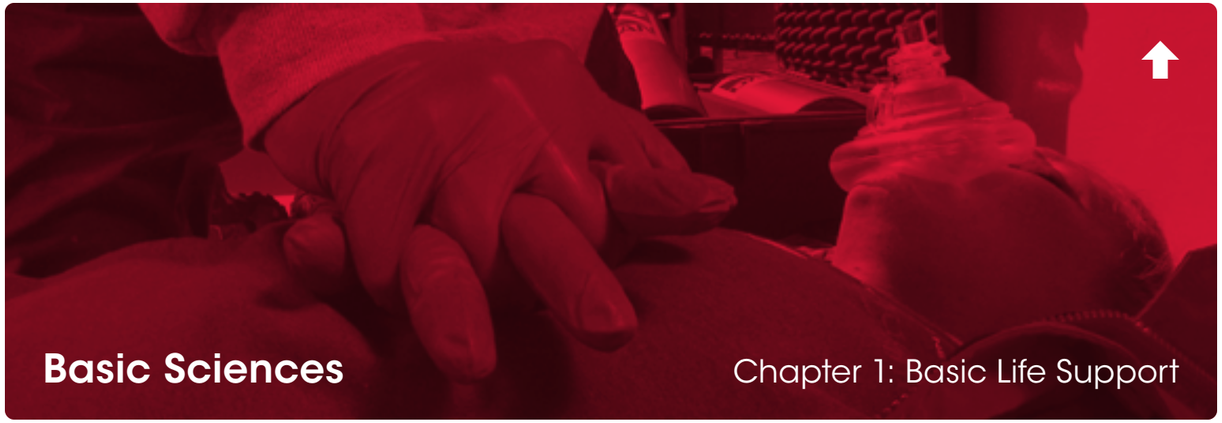
Reading this handbook without instruction and skill practice will not make someone competent to provide CPR or first aid assistance.

Some skills that are covered in this material may not be allowed or have other restrictions in your region. Your DAN Instructor will advise you of any of these restrictions. You will still be responsible for the academic content on the final exam.

After you have completed the required e-learning and the skills-development portion of the course with your DAN Instructor, your instructor will process your credentials. You can find your credential card(s), in your e-learning profile at dan.diverelearning.com under the “completed” tab, by selecting the course you want. There you will see a grey ‘course record’ box with information about your course. To the right of that grey box you will see your credential card. You can click on that image and then either print it or save it as an image file. If your course is approved by the United States Coast Guard, there will also be a wall certificate available.

Your credentials are good for two years from the approval date. It is recommended you are retrained prior to your credential expiration to keep your skills proficient.

Thank you for taking this DAN course and your support of DAN – your dive safety organization!



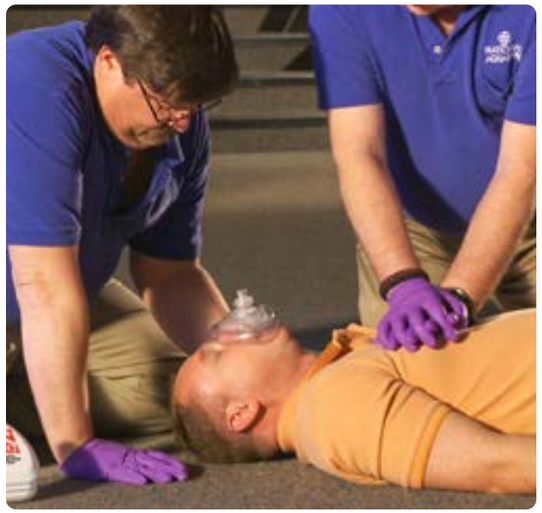
Basic Sciences

Chapter 1: Basic Life Support

Objectives

1. What is the goal of CPR?
2. Why is asking permission necessary before rendering care?
3. What are the six links in the chain of survival in the proper sequence?
4. What is the first step for a rescuer once unresponsiveness has been established?
5. What are the warning signs of heart attack?
6. What is the first step for a rescuer if the injured person is a child, infant or the victim of a drowning incident?
7. What CPR protocol is to be followed for drowning victims?
8. What can a rescuer do to deal with emotional stress?

Maintenance of tissue oxygen supply is vital for life. While establishing and keeping an open airway is a critical step when caring for an unconscious or nonbreathing person, initiating and maintaining circulation with chest compressions is the primary step. Airway obstruction impedes or prevents oxygen delivery to the lungs, which then prevents delivery to the blood and subsequently to tissues.

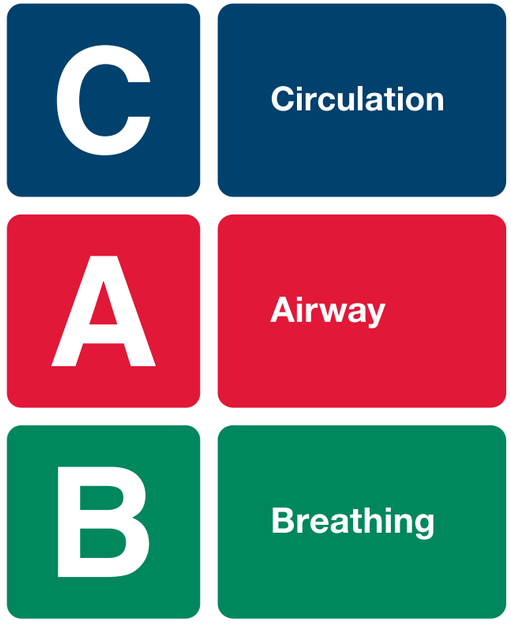


When oxygen supplies are interrupted, our organs will suffer and eventually die. Without oxygen, specially vulnerable tissues such as the brain may start dying after 4-6 minutes. The need for immediate action is therefore crucial.

During CPR, rescuers provide and maintain blood circulation with chest compressions, while ventilations provide oxygen. Key steps in CPR for the rescuer include the following:

1. Check for responsiveness, and activate emergency medical services (EMS).
2. Check for pulse and normal breathing (approximately 10 seconds).
3. If the person is not breathing normally and a definite pulse is not felt, provide chest compressions to temporarily take over the function of the heart and circulate blood.
4. Open the airway, and provide rescue breaths to deliver air to the lungs.

During CPR, rescuers provide and maintain blood circulation with chest compressions, while ventilations provide oxygen. The goal of CPR is not to restart the heart but to provide critical blood flow to the heart and brain and to keep oxygenated blood circulating. CPR delays damage to vital organs such as the brain and improves the chances of successful defibrillation.



Note:
The exhaled air used during rescue breathing contains about 16 percent oxygen compared with 21 percent in room air. Despite this reduction in oxygen concentration, ventilations still provide adequate oxygen supplies to sustain vital organs.

Also worth noting is the difference between sudden cardiac arrest (SCA) and myocardial infarction (MI), or heart attack. Sudden cardiac arrest, as its name implies, is sudden and can happen without warning or may be preceded by brief generalized seizures. In this circumstance, the heart has either completely stopped or is in a dysrhythmia such as ventricular fibrillation that cannot support life. Check for normal breathing once seizure activity has stopped and activate EMS. Initiation of CPR and implementation of an AED, if available, is critical.

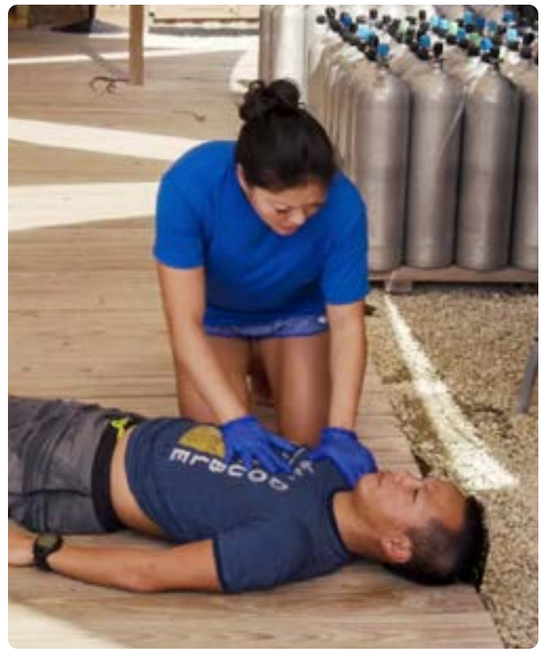
Heart attacks are serious cardiac events as well but may not result in unresponsiveness or the need for CPR. For an individual experiencing a heart attack, activate EMS and monitor the person continuously. Be prepared to initiate CPR if the individual loses consciousness.

Duty of Care

As a potential volunteer first responder, you have no legal obligation to provide medical care. In some areas, however, you may have an obligation to notify authorities that someone is in need of medical assistance. If you engage in basic life support, be sure to provide care within your scope of training.

Ask an individual for permission before you provide care. This can be done by saying: "My name is _____, and I am a first-aid provider. May I help you?"

If responsive, the individual should give permission before care is provided. Not asking for permission or forcing care against a person's will exposes you to potential legal action for involuntary assistance or battery. If a person is unresponsive, permission to provide medical assistance is implied.



Precipitating Conditions

The need for CPR and other basic life-support measures frequently involves the following conditions. Other conditions may also precipitate a need for life support, but those conditions are not covered here. Awareness that something is wrong is the primary concern.

Heart Attack

A heart attack — acute myocardial infarction (AMI) or acute coronary syndrome (ACS) — is the term used to describe the symptoms associated with blockage of the arteries that supply the heart. If the heart attack is severe enough to cause the heart to stop functioning or to stimulate a life-threatening arrhythmia, first responders may need to initiate CPR and use an automated external defibrillator (AED).

When someone suffers a heart attack but is still conscious and breathing, your role is more supportive. In this situation, keep the person in a position of comfort, and activate EMS. Some people with a history of heart problems may carry nitroglycerine, which is available as either pills or a sublingual spray. You may need to assist the person with taking his own medicine, but do not attempt to give nitroglycerine to anyone who doesn't have a prescription. When assisting someone with nitroglycerine, do not handle the pills with bare hands because the medication can be absorbed through the skin. Nitroglycerine is administered under the tongue to be absorbed and not swallowed. It can be administered as frequently as every five minutes for a total of three doses. Do not administer more than three doses, regardless of the person's condition.

Note:
Health-care providers acting in the capacity of their profession may have a legal duty to respond. Other professionals such as dive instructors or dive-safety team members may also have a duty to respond.

Not all heart attacks are painful, and there are many variables to look for with heart conditions.

Possible symptoms of heart attack:

- Heavy pressure or squeezing pain in the center of the chest or center of the back
- Shoulder, arm, neck or jaw pain
- Shortness of breath
- Nausea and vomiting
- Indigestion, heartburn
- Sense of impending doom
- Sweating

Symptoms vary between men and women as well as among individuals with preexisting medical conditions.

Note:
The term “massive heart attack” is often used to describe a sudden cardiac arrest.

Special Circumstances with Resuscitation

Pregnancy

While cardiac arrest is rare in pregnant women, it appears the rate may be increasing for women who are in the second half of pregnancy. There are several potential causes, but these are irrelevant to the first aid responder. To perform effective compressions when the top of the uterus is above the mother’s umbilicus, the recommendation is to manually displace the uterus to the mother’s left to reduce the uterus’ direct compression on the large blood vessels returning to the heart while compressions are performed. For quality compressions to be delivered, a second rescuer is required. Activate EMS immediately regardless because additional measures will be required in a hospital setting.

Opioid Overdose

In 2012 opioid overdose became the leading cause of death for people 25-60 years of age in the United States. Most of these deaths are associated with prescription medications. Because of its presentation, opioid overdose can be confused with unconsciousness and can be difficult to ascertain as the cause. An opioid overdose progresses from central nervous system (CNS) depression to respiratory arrest to cardiac arrest. For first aid purposes, this situation is referred to as an opioid-associated life-threatening emergency. Naloxone is a medication that interferes with the action of opioids in the brain, spinal cord and gastrointestinal system. Because there are no known harmful side effects when this medication is used with or without opioid intoxication present, the U.S. Food and Drug Administration has approved a naloxone auto-injector as well as an inhaled nasal mist for use by lay rescuers in the first-aid setting.

As with all life-threatening emergencies, check to see if the person is breathing or gasping. Begin CPR if the person is not breathing or is gasping. If naloxone is available, administer 0.4 mg with an auto-injector, and continue CPR. The dose may be repeated every four minutes. Watch for the individual to become responsive with purposeful movement or regular breathing.

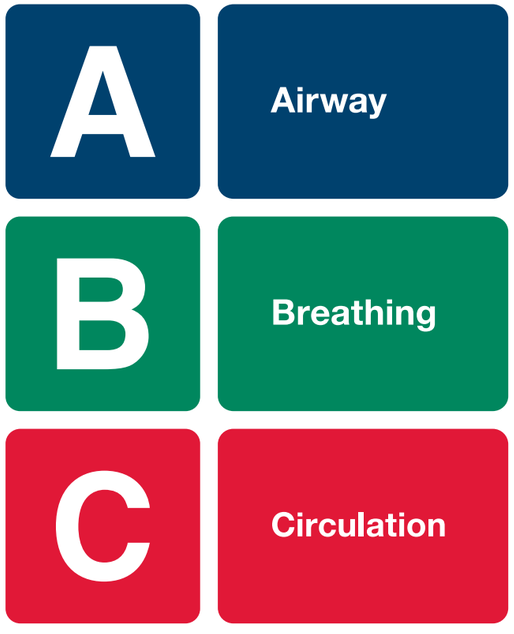
Continue to monitor breathing and responsiveness until EMS arrives. Resume CPR if the person’s condition relapses, and administer additional doses of naloxone. If the individual does not respond, continue CPR, and verify that EMS is on the way.

Drowning

Drowning is defined as submersion/immersion in a liquid that impairs respiration and can be fatal or nonfatal. In the event the heart stops or experiences an arrhythmia due to submersion with a resulting loss of circulating oxygenated blood, immediate intervention with CPR can provide the individual with the support necessary for survival. Multifaceted medical intervention is required, however, so CPR alone is usually not sufficient. As with heart attacks, CPR for a drowning victim is merely the aid that facilitates access to advanced care.

After determining unresponsiveness of a drowning victim, initiate CPR with rescue breaths (not compressions). This protocol, with the acronym A-B-C, is used due to the hypoxic condition of drowning.

Perform CPR for two minutes, then activate EMS if not already done. Continue CPR with two rescue breaths followed by 30 chest compressions.



Compression-only CPR is not appropriate in this circumstance.

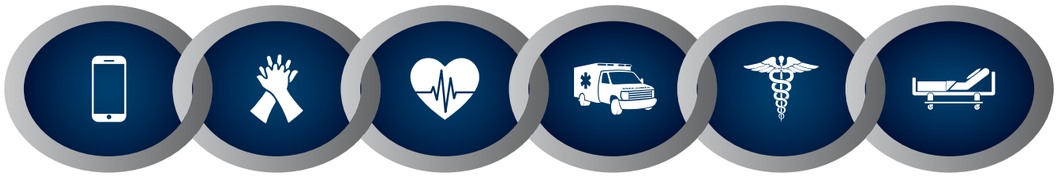
Nonfatal drowning refers to a situation in which someone almost died from being submerged and unable to breathe. While nonfatal-drowning victims may revive quickly, lung complications are common and require medical attention.

Symptoms of nonfatal drowning may include difficulty breathing, bluish discoloration of lips, abdominal distention, chest pain, confusion, coughing up pink frothy sputum, irritability and unconsciousness. Individuals may also be anxious or cold and would benefit from removal of wet clothes and possible treatment for hypothermia.

As a first responder, your primary role is to monitor vital signs and be prepared to start CPR, provide supplemental oxygen and transport the person to the nearest medical facility as soon as possible.

Chain of Survival

There are six key steps in the chain of survival.



Immediate Recognition and Activation of EMS

In the event of an emergency, the critical first step is recognizing that an emergency exists. Follow recognition of a medical problem with prompt action. Responses include evaluating the severity of the emergency, assessing available resources and utilizing those resources. After establishing unresponsiveness, call EMS. By activating local EMS, the chance of survival increases. Either call EMS yourself, or ask a bystander or other rescuer to do it.

If you are alone, EMS can be activated utilizing your cell phone on speaker setting. This practice minimizes lost time and can reduce any delays that otherwise may occur in starting CPR. If you are not alone, have someone else activate EMS while you begin CPR.

There are two scenarios in which the solo rescuer should initiate CPR before activating EMS:

- Child or infant injured/ill person
- Drowning victim

In these cases, the cause of cardiac arrest has a high probability of being respiratory rather than cardiac in origin. If a cell phone is unavailable, the lone rescuer should perform two minutes or five cycles of CPR before calling for help. This slight alteration in procedural order is recommended because infants, children and drowning victims may spontaneously recover if CPR is initiated immediately. In contrast, acute coronary syndromes (heart attacks) often cause unstable heart rhythms that respond best to rapid defibrillation. Since most people do not have AEDs readily available, getting a defibrillator and advanced medical care (EMS) on the way provides the best chance of reestablishing a life-sustaining heart rhythm. Do not delay CPR for an AED if one is not immediately available. Regardless of who calls EMS, the person relaying information to them should state the following:

- Caller's name
- Exact location
- Call-back phone number
- Number of injured persons
- Condition of the injured person(s)
- What happened
- Care provided

Do not hang up until the operator releases. It is important to answer all dispatcher questions to assure an appropriate response team and resources are sent to the site. The operator may repeat critical information before ending the call, which ensures that the message was received and key facts were conveyed. If someone else is calling EMS, be sure to have that person return to the scene after making the call to verify that help is on the way.

Remember, the sooner you make the call, the sooner advanced life support will arrive.

Rapid Initiation of High Quality CPR

Early CPR significantly improves the chance of survival. Chest compressions temporarily take over the function of the heart, manually circulating blood in the body. Rescue breaths deliver air to the lungs and ensure a supply of oxygen for the body, especially in critical areas such as the heart and brain. Rescuers should initiate CPR within 10 seconds of recognizing cardiac arrest.

Early Defibrillation

Cardiac arrest often results from a non-life-sustaining rhythm known as ventricular fibrillation (VF). This rhythm disturbance results in the cessation of blood flow to vital organs and therefore is life-threatening.

Defibrillation, the process of delivering an electrical shock to the heart in an attempt to establish a normal cardiac rhythm, is the single most important intervention in the case of an unstable cardiac rhythm. It provides the greatest chance of survival. While CPR will not restart the heart, it may delay tissue damage associated with inadequate oxygen supplies while waiting for an AED to arrive.

It is crucial to defibrillate a person with suspected sudden cardiac arrest as soon as possible. Delays of as little as 7-10 minutes greatly reduce the chance of survival.

Advanced Cardiac Life Support

CPR and defibrillation may not restore a normal cardiac rhythm. In those cases, medical interventions such as advanced airway management and the delivery of medications may increase resuscitation success. Should CPR and/or defibrillation be successful, advanced life support will

help stabilize the person and make the patient ready for hospital transport. Remember: Advanced cardiac life support will not arrive until local EMS is activated.

Post-Cardiac-Arrest Care
If a spontaneous heart rhythm resumes and effective circulation is restored, the individual still requires supportive care and immediate medical attention. Maintain airway support, and continually monitor the individual until help arrives to provide additional care and transportation to a hospital. Unstable heart rhythms that can lead to unconsciousness or death may recur without warning.

Recovery
Recovering from a cardiac arrest is a long-term process. Support for cardiac arrest survivors includes mental and emotional well-being as well as support for the physical healing processes. This support begins while the survivor is still hospitalized but needs to continue after discharge to assure a return to normal social functioning.

Emotional Stress and Fear of Doing Something Wrong

Helping others in need gives you a good feeling, but it might also create emotional stress before, during and after the rescue.

When a person has an accident or is in sudden cardiac arrest, bystanders commonly wait for someone to take charge and provide aid.

Hesitation is often caused by:
- Fear of doing something wrong, causing harm or not being able to bring back life
- Fear of being sued
- Fear of infection (The next section instructs how to avoid infection.)

Anxiety is a normal emotion for both the rescuer and an injured or ill person during an emergency. Some potential rescuers may avoid such situations to avoid making mistakes or providing imperfect care. On the whole, providing some care (even if not "perfect") is a much more effective approach than providing no care at all.

The hard truth regarding cardiac arrest is that in most cases CPR, even when coupled with advanced techniques, does not restart the heart or restore a life-sustaining rhythm — even when performed perfectly. CPR increases the chances of survival but does not guarantee it.

Unsuccessful rescues may cause emotional distress. Rescuers may blame themselves for not saving a life and/or think they did something wrong. Some rescuers may benefit from a critical-incident debriefing or professional counseling to help work through such concerns.

A key point to remember if you ever have to perform CPR is that a person in cardiac arrest (with no signs of life) is in the worst possible condition. If no one initiates CPR, someone in cardiac arrest is certain to die; you cannot make them any worse. CPR is a critical link in the chain of survival.

Review Questions

1. The goal of CPR (without defibrillation) is to maintain adequate circulation of oxygenated blood to vital organs such as the
   a. spleen, pancreas
   b. stomach, kidney
   c. heart, brain
   d. liver, muscles

2. Exhaled air contains about 10% oxygen
   a. True
   b. False

3. To avoid legal problems, always ask the person for _____ before you provide first aid. This may be done by stating: _____
   a. permission, "My name is… I am a first aid provider. May I help you?"
   b. autograph, "My name is… I am a first aid provider. May I help you?"
   c. certification card, "My name is… I am a first aid provider. May I help you?"

4. What CPR protocol should be used when responding to a victim of drowning?
   a. A-B-C
   b. B-A-C
   c. C-A-B
   d. C-B-A

5. The six links in the chain of survival in correct order are:
   a. 911, CPR, AED, Advanced Cardiac Life Support, Post Cardiac Arrest Care, Recovery
   b. CPR, 911, AED, Advanced Cardiac Life Support, Post Cardiac Arrest Care, Recovery
   c. AED, Advanced Cardiac Life Support, Post Cardiac Arrest Care, 911, CPR, Recovery
   d. Post Cardiac Arrest Care, Advanced Cardiac Life Support, 911, CPR, AED, Pay the bill

6. When calling EMS you should tell them:
   a. what happened and the condition of the injured person
   b. the location of the emergency and a call-back number
   c. how many persons are involved
   d. your name and the first aid provided
   e. all of the above

7. During CPR, the functions of the heart and lungs are temporarily taken over by
   a. chest compressions and ventilations
   b. cardiac defibrillation and an oxygen bottle
   c. advanced medications and ventilator machines

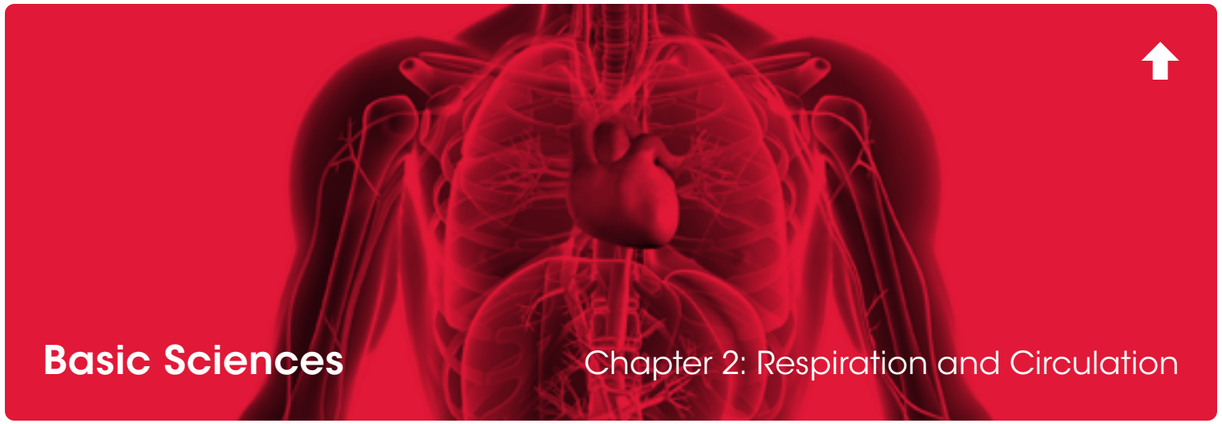
8. Heart attack symptoms may
   a. vary between men and women
   b. differ in individuals who have preexisting medical conditions
   c. include heavy pressure or squeezing in the center of the chest or back
   d. include nausea and vomiting
   e. all of the above
   f. only c. and d.

9. In most cases, the heart restarts aftersome one performs CPR.
   a. True
   b. False

10. In the case of children and drowning victims, once unresponsiveness has been established, the single rescuer should:
    a. check for injuries
    b. check the mouth for foreign bodies
    c. activate EMS
    d. perform CPR for 2 minutes and then call EMS

11. Emotional stress may occur before, during or after a rescue.
    a. True
    b. False

Review answers are on Page 62.



Basic Sciences

Chapter 2: Respiration and Circulation

Objectives

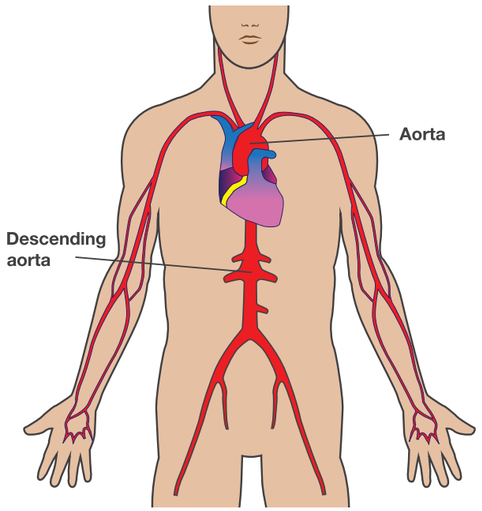
1. What is hypoxia?
2. Why is oxygen necessary for life?
3. Where does gas exchange occur in the body?
4. What body structures comprise the respiratory system?
5. What body structures are included in the cardiovascular system?

It has already been noted that CPR takes over the function of the heart and lungs when someone is in cardiac arrest. A basic understanding of respiration and circulation is beneficial to understanding how CPR can help as well as the impact of injury first aid.

Cardiovascular System

The cardiovascular system includes the heart and blood vessels. It is a closed-circuit system with the primary purpose of pumping blood, transporting oxygen and nutrients to tissues and removing waste products.

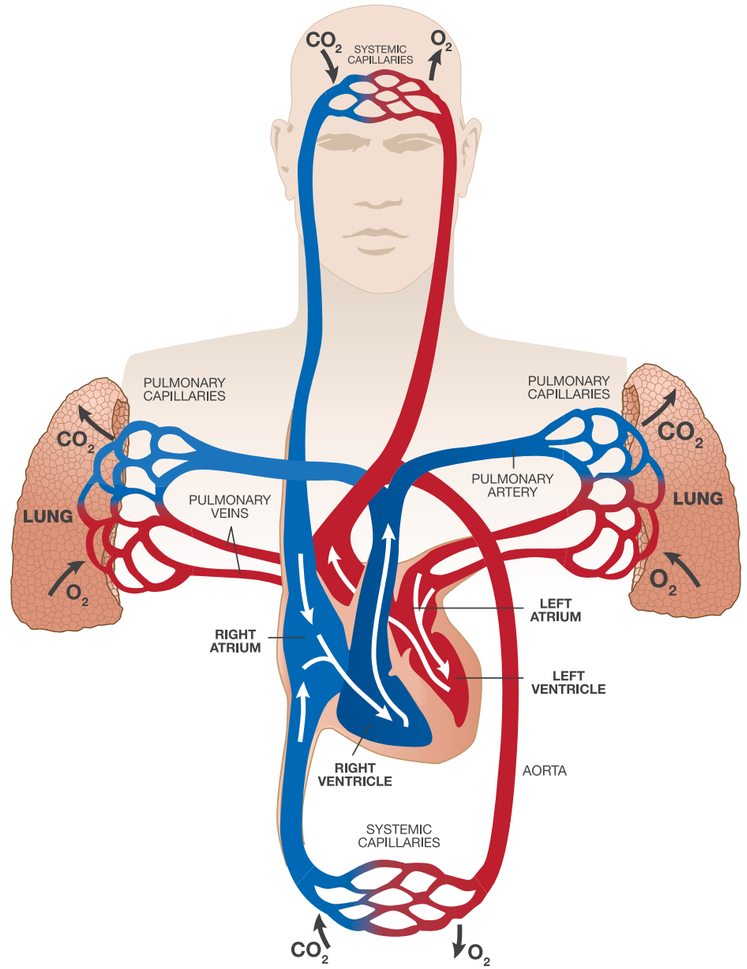
The heart is a hollow muscular organ situated in the thoracic cavity between the lungs in a space called the mediastinum. A thin connective tissue sac called the pericardium surrounds it. The pericardium reduces friction between the heart and surrounding structures.

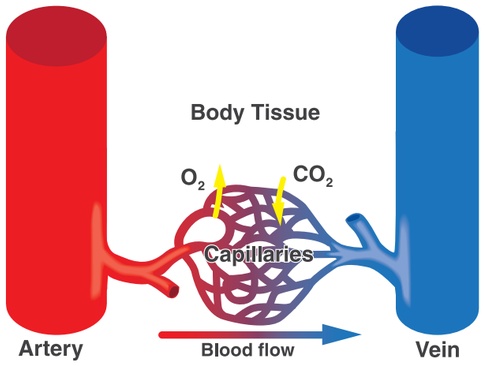


The heart is a strong muscular pump that, in the average adult, has the capacity to beat spontaneously at a rate of about 70 times per minute (the normal resting heart rate is 60-100 beats per minute and may be as low as 40 beats per minute in athletes[4]). Every minute approximately 6 liters (about 1.5 gallons) of blood is pumped throughout the body. When exercising, this output may double or triple depending upon the amount of exertion.

The heart is divided into a right and left pump system (also known as the right heart or pulmonary circuit and the left heart or systemic circuit). The right heart receives deoxygenated blood from the venous system and pumps it to the pulmonary circuit to exchange gases. Oxygenated blood is returned to the left heart, where it is pumped to the systemic circuit.

Transportation of blood through both circuits completes a circulatory cycle. Blood leaves the left ventricle via the aorta, which then branches into smaller arteries to supply the head, arms, torso and legs. The blood vessels make up the vascular tree, with each branch leading to progressively smaller branches, which give rise to capillaries, the smallest of





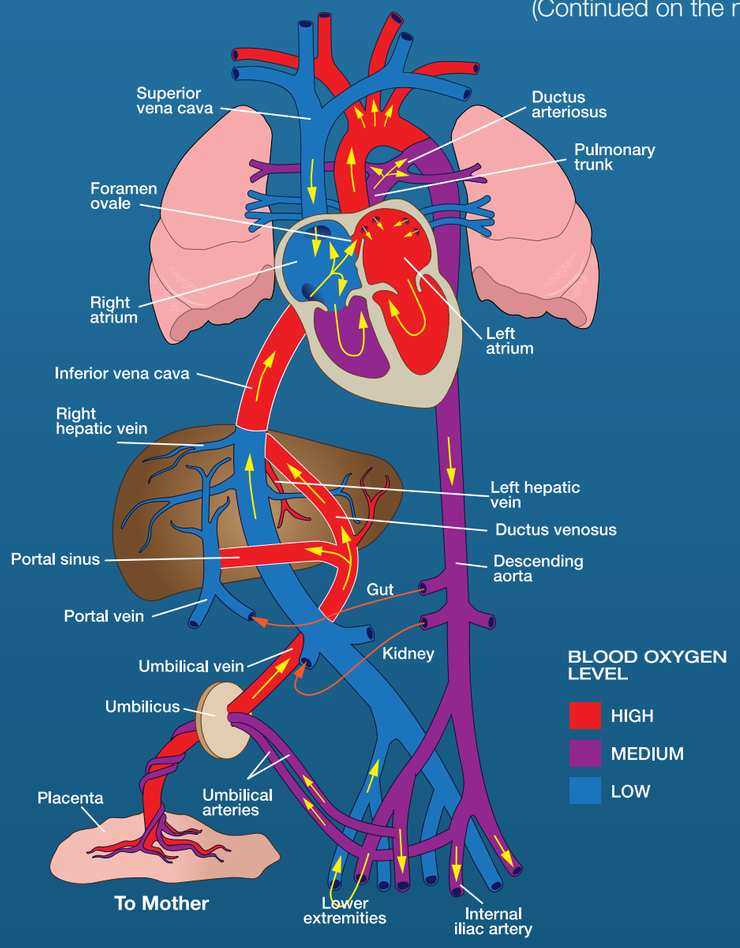
all blood vessels. Through these thin capillary walls, gases, nutrients, and metabolic waste products are
exchanged. Functionally, the heart and large blood vessels represent a pump and distribution system for the
capillaries, which are responsible for supplying tissues with oxygen and

Advanced Concepts

Fetal Circulation

Within the uterus, the fetus lives in a fluid-filled environment. As such, the lungs are not used for gas exchange, and circulating blood is largely shunted away from pulmonary tissue. In the fetus, gas exchange takes place in the placenta, drawing available oxygen from the mother's blood.

(Continued on the next page.)



Fetal Circulation (Continued)

Two unique passages in the fetal circulation allow blood to bypass the lungs. These two portals, known as the ductus arteriosus and foramen ovale, usually close soon after birth with the baby's first breaths.

The ductus arteriosus (a duct between two arteries) enables blood coming from the right ventricle to directly enter the aorta and thus bypass the lungs. Once this passage closes, blood is transported to the lungs, which are now needed for blood oxygenation. A vestige (remnant) of the ductus will remain as a ligament bonding the aorta and the pulmonary artery (ligamentum arteriosum or arterial ligament).

The foramen ovale (an oval-shaped hole) is a passage between the atria that allows blood to shunt from the right atrium to the left, thus bypassing the nonfunctional lungs. At birth, when the pressures in the left atrium increase, this passage usually closes, leaving only a depression in the wall, known as the fossa ovalis. Closure of the foramen is incomplete in approximately 25-30 percent of the population, thus leaving a patent (open) foramen ovale (PFO). The PFO is not physiologically relevant in many persons, but it may predispose a small number of people to certain medical issues.

nutrients and removing CO_2 and other metabolic waste products. From the peripheral capillaries, the blood is gathered into small, thin walled veins and returned via larger veins to the atria of the heart. Most veins direct blood flow by means of one-way valves that prevent blood from traveling in the wrong direction or pooling due to gravity.

Respiratory System

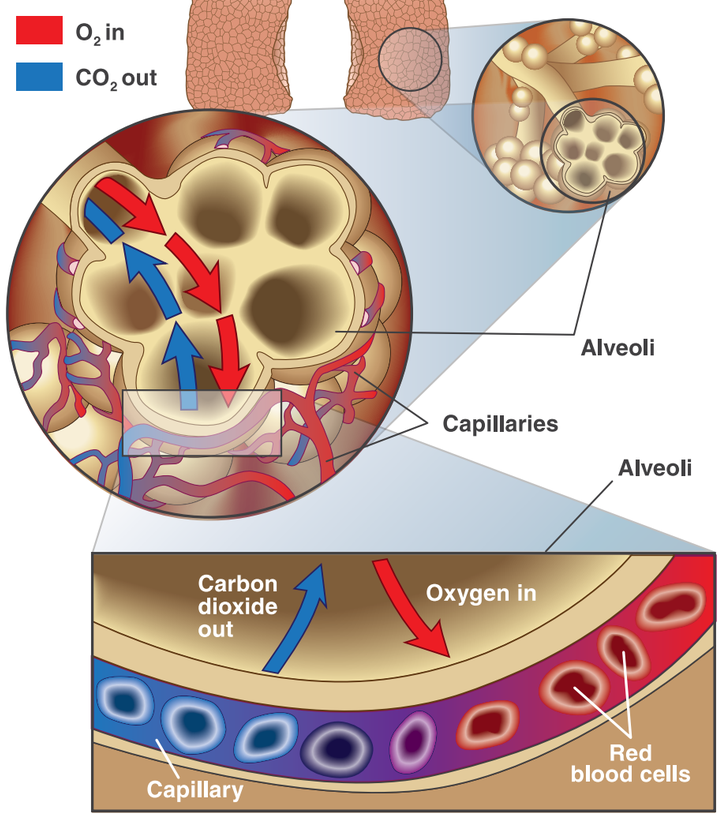
The respiratory system is comprised of the upper airways (mouth, nose and pharynx), the trachea (windpipe) and the lungs. Key supporting structures include the chest wall (ribs and intercostal muscles) and diaphragm (a muscle critical to respiration that separates the thorax from the abdomen). Surrounding the lungs and lining the inside of the chest wall is a thin membrane called the pleura. Although this is one continuous membrane, its coverage of both the lungs and chest wall forms a double layer. Between these two pleural membranes is a potential space that contains a thin layer of fluid that acts as a lubricant, allowing efficient movement of the lungs during breathing. Air is drawn into the mouth and nose and passes into the pharynx. The pharynx divides into two distinct passages: the trachea and the esophagus.

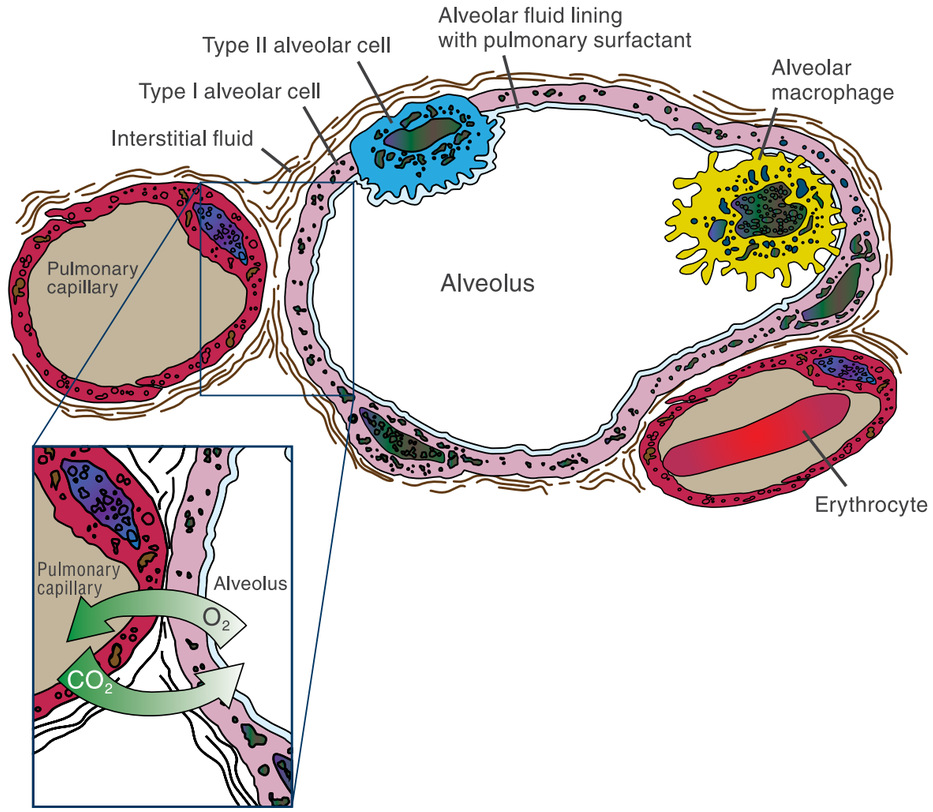
The opening to the trachea is protected from food (solids and liquids) during swallowing by a flexible flap of tissue called the epiglottis. The esophagus, located behind the trachea, is a conduit for food and fluids en route to the stomach. It is the proximity of these two structures that makes appropriate lung volume during CPR critical.

Overventilation can lead to stomach distention and regurgitation of stomach contents. If this happens, stomach contents can enter the lungs and compromise recovery.

In contrast to solids and fluids, air travels from the pharynx through the larynx (voice box) and into the trachea. The trachea consists of a series of semicircular cartilaginous rings that prevent collapse. The trachea passes down into the chest cavity and branches into the right and left bronchi, which enter the right and left lungs, respectively. The bronchi progressively divide into smaller and smaller tubes and finally into the alveoli. This branching pattern is commonly referred to as the bronchial tree.

The alveoli, located at the end of the smallest branches of the bronchial tree, have extremely thin walls and are surrounded by the pulmonary capillaries. The alveoli have been likened to tiny balloons or clusters of grapes. In both lungs, millions of alveoli cover a combined surface area of around 750 square feet (70 square meters) — roughly the size of a tennis court. The average adult alveolus has an estimated diameter of 200-300 micrometers and is only a cell layer thick. Alveoli lie adjacent to capillaries that are also one cell layer thick, and this proximity enables the rapid exchange of CO_2 and O_2. The thin alveolar-capillary membrane separates the content of the lung from the bloodstream. If this membrane tears or becomes compromised due to trauma, it may enable gas to pass out of the alveoli and into the bloodstream. Gas entering the vascular system can travel throughout the body, even air bubbles.





Review Questions

1. The respiratory system includes the:
   a. heart, lungs, brain
   b. arteries, spinal cord, nose
   c. nose, trachea, lungs
   d. bones, muscles, skin

2. The cardiovascular system includes the:
   a. veins, arteries, heart
   b. mouth, lungs, stomach
   c. skin, bones, muscles
   d. nose, lungs, pharynx

3. Gas exchange takes place at the
   a. vein-artery interface
   b. long bone joints
   c. alveolar-capillary membrane
   d. muscle-nerve junctions
   e. lungs

Review answers are on Page 62.

Response & Assessment

Chapter 3: Scene Safety Assessment

Objectives
1. What is S-A-F-E?
2. What are some hazards that need to be assessed before providing first aid?
3. Why is exposure protection critical for rescuers?
4. What are some examples of personal exposure protection equipment?

Rescuer safety comes first. The ability to provide first aid is impaired if the rescuer is injured when approaching an individual or rendering care. Taking the time to assess the scene and circumstances surrounding the individual may prevent compromising the rescuer and causing further injury to the individual. Before providing assistance, assess the scene, and take steps to avoid or remove any sources of potential injury.

ANZCOR Guidelines utilize DRS ABCD.
D - Check for DANGERS to you, bystanders, and the injured/ill person.
R - Is the injured/ill person conscious?; do they RESPOND?
S - SEND for Help (Activate EMS and answer questions from the dispatcher)

A - Is the AIRWAY open and clear?
B - Is the injured/ill person BREATHING?
C - Begin CPR if the injured person shows no signs of breathing or circulation
D - DEFIBRILLATE with an AED

Note: This reflects an ABC protocol versus the CAB protocol currently used in most of the world.

Scene Safety Assessment

Before providing aid, take a moment to remember the mnemonic S-A-F-E.

S-A-F-E is a reminder to:

- ***Stop:*** Take a moment to think and then act.
- ***Assess*** the scene: Before assisting another person, determine if the scene is safe.
  Dangers may include:
  - — fire
  - — chemicals
  - — electricity or gas
  - — traffic
  - — animals (tentacles from a jellyfish or a pet that feels threatened)
- ***Find*** your first aid kit, oxygen unit and AED.
- ***Exposure*** protection: Avoid contact with blood and other body fluids.
  - — Locate and don barriers such as gloves, eye shields and resuscitation masks.

Risk of Infection

Anyone in a position to provide medical care may come in contact with body fluids or other potentially infectious tissue. Personal protection is a critical aspect of first aid and should be exercised in all situations and for all people — this is the principal of standard precautions.

For individuals who may provide CPR and first aid as part of their work-related duties, the U.S. Occupational Safety and Health Administration (OSHA) has created a bloodborne pathogen standard to help minimize exposures. This standard addresses the immediate safety of those who may come in contact with human blood, body fluids, body tissues, human waste, vomitus or organs. If you believe you potentially have been exposed to a bloodborne pathogen through an open wound, follow these steps:

- Do not milk the wound to make it bleed
- Wash the wound with soap and water
- For splashes in your face, flush potentially contaminated material from the mucous membranes of your eyes, nose and mouth, using large amounts of running water
- Wash potentially contaminated material off your skin as quickly as possible with soap and water. This is especially important when your skin has cuts, rashes or scrapes.
- Seek medical evaluation and counseling regarding exposure at a local medical facility (emergency department). If the incident occurred in the course of work activity, report the exposure immediately to your supervisor, and follow your employer's exposure control plan. There are three main bloodborne infection concerns: viral hepatitis types B and C and human immunodeficiency virus (HIV).

Hepatitis B

Hepatitis B virus (HBV) attacks the liver and may cause both acute and chronic disease. Those infected with the HBV are themselves potentially infectious.[9] Fewer than 5 percent of otherwise healthy people infected with HBV as adults will develop chronic liver disease. The percentage is higher in children infected before age 5. Roughly 20 to 30 percent of adults with chronic infections will develop cirrhosis and/or liver cancer.

- **Transmission**. HBV is transmitted via blood and other bodily tissues including blood transfusions, needle sticks, tattooing and piercing, as well as intravenous drug use and sexual intercourse (vaginal fluids and semen). HBV is very contagious; one in three people exposed to the virus from a puncture wound with a contaminated object will become infected. The virus is also very stable on surfaces outside the body. It can last for up to seven days, making decontamination and clean up very important. There is a vaccine available for HBV that is 98-100% effective and is required of most health care workers.

- **Symptoms**. Most people do not experience symptoms when newly infected. Acute symptoms can last for several weeks. Symptoms may include:
  - – Yellowing of the skin and eyes (jaundice)
  - – Extreme fatigue
  - – Dark urine
  - – Nausea and vomiting
  - – Abdominal pain

  For some people, symptoms may persist for several months or up to a year.

Hepatitis C

Hepatitis C virus (HCV) is another bloodborne pathogen that can cause severe liver damage. Of those infected with HCV, about 30 percent of infected people spontaneously clear the virus in six months without treatment. Antiviral medications cure more than 95 percent. The remainder have a 15 to 30 percent risk of developing cirrhosis within twenty years.[10]

HCV may cause a relatively mild acute illness or jaundice. Approximately 80 percent of people do not exhibit symptoms, and symptoms may take 2 weeks to 6 months to manifest. Acute symptoms are similar to those of Hepatitis B. Even chronic disease may remain asymptomatic.

- **Transmission**. Routes of transmission/infection are the same as for HBV. The most common source for infection is seen in people who share injection equipment or reuse needles. HCV has also been contracted from blood transfusions (prior to July 1992), needle sticks in health care settings and through sexual intercourse.[10]

- **Symptoms**. People infected with HCV are potentially infectious even if asymptomatic.

Symptoms for HCV include:
- Fever
- Fatigue
- Decreased appetite
- Nausea and vomiting
- Abdominal pain
- Dark urine
- Gray colored feces
- Joint pain
- Yellowing of skin and eyes (jaundice)

HIV/AIDS[11]

The human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), attacks the immune system and impairs the body's ability to fight infections.

- **Transmission**. HIV can be transmitted from person to person through contact with infected blood and bodily fluids, including breast milk. HIV cannot be transmitted through casual contact. A puncture-wound exposure from an infected source has an infection risk of 1 in 300. There currently is no immunization or known cure for HIV. However, treatments are available that have been successful in suppressing the virus, reducing its transmission.

- **Symptoms**. People infected with HIV may remain asymptomatic for 2 to 15 years years but can still pass the infection to others. Most infected people develop antibodies within 28 days. Once infection has been confirmed, retesting and treatment options should be pursued.

Some of the potential signs and symptoms of infection include:

The first few weeks after initial infection may be characterized by influenza-like illness including fever, headache, rash or sore throat.

As the infection progresses symptoms may include:
- Swollen lymph nodes
- Weight loss
- Fever
- Diarrhea
- Cough

Standard Precautions

The first-aid provider must be aware of possible disease transmission. Blood, semen and vaginal secretions have the highest risk of transmitting bloodborne pathogens. Saliva, sweat, urine and feces have a lower risk. Casual social contact will not transmit these infections.

When providing care to an injured person, be aware of any active bleeding, and protect yourself from possible exposure. Use appropriate personal protective equipment (PPE), including nonlatex gloves, face shields, protective eyewear and ventilation masks. In some instances you may consider gowns for added protection. Many employers provide PPE in locations where high-risk exposures are likely.

Additional safety precautions

- Avoid contaminated sharp objects such as needles or scalpel blades. Promptly dispose of sharps in an approved container after use.
- Thoroughly wash hands after providing first aid

Note:
In the event of an accidental needle stick or cut from a potentially infected sharp, immediately wash the area with copious irrigation and warm soapy water. Further medical attention is warranted to determine if an infection occurred.

Responsibility for standard precautions lies with the rescuer. To minimize your risk, carry protective barrier devices in every first aid kit. Gloves should be a standard part of your emergency response kit and should be donned before providing care. Replace them if they become torn, punctured, contaminated or compromised.

When removing gloves, avoid contact with the contaminated exterior of the gloves. Remove them in a manner that keeps the outer surfaces of the gloves from touching your bare skin. The skills-development section provides details about how to remove gloves safely.

Note:
Gloves protect a rescuer but may become contaminated while providing aid. Be careful to avoid skin contact with bodily fluids when removing gloves.

Contaminated Water and Chemicals

Exposure to contaminated water and chemicals is a common risk faced by some professional divers, including commercial and public safety divers; this requires specialized training that is beyond the scope of this course.

Hazardous-material and contaminated-water training is available through emergency and disaster training agencies. A number of resources are provided in the back of this book for those interested or in need of this kind of training.

Whatever care you provide, particularly as it relates to emergency and disaster response, act within the scope of your training and preparation and with the appropriate equipment.[6] Do not put yourself in danger.

Review Questions

1. Potential hazards that should prompt caution when approaching the scene of an accident include:
   a. fire and animals
   b. expired first aid certifications
   c. electricity, gas and traffic
   d. a and c

2. The S-A-F-E mnemonic helps us remember
   a. to activate EMS
   b. scene safety assessment
   c. to use personal protective equipment
   d. b and c
   e. none of the above

3. Personal protective equipment is a critical part of keeping yourself safe while providing care.
   a. True
   b. False

4. Protective equipment includes:
   a. nonlatex gloves
   b. eye shields
   c. resuscitation masks
   d. all of the above

5. When removing gloves after providing first aid, it is important to keep the outer surface of the glove from touching your skin.
   a. True
   b. False

Review answers are on Page 62.

Response & Assessment

Chapter 4: Initial Assessment and Positioning for Care

Objectives
1. What are the steps to the assessment sequence?
2. How is a pulse located on an adult, a child and an infant?
3. What technique assists the rescuer in placing an unresponsive person on his back?
4. What is agonal breathing?
5. When should the recovery position be used?
6. When should the recovery position not be used?

The initial assessment sequence consists of these primary steps:
- Assess for responsiveness, including rapid assessment of normal breathing and evidence of circulation.
- Activate EMS.
- Adjust the individual's position for ongoing care as appropriate.

Assessing Responsiveness & Pulse Check

Once a rescuer ensures the scene is safe, assess the individual's level of responsiveness.

The level of consciousness can be evaluated using the **A-V-P-U** acronym.

This assessment can and should be used continuously during care while awaiting EMS. It will identify changes in responsiveness, alerting you to changes in the injured diver's condition.

A	**Person is alert**
V	**Not alert but responds to verbal stimuli**
P	**Not alert but responds to painful stimuli**
U	**Unresponsive to all stimuli**

If the injured diver is responsive, remember to introduce yourself, state you are trained in first aid, and ask permission to help. The injured person should initially be left in the position in which they were found. Call EMS. Conduct a secondary assessment (discussed later in this book) to determine if any injuries are present. If no evidence of injury is present, then the person may be placed in the recovery position or a position of comfort. Reassure the individual by showing a caring attitude, and talk to them about what is happening. The rescuer should also try to keep bystanders at a distance to avoid added stress.

If the individual is unresponsive, tap their collarbone and shout, "Are you OK?" At the same time, look quickly for normal breathing and evidence of circulation: chest movement and pink nail beds.

Note:
Abnormal respirations are commonly associated with cardiac arrest. Breathing efforts may be infrequent, irregular, diminished or characterized by noisy gasps known as agonal breathing. This type of breathing is quite different from that seen in a normal resting or sleeping person and is not adequate to support life.

Note:
For individuals with a definite pulse or showing signs of life (movement) but not breathing normally, chest compressions are not required. Provide rescue breaths to supplement abnormal or absent breathing. This skill is addressed later in this course.

If breathing is not present and airway adjustment is ineffective, check for a pulse. To check for a pulse, use the first two fingers of either hand to press gently. For adults and children, check for the presence of a pulse at the carotid artery in the neck. Locate the carotid artery by placing your fingers on the "Adam's apple" of the individual's throat, and slide your fingers toward you and slightly upward into the groove on the side of the neck. Allow at least five seconds but no more than 10 seconds to determine if a pulse is present. Some pulses may be difficult to identify if thick tissue is present in the neck. Adjust the pressure of your fingers as necessary, but avoid excessive pressure because blood vessels can be collapsed, obscuring a pulse. If no pulse is present or you are unsure if a pulse is present, activate EMS immediately or send a bystander to call for help.

To establish responsiveness in infants, rub or tap the soles of their feet, or tap their shoulder or chest. Do not shake an infant. Check for a pulse in infants at the brachial artery in the upper arm as high on the underside of the arm as close to the arm pit as possible. Locate the brachial pulse by placing your fingers in the groove along the inside of upper arm. Use gentle pressure here as well, adjusting as necessary to find a pulse. Allow at least five seconds but no more than 10 seconds to determine if a pulse is present. If no pulse is present and you are alone, begin CPR (described later in this book). For infants, conduct CPR for two minutes then activate EMS if not already done.

Activate EMS if not already done then turn them on their back and begin CPR. (CPR techniques are covered later in this book.) To turn an adult from a face-down position onto their back, use the log-roll technique.

Log Roll

If the person is not on their back, you need to roll them into that position. To minimize the risk of neck and back injury or in the case of suspected spinal trauma, use the log-roll technique.

- Kneel at the unresponsive person's side.
- Carefully straighten their arms and legs; place the arm closest to you above their head; place their other arm against their torso.
- Support the head and neck with one hand.
- Place your other hand on the opposite arm, and pull it gently into their side.
- Roll the individual toward you, while avoiding twisting their head, neck and back.
- Use a smooth, continuous movement to roll the person to their side and then onto their back.
- Keep twisting movements to a minimum throughout the entire roll.

Note:
When two rescuers are present, one should immobilize the individual's head while the second person rolls them onto their back. The rescuer at the head controls the action by directing when to roll the person.

Positioning an Injured or Ill Person for Care

- Responsive, breathing injured diver — After assessing for injuries, place an injured person who is responsive and fully alert in a position of comfort: seated, supine position (lying flat on the back) or in the recovery position.
- Unresponsive, breathing diver — Place an injured person who is unresponsive but breathing in the recovery position. This minimizes the risk of airway obstruction by the tongue or body fluids for individuals with a reduced level of consciousness.

Recovery Position

Place the injured person in the recovery position to ensure an open airway. In the absence of other relevant factors (injury, trauma, access), it does not matter which side. This helps prevent blood and vomit from obstructing the airway or flowing into the lungs. Should vomiting occur, or if blood or other fluids are present in the mouth, gravity will aid in removal and minimize the chance of aspiration.

Remember to call local EMS. Until help arrives, continually check that the individual is still breathing. If EMS is delayed, rotate the person to the other side every 30 minutes. The recovery position is accomplished from a supine position.

- Kneel beside the individual, and make sure that both of their legs are straight.
- Place the individual's arm nearest to you at a right angle to their body, with elbow bent and palm facing upward.
- Bring the far arm across the individual's chest, and hold their hand against the cheek nearest to you.
- Place your other hand under the leg farthest from you just above the knee, or grab the pant leg of their clothing, and pull the knee up, keeping the foot on the ground.
- Holding the individual's hand against their cheek, pull the far leg to roll them toward you and onto their side.
- Adjust the top leg to form 90-degree angles at both the hip and knee.
- Tilt the head to ensure the airway remains open.
- Adjust their hand under their cheek, if necessary, to keep the head tilted.
- Assess breathing and circulation regularly.

Note:
Do not place people with suspected spinal injury in the recovery position because it places them at increased risk of further injury.

If you use the recovery position, monitor the peripheral circulation of the person's lower arm, and ensure that the duration of pressure on this arm is kept to a minimum.

Review Questions

1. Initial assessment includes:
   a. assessing for responsiveness and activating EMS
   b. adjusting the individual's position for care
   c. initiating CPR
   d. all of the above
   e. a and c only
   f. b and c only

2. To check for a pulse on an adult or child, use gentle finger pressure on the
   a. carotid artery
   b. brachial artery
   c. femoral artery
   d. radial artery

3. To check for a pulse on an infant, use gentle finger pressure on the
   a. carotid artery
   b. brachial artery
   c. femoral artery
   d. radial artery

4. Any breathing sounds at all are considered normal.
   a. True
   b. False

5. Placing an unconscious, breathing person in the recovery position is important to maintain an open airway and to minimize the potential of blood and vomit to obstruct the airway.
   a. True
   b. False

6. Persons with back or neck injuries should not be placed in the recovery position.
   a. True
   b. False

Review answers are on Page 62.

CPR & Related Skills

Chapter 5: Cardiopulmonary Resuscitation

Objectives

1. What is the recommended rate for compressions during CPR?
2. What is the recommended depth for CPR compressions on an adult?
3. What is the compression/ventilation ratio?
4. When is full CPR always recommended?
5. What CPR protocol is to be followed for drowning victims?
6. What barrier devices (exposure protection) are recommended when doing rescue breathing?
7. How long should ventilations last?

Starting CPR: Support Circulation

In many circumstances when normal breathing or a definite pulse is not present, a single rescuer initiates CPR, while another individual (if available) activates EMS. The individual who activates emergency services should inform them that the person under care is not breathing normally and has no pulse.

The single rescuer should ensure the individual is on a hard surface and then begin CPR, starting with 30 compressions followed by two breaths. If a second rescuer is not available, the single rescuer should call EMS and secure an AED, if readily available, before beginning CPR on an adult. After starting chest compressions, limit interruptions to less than 10 seconds. The next section will cover rescue-breathing techniques.

Chest Compressions on Adults

Begin chest compressions by locating the center of the individual's chest, which can be accomplished by drawing an imaginary line between the nipples. After determining the site for compressions, stack your hands with the fingers of both hands interlocked and raised off the chest wall with the heel of the bottom hand on the center of the chest between the nipples. Position your shoulders directly over your hands, keeping your elbows straight. Keep your fingers raised off the chest wall, and compress the chest 30 times at a rate of 100-120 per minute. Pivoting from the hips for compressions allows the rescuer to use their body weight to assist with compressions and facilitates a smooth, rhythmic motion.

Compression depth should be 5-6 cm (2-2.5 inches). Compressions should be to this full depth and should allow for complete recoil of the chest. It is important to release the pressure on the chest between the compressions but without losing contact on the chest with your hands. The skills-development section covers the exact hand position and compression technique in more detail.

During compression, blood is pushed out of the left side of the heart and then throughout the body. At the same time, deoxygenated blood is squeezed from the right side of the heart to the lungs, where it will take oxygen from the lungs. When releasing the pressure on the chest, blood flows from the body into the right side of the heart, and oxygenated blood returns from the lungs to the left side of the heart.

When compressions are too fast, the heart does not have time to refill with blood, thus decreasing the resulting volume that flows out of the heart. Rescuer fatigue occurs quickly and results in decreased compression effectiveness. When compressions are too slow, the amount of circulating oxygen available to tissues decreases. When compressions are not deep enough, blood flow is reduced, and the amount of blood pushed out of the heart may be inadequate to support tissue oxygen demands.

After each cycle of 30 compressions, provide two rescue breaths. (The next section covers rescue breathing.)

Ventilations

Ventilations deliver oxygen to the lungs to oxygenate the blood and are an important part of CPR. For effective ventilations, tip back the individual's head and extend the jaw. This position opens the airway and prevents the tongue from creating an obstruction. A seal must be created with either a barrier device or directly on the individual's mouth. Barriers are recommended to minimize exposure risk. They are available as small as a simple face shield that can be carried in minimal space like a wallet. Larger barriers include various oronasal resuscitation masks and devices.

Mouth to mouth may be the only option if no barrier aids are available.

Alternatively, in the absence of a barrier device you may perform hands-only CPR if you are unwilling or uncomfortable with performing unprotected ventilations. Compression only support is acceptable in the case of a witnessed collapse of an adult who stops breathing normally. For drowning victims or scuba diving injuries, however, full CPR is always recommended. This course teaches full CPR, which is part of the requirements for certification.

Two-Person Adult CPR

When a second trained rescuer is available, the two rescuers should perform CPR as a team. Use the same compression and rescue-breathing techniques described for one rescuer but with one rescuer performing compressions and the other performing rescue breaths using the same 30:2 ratio. The first rescuer begins chest compressions, while the second rescuer monitors compression rate and depth and maintains an open airway. At the completion of the 30th compression, the first rescuer pauses while the second rescuer administers two breaths (approximately one second per breath). Following the second breath, the first rescuer immediately resumes compressions without delay. Reducing the interruption of compressions is a critical element of CPR. Do not interrupt compressions for more than 10 seconds, other than during use of an AED.

Note:
If more than one rescuer is present, alternate the role of performing chest compressions about every one to two minutes to minimize rescuer fatigue.

Note:
Pause compressions during administration of rescue breaths to minimize air moving into the stomach (gastric distension).

Full CPR

Full CPR is accomplished by using chest compressions and ventilations together as this chapter describes. Full CPR can be accomplished with one or two rescuers. The skill-development portion of this course will provide an opportunity to develop compression and ventilation techniques as well perform full CPR on manikins.

Chest Compressions on Children

Evaluate unresponsiveness in a child just as you would with an adult. Tap the collar bone and shout, "Are you OK?" while looking for any movement or signs of life, including normal breathing. Feel for a pulse at the carotid artery in the neck of a child. If in doubt about the presence of a pulse and the child shows no signs of life, begin chest compressions.

Performing CPR on a child is very similar to CPR on an adult. Children are generally considered to be between 1 year old and puberty, but the physical size of the child, not their age, will determine how CPR is performed.

Note:
The lone rescuer should perform CPR on a child or infant for approximately two minutes before going for help or calling EMS. If a cell phone is available, activate EMS utilizing the phone's speaker setting while beginning CPR.

With small children, using a single hand for compressions with the same technique as for an adult may be all that is necessary for adequate compressions. Large children, however, may require techniques similar to those used on an adult.

Compression depth on a child is approximately 5 cm (2 inches) or approximately one third of the thickness of the child's chest. The compression rate remains at least 100 per minute. A single rescuer should use the 30:2 CPR compression and ventilation ratio for children.

Two-Person Child CPR

When a second rescuer is available to perform CPR on a child, the compression to ventilation ratio changes to 15:2, maintaining a rate of 100-120 compressions per minute. The more frequent ventilation rate compensates for the slightly faster natural respiratory rate of children. As with

adults, one rescuer performs 15 compressions to a depth of 5 cm (2 inches) then pauses while the second rescuer administers two rescue breaths. The first rescuer immediately resumes compressions for another count of 15. The cycle of compressions and rescue breaths then repeat.

Chest Compressions for Infants

Infants generally are considered to be younger than 1 year old. To begin chest compressions on an infant, draw an imaginary line between the nipples to identify the compression site. With two fingers positioned vertically on the breastbone in the center of the chest between the nipples, compress straight down about one-third of the chest depth. A lone rescuer should perform 30 compressions followed by two small breaths (puffs of air from the rescuer's cheeks), then repeat.

Two-Person Infant CPR

With the addition of a second rescuer, the preferred method for compressions on an infant is to use two thumbs for compressions with the hands encircling the chest. This method is less tiring for the rescuers and may allow for more consistent force and depth, resulting in better blood flow and higher blood pressures. Monitor the thumb positions to avoid their migration off the compression site.

The rescuer performing compressions should be positioned at the infant's feet. Draw an imaginary line between the nipples, and place both thumbs on the infant's chest at this line, with the thumbs either overlapping or side by side. Encircle the infant's body with both hands, using fingers to support the infant's back. Press and release the chest with your thumbs, being careful not to squeeze the sides of the chest. Allow the chest to fully recoil between compressions. As with children, two rescuers with an infant should perform 15 compressions followed by two breaths, switching positions about every 10 cycles (approximately every two minutes).

Note:
The technique of two thumbs with hands encircling the infant's chest should be used only with two rescuers. A single rescuer should continue using fingers to facilitate rapid movement between compressions and breaths.

Victim	One Rescuer	Two Rescuers	How to Compress	Depth
Adult	30:2 ratio	30:2 ratio	Two hands stacked	5-6 cm (2-2 1/2 inches)
Child	30:2 ratio	15:2 ratio	Heel of one hand or two hands stacked	5 cm (2 inches) or 1/3 chest depth)
Infant	30:2 ratio	15:2 ratio	Two or three fingers (1 rescuer); two thumbs (2 rescuers)	3.5 cm (1 1/2 inches) or 1/3 chest depth)

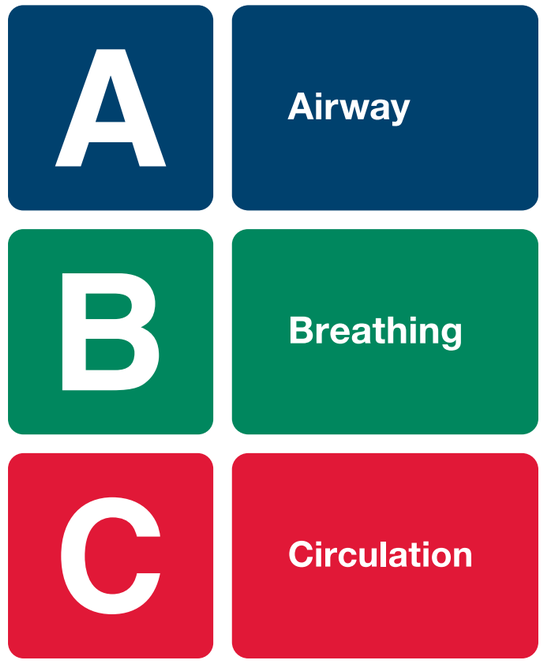
NOTE: The rate of compressions for all age groups is 100-120 per minute.

Special Circumstances with Resuscitation

Drowning

Drowning is the third-leading cause of accidental death worldwide.[7] Responding to these incidents promptly and effectively can help reduce the mortality of drowning. It has already been noted that for victims of drowning a lone rescuer should conduct CPR for two minutes before activating EMS.

Another shift in protocol for drowning victims is for rescuers to initiate CPR with ventilations (not compressions) after determining unresponsiveness. This change is due to the hypoxic condition of drowning. It also is possible that prompt oxygenation of tissues with the use of a ventilations-first protocol can prevent cardiac arrest (if it has not already occurred). The rescuer can also consider using supplemental oxygen if available. Begin CPR for drowning victims by establishing an open airway, delivering two ventilations and then performing 30 compressions — a protocol acronym of A-B-C.



Continue with two ventilations after every 30 chest compressions. Hands-only CPR is not appropriate in this situation.

Use of Oxygen During Resuscitation
Supplemental oxygen improves the delivery of oxygen to tissues during resuscitation. When usedeffectively, the concentration of delivered oxygen may increase to levels approaching

100 percent. The use of oxygen is very important for victims of drowning and scuba diving accidents, where hypoxia is a major concern. Oxygen should be present at every swimming pool and dive site. BLS: CPR and First Aid providers are encouraged to complete the Emergency Oxygen for Scuba Diving Injuries course.

Pregnancy

While cardiac arrest is rare in pregnant women, it appears the rate may be increasing for women who are in the second half of pregnancy. There are several potential causes, butthese are irrelevant to the first-aid responder. To perform effective compressions whenthe top of the uterus is above the mother's umbilicus, the recommendation is to manually displace the uterus to the mother's left to reduce pressure in return circulation to the heart while compressions are performed. For quality compressions to be delivered, a second rescuer is required. Activate EMS immediately because additional measures will be required in a hospital setting.

Opioid Overdose

In 2012 opioid overdose became the leading cause of death for people 25-60 years of age in the United States. Most of these deaths are associated with prescription medications. Because of its presentation, opioid overdose can be confused with unconsciousness and can be difficult to ascertain as the cause. An opioid overdose progresses from central nervous system (CNS) depression to respiratory arrest to cardiac arrest. For first aid purposes, this situation is referred to as an opioid-associated life-threatening emergency.

Naloxone is a medication that interferes with the action of opioids in the brain, spinal cord and gastrointestinal system. Because there are no known harmful side effects when this medication is used with or without opioid intoxication present, the U.S. Food and Drug Administration has approved a naloxone auto-injector as well as an inhaled nasal mist for use by lay rescuers in the first-aid setting.

As with all life-threatening emergencies, check to see if the individual is breathing or gasping. Begin CPR if the person is not breathing or is gasping. If naloxone is available, administer 0.4 mg with an auto-injector as well as an inhaled nasal mist, and continue CPR. The dose may be repeated every four minutes. Watch for the individual to become responsive with purposeful movement or regular breathing. Continue to monitor the individual's breathing and responsiveness until EMS arrives. Resume CPR if the person's condition relapses, and administer additional doses of naloxone. If the individual does not respond, continue CPR and verify that EMS is on the way.

Review Questions

1. The recommended rate of compression for all ages is
   a. 60-80 per minute
   b. 100-120 per minute
   c. at least 140 per minute
   d. rate is not important as long as compressions are being done.

2. The recommended depth of chest compression for an adult is
   a. 1 ½" - 2"
   b. 2" - 2 ½"
   c. 3" – 3 ½"
   d. Depth is not important as long as compressions are being done.

3. The recommended depth of compressions for infants and children is
   a. 1/3 of chest depth
   b. 5 cm (2 inches)
   c. 2.5 cm (1 inch)

4. The compression/ventilation ratio for an adult is:
   a. 30:2
   b. 15:2
   c. 5:1
   d. 50:2

5. Full CPR is always recommended for drowning and scuba diving injuries
   a. True
   b. False

6. Each ventilation should take about _____ in duration.
   a. 2 seconds
   b. 1 second
   c. 5 seconds

7. The compression-to-ventilation ratio for two-person CPR on children and infants is
   a. 30:2
   b. 30:3
   c. 15:2
   d. 15:1

8. CPR for drowning victims should follow an A-B-C protocol.
   a. True
   b. False

Review answers are on Page 62.

CPR & Related Skills

Chapter 6: Supporting Respirations

Objectives

1. What barrier devices (exposure protection) are recommended when doing rescue breathing?
2. How long should rescue breaths last?
3. What is the compression/ventilation ratio for a single rescuer on an adult? For two rescuers?
4. What is the compression/ventilation ratio for a child?
5. When providing ventilations only, how often should rescue breaths be delivered for an adult? For a child? For an infant?

Rescue Breathing

Rescue breaths deliver oxygen to the lungs to oxygenate the blood and are an important part of CPR. For effective rescue breaths, tilt back the individual's head and extend the jaw by lifting the chin. This opens the airway and prevents the tongue from creating an obstruction.

A seal must be created with either a barrier device or directly on the person's mouth. Barriers are recommended to minimize exposure risk. Disposable face shields are available in packets that can be carried in a wallet. Larger barriers such as oronasal resuscitation masks and devices are often included in first aid kits. Mouth-to-mouth ventilations may be an option if no barrier aids are available.

When providing rescue breaths with mouth-to-mouth ventilations, the person's nose must be pinched closed to ensure effective, adequate ventilations.

Alternatively, in the absence of a barrier device you may perform hands-only CPR if you are unwilling or uncomfortable with performing unprotected rescue breaths. Compression-only support is acceptable in the case of a witnessed collapse of an adult who stops breathing normally. For drowning victims or scuba diving injuries, however, full CPR with ventilations is always recommended. This course teaches full CPR, which is part of the requirements for certification.

Deliver each rescue breath for one second as you watch for the chest to rise. Avoid using excessive volumes of air with rescue breathing for all age groups. The chest rise should be gentle and just visible. Excessive volumes of air and a pronounced chest rise increase the risk of regurgitation and possibly obstruction of the airway.

Allow the chest to fall (exhalation) about one second, then deliver a second breath. If rescue breaths do not cause the chest to rise, reposition the individual's head. If efforts do not make the chest rise after two attempts, return to compressions. Check for visible obstructions after completing an additional cycle of 30 chest compressions and/or try to ventilate again. Each pause from chest compressions to ventilate should not last more than 10 seconds. The skills-development section provides full technique descriptions. Do not delay compressions if rescue breaths are ineffective. The priority is chest compressions to keep blood circulating.

Note:
Remove the person's dentures only if they cannot be kept in place. In all other situations, keep them in the individual's mouth because they will make it easier to create a seal.

Bag valve mask (BVM)

The BVM is a self-inflating bag that aids rescuers in providing ventilations to a non-breathing or inadequately breathing injured diver or in situations where other barriers are not available. It is a good choice when two rescuers are available because it provides a higher percentage of oxygen than mouth-to-mask ventilations, even without supplemental oxygen, and is less fatiguing than providing rescue breaths.

The BVM is connected to a mask by means of a mechanism with several oneway valves.

When available because it provides a higher percentage of oxygen than mouth-to-mask ventilations, even without supplemental oxygen, and is less fatiguing than providing rescue breaths. Air or oxygen is compressed and is directed through the mask into the injured diver's lungs. The BVM can also be connected to an advanced airway device such as an endotracheal tube used by EMS personnel.

Since BVMs ventilate with air, they provide oxygen at concentrations and volume of 21 percent, compared with the 16-17 percent delivered through rescue breathing. BVMs can provide much higher oxygen concentrations when connected to an oxygen cylinder. The oxygen concentrations are
substantially reduced when the mask seal is poor. The ventilation bag and the mask are available in sizes suitable for adults, children and infants. Most adult selfinflating bags have a volume of 1600 mL. A system for an adult should never be used on a child since the bag can overexpand a child's lungs. In addition to having a smaller bag, some systems for children include a system for preventing lung overexpansion.

Note:
When providing emergency oxygen with a BVM, it is recommended that a tidal volume of 400-600 mL (roughly one-third of the ventilation bag volume) be given for one second until the chest rises. These smaller tidal volumes are effective for maintaining adequate arterial oxygen saturation, provided that supplemental oxygen is delivered to the device. These volumes will reduce the risk of gastric inflation.

Current BVMs incorporate a tube connection for oxygen and a reserve bag that is usually connected to the base of the resuscitation bag. Oxygen passes into both of them every time the reservoir is compressed.

Many studies have clearly shown that the BVM technique applied by a single rescuer produces very poor ventilations, even though the rescuer may be well trained and conduct it perfectly. Therefore, it is recommended that the BVM be used by a minimum of two trained rescuers to guarantee the optimal ventilation. One rescuer manages the airway and keeps the mask sealed well, and the other compresses the bag. The BVM is a good choice when two rescuers are available because using it is less fatiguing than providing rescue breaths.

Newer versions of the BVM have a stop valve to help prevent overinflation. It restricts air flow from the bag to the injured diver if resistance, due to the lungs being overfilled for example, occurs during ventilations. The stop valve may also be activated if the rescuer uses too much pressure to operate the system. Either way, the stop valve prohibits further air from being administered.

Despite the potential problems, the BVM can be very effective if used by properly trained rescuers.

Note:
Achieving a good seal while lifting the diver's jaw with one hand and using the other to compress the bag is very difficult for a single rescuer. The injured diver's mouth may remain closed beneath the mask, or the tongue may create an obstruction due to poor airway management. Leaks are difficult to prevent when attempted by a single rescuer. Potential leaks are minimized with two-rescuer delivery. On the other hand, if a good seal is obtained on the injured diver's face, the BVM can produce enough pressure to expand the stomach and/or damage the lungs — hence the recommendation to limit tidal volume to 400-600 mL.

Description and Function of a Typical BVM Device

Even though various models of the BVM have differing design details or characteristics, the operating principles are the same. You should become familiar with the model you use.

Ventilation bag. This bag is designed to reinflate after it is compressed. It refills with air or oxygen through a suction valve at the end of the bag. The suction valve also functions as a nonreturn valve, preventing the gas from escaping at the bottom of the bag and preventing strain around the neck of the bag.

Tolerance valve. Depending on the manufacturer, this assembly contains two one-way valves. The first is the "lip valve," which opens when the gas exits from the ventilation bag and closes when the gas goes in the opposite direction. This allows the gas contained in the ventilation bag to be directed toward the injured diver and prevents the expired gas from reentering the bag. The expired gas is directed from the assembly through a separate membrane or through the lip valve, which rises to allow the gas to be dispersed. This membrane also prevents the air from returning to the injured diver.

Oxygen reserve bag. The majority of BVM devices have a reserve bag of some type. The reserve bag is designed to collect the oxygen during the expiration cycle so that it is available for the inspiration cycle.

The BVM should include a system for preventing excess pressure in the system and/or in the reserve bag caused by the introduction of

unused gas. Some systems have slits in the reserve bag that open under pressure and allow excess gas to escape. Other devices use an outlet valve or a membrane.

In addition, the BVM requires an inlet that allows a certain amount of air to reenter when the reserve bag is used if there is insufficient gas to allow the ventilation bag to refill.

Rescue Breathing for Children

For children, use a head-tilt, chin-lift method (similar to the adult technique) and a rescue breath volume that will achieve a gentle chest rise as you deliver the breaths. Avoid overexpansion of the child's lungs by adjusting your volume to the size of the child.

Rescue Breathing for Infants

The technique for providing rescue breaths for an infant requires less extension of the infant's neck and a smaller volume of air. Gently tip the infant's head to straighten the neck and airway to a neutral position. Overextending the neck as with adults and children will collapse an infant's airway. The volume of air required to provide rescue breaths to an infant can be met by simply using the air from the puffed cheeks of the rescuer. Breaths should not be long or forceful because infants' lungs are very small.

Deliver rescue breaths to an infant using either an oronasal resuscitation mask or by placing your mouth over the infant's mouth and nose. If using an oronasal mask, achieve a better seal by turning the mask 180 degrees from how it would be used on an adult or child. A seal still needs to be maintained for effective rescue breathing. When using mouth to mouth on an infant, both the infant's mouth and nose must be covered to ensure an adequate seal.

Rescue Breaths without Compressions

If a pulse is present but the person is either not breathing or not breathing normally, the rescuer should provide rescue breaths. For all age groups, begin rescue breaths with a single ventilation. Continue with one breath every five to six seconds for adults and children and every three to five seconds for infants. Use the same techniques as when providing rescue breaths during full CPR.

Maintain the airway, and monitor the individual for regurgitation or spontaneous return of breathing. Continue to monitor the pulse as well, checking every two minutes to ensure circulation is continuing. Remain prepared to initiate CPR if the pulse disappears.

Use of Oxygen During Resuscitation

The use of oxygen is especially important for victims of drowning and scuba diving accidents, where hypoxia is a major concern. In the case of prolonged asphyxia (not breathing) or reduced cardiac and lung function due to submersion, oxygen therapy may be crucial. It improves the delivery of oxygen to tissues during resuscitation. When used effectively, the concentration of delivered oxygen may increase to levels approaching 100 percent. Therefore, oxygen should be present at every swimming pool and dive site. Providers are encouraged to complete the DAN Emergency Oxygen for Scuba Diving Injuries course.

Full CPR (performing both compressions and rescue breaths) is recommended for all victims of immersion incidents (drowning and scuba diving accidents).

Review Questions

1. Each rescue breath should last about
   a. 2 seconds
   b. 1 second
   c. 5 seconds

2. The volume of rescue breaths for children should be adjusted to accommodate their size to avoid overexpansion of their lungs.
   a. True
   b. False

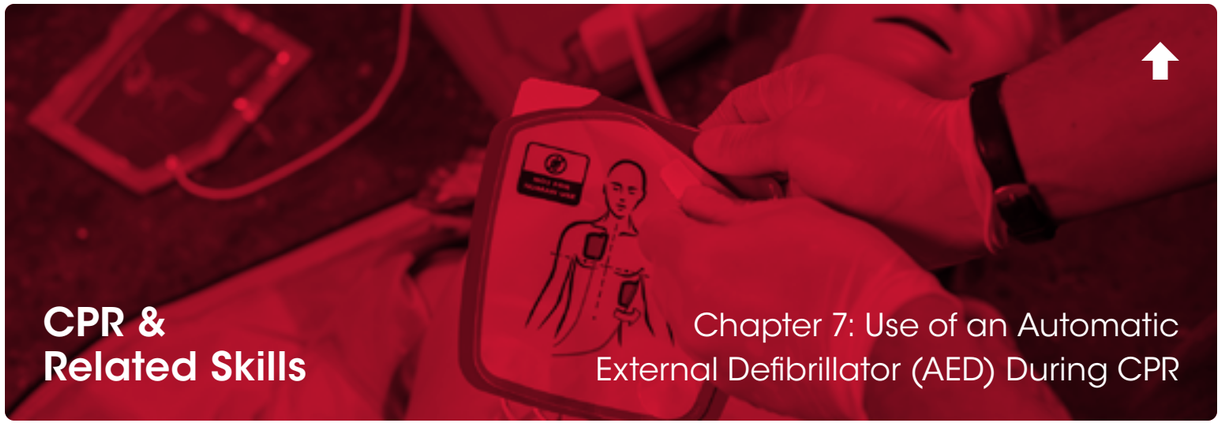
3. When delivering rescue breaths to an infant, the head should
   a. be extended as it would for an adult or child
   b. not be extended at all
   c. be extended gently but not as far as you would for an adult or child

4. When delivering only rescue breaths (no compressions) on an adult, the rate of ventilations is one breath every
   a. 10 seconds
   b. 5-6 seconds
   c. 3 seconds

5. Rescue breaths only (no compressions) on an infant should be delivered every 3-5 seconds.
   a. True
   b. False

6. Full CPR is always recommended for
   a. drowning victims
   b. scuba diving injuries
   c. both a and b

Review answers are on Page 64.



CPR & Related Skills

Chapter 7: Use of an Automatic External Defibrillator (AED) During CPR

Objectives

1. Why are AEDs recommended?
2. What are the considerations for using an AED on children or infants?

Use of AEDs During CPR

The heart has an inherent electrical system that stimulates heart muscle contractions. As these electrical impulses fire and the muscles contract, blood is pumped from the heart to either the lungs or systemic circulation via arteries.

When something upsets these electrical impulses and breaks the heart's rhythm, sudden cardiac arrest (SCA) may occur. The most common life-threatening rhythm disturbance (arrhythmia) that occurs during an SCA is ventricular fibrillation (VF). Fibrillation refers to disorganized and ineffective muscular contractions. When this occurs in the ventricles — the chambers responsible for pumping blood to the lungs and body — circulation essentially stops, and a person will die.

The most effective way to reestablish a normal heart rhythm is with defibrillation. While CPR helps to oxygenate blood and circulate it throughout the body, CPR cannot reestablish a normal heart rhythm. Only defibrillation can do that.

Defibrillation sends an electric shock through the heart and essentially hits a "reset" button. The electric shock overrides the misfiring rhythm and allows the body's natural pacemaker to restore a normal rhythm.

Prior to the advent of AEDs, only highly trained professionals could use defibrillators. Fortunately, AEDs available to the general public are simple to use and reduce the time from initial collapse to initial shock delivery. Take time to notice AED locations in stores and other areas you frequent so you will know where to find one in the event one is needed. All AEDs provide audible user prompts and an easily recognizable light that indicates when to deliver the shock. Turn on the AED, and follow the directions provided by the unit. In the skills-development section, your instructor will introduce you to the process using an AED training unit.

CPR combined with the use of an AED provides the highest rate of survival. When defibrillation is provided in conjunction with CPR within the first few minutes after VF begins, the person's chances for survival increase. Survival rates drop about 7 to 10 percent for every minute a person is in VF without CPR.[9] The longer a person remains in an unstable rhythm, the lower the chances of successful defibrillation. It is recommended that the lone rescuer retrieve any readily available AED unit while concurrently using a cell phone to activate EMS, thereby reducing the time for emergency care arrival and providing for quick implementation of the AED. Place the cell phone on speaker function and keep it close, allowing for constant contact with EMS dispatch while initiating care.

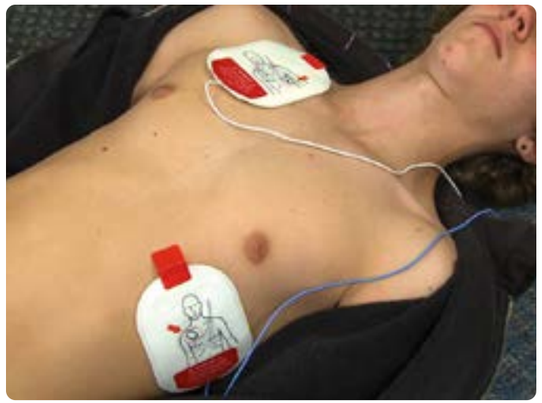
When a second rescuer is available, perform CPR while the second rescuer locates and sets up the AED unit. Interrupt CPR only after the AED pads are in place so the unit can evaluate the individual's heart rhythm.

To utilize an AED, the person's chest must be bare. Place the AED pads on reasonably dry skin, following the diagrams on the pads — one on the upper right chest and the other wrapped around the lower left side of the rib cage. If the pads are switched, the AED will still work.

Software within the AED performs heart-rhythm analysis and advises the rescuer if a "shockable" rhythm is detected. If a nonshockable rhythm is detected, the unit will provide a "no shock advised" message. The rescuer should then continue CPR uninterrupted until EMS arrives or another rescuer takes over.

If a shockable rhythm is detected, the AED unit will prompt rescuers to clear the area ("Do not touch the patient") and then will deliver the shock. Once the AED delivers the shock, immediately resume chest compressions. The heart still needs the support of chest compressions, so resume them immediately after a shock is delivered. There is no lingering charge from the use of an AED that will cause harm to the rescuer. Continue CPR for two minutes or until the AED unit advises it is analyzing the heart rhythm again. The unit may advise for additional shocks, so be prepared to deliver multiple shocks based on the AED prompts.

AED Pad Placement



AED use requires placement of the pads on the chest in a manner that allows the current administered during the shock to travel through the heart muscle. On an adult, place one pad on the right side of the chest below the clavicle (collar bone) and the other pad on the left side of the chest wall under the person's arm (see photo). Placing the left pad too far forward on the chest wall may allow the current to bypass the heart. Illustrations on the pads will aid in correct placement. If the pad positions are switched, the AED will still work.

AED pads should be placed on children the same way as for an adult. Use pediatric pads if they are available. If an adapter is not available, however, use the AED with adult pads at full power.

There is no clinical evidence of damage to the heart tissue from AED use, so use on infants is approved. As with children, use an adapter to reduce the amount of current flow. In the absence of an adapter, however, using an AED may still be helpful. On an infant, apply the pads on the center of the chest and the center of the back.

Cautions

While AEDs can be used in wet environments, they should not be used in standing water. Move an ill person away from pools of water if necessary.

Metal surfaces, as may be encountered on a dive boat, do not require special consideration as they do not pose a hazard to the ill person or the rescuers providing care. However, exercise caution to ensure that neither the pads themselves nor their conducting gel are in contact with the metal surface. In all circumstances, providers should not be in contact with the ill person during shock delivery. Part 4: The Automated External Defibrillator: Key Link in the Chain of Survival

If supplemental oxygen is being used in the person's care, discontinue its use, turn off the oxygen flow and move away from the person. Once the shock has been delivered, resume use of oxygen.

Note:
While AEDs can be used in an aquatic setting (near water or where water is on or around the person), it should not be used in standing water. You must dry the chest before placing the pads on the individual. Place AED pads on the person's bare chest according to the diagrams on the pads.

Troubleshooting

AEDs typically are trouble-free, but when problems occur they frequently involve the pads. When the AED unit detects problems, it will provide prompts to check for issues such as poor pad placement or attachment. Chest hair or wet skin may interfere with pad adhesives, so be sure the chest is free of excessive moisture. It may be necessary to shave off heavy chest hair for adequate pad contact.

The vibrations caused by running boat engines may make it difficult to use an AED on a moving boat.

Maintenance

Check the AED status indicator daily. If the battery is low, replace it with a new or freshly recharged one. Do not use an AED with a low battery.

AED pads have expiration dates. Check components regularly, and replace items as necessary.

Carefully handle pads using the provided tabs or the place where the wires attach. If the pads appear damaged or if wires are loose, a new set of pads may be required for the AED to operate properly.

Be aware that rules and regulations concerning AED use vary from region to region. Check for laws that may apply in your area, or ask your DAN Instructor about possible restrictions on AED use where you live or work.

Review Questions

1. The use of an AED is often helpful but may decrease the chance of survival.
   a. True
   b. False

2. Every minute the heart is in fibrillation, survival rates decrease by
   a. 3-5%
   b. 7-10%
   c. 12-15%
   d. 20-25%

3. All cardiac arrests can benefit from the shock delivered by an AED.
   a. True
   b. False

4. The charge from a delivered shock should be allowed to dissipate before touching the person to resume CPR.
   a. True
   b. False

5. AEDs with adult pads may be used on infants and children.
   a. True
   b. False

6. AED pad placement on adults is
   a. on the right chest and left side
   b. on the center of the chest and center of the back
   c. under both arms, centering the heart between them

7. AED pad placement on infants is
   a. on the right chest and left side
   b. on the center of the chest and center of the back
   c. under both arms

Review answers are on Page 64.

Objectives

1. What is the most common cause of choking in adults?
2. How can a partial airway obstruction be identified?
3. How should a rescuer respond to a partial airway obstruction?
4. How can a complete airway obstruction be identified?
5. What action should be taken if a choking victim becomes unconscious?
6. When can a finger sweep be used?
7. What is the maximum time suctioning may be used on an adult? On an infant?

Foreign bodies are the main cause of blocked airways and choking. The most frequent culprit in adults is food. In children it may be toys, coins, nuts or other small objects. Airway obstruction prevents normal airflow into the lungs and may result in respiratory arrest and eventually cardiac arrest.

Airway obstruction may be partial or complete. A choking victim may suddenly become silent or grasp at their throat — this is the universal sign for choking. Ask the person, "Are you choking?" People who are able to move air will usually cough to dislodge the object and may not require an intervention.

Of greater concern is the severe obstruction, when a person is unable to breathe at all and

can only nod their head to your question. They cannot cough or speak. This person is unable to move air and will become unconscious without intervention. If possible, provide assistance before unconsciousness occurs. Remember to ask permission to assist a conscious, choking person before providing care.

First Aid for Choking Adults and Children

In the case of a partial or mild airway obstruction (e.g., the person can speak, cough, make sounds), the rescuer should encourage the choking victim to cough but should do nothing else.

If the person shows signs of a severe airway obstruction and is conscious, there are three major methods to clear an obstructed airway in adults.

- Abdominal thrusts
- Back blows
- Chest compressions

All have been shown to be effective with no single method more effective than another. Multiple techniques may be required to clear an obstructed airway. No clear evidence of an effective order of use has been demonstrated. Utilize the method of choice or whichever method is regionally preferred. A combination of techniques may be required to relieve an obstructed airway.

Each technique does present potential risks:

- Abdominal thrusts have been associated with rupture of internal organs.
- Chest thrusts may cause rib and sternal fractures.
- Back blows may lodge the foreign body tighter in the trachea[18].

Always ask permission to assist before providing care.

Abdominal Thrusts:

Stand behind the person, and put both arms around the upper part of the abdomen.

- Clench your fist, and place it between the navel and bottom tip of the sternum with the thumb side of your fist against the choking victim's abdomen.
- Grasp your fist with your other hand, and pull sharply inward and upward.
- Repeat until the object is expelled or the person loses consciousness.

Chest Thrusts:

- Stand behind the individual encircling their chest, placing your arms directly under their armpits.
- Form a fist and place the thumb side of your fist on the middle of breastbone (avoid the xiphoid process or margins of the rib cage).
- Grasp your fist with your other hand and deliver 5 quick forceful thrusts.
- Continue the series of chest thrusts until the obstruction is relieved.

Back Blows:

- Stand to the side and slightly behind the victim.
- Support the chest with one hand and lean the victim forward.
- Give up to five sharp blows between the shoulder blades with the heel of your hand.
- Check to see if each back blow has relieved the airway obstruction.

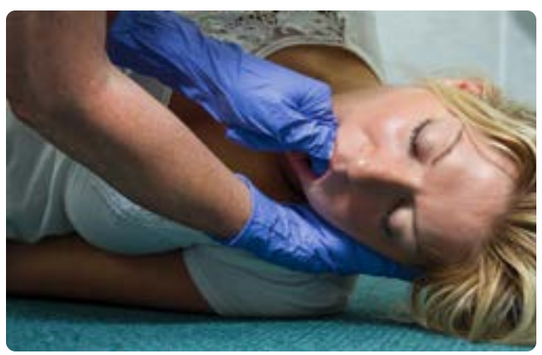
Continue applying FBAO techniques until the obstruction is relieved. Rotating techniques is acceptable.

If the person at any time becomes unconscious:

- Carefully lower the individual to the ground.
- Activate EMS.
- Begin CPR (chest compressions followed by rescue breaths).
- Look in the mouth for the obstruction before each pair of breaths. Use a finger sweep to remove any visible objects.

Finger Sweep:

When you can see solid materials in the airway, use a gloved finger to remove the foreign matter. Do not perform a finger sweep if you cannot see an obstruction or foreign object in the mouth. If the removal of a foreign object enables spontaneous breathing, continue to monitor the person and call EMS. If spontaneous breathing doesn't start with the removal of foreign material, initiate CPR.



First Aid for Choking Infants

Infants have very small airways that can easily become obstructed. Because they often explore with their mouths, aspiration of small objects is a very real concern.

To dislodge an object from a responsive infant's airway, begin by placing the infant face down on your forearm, supporting the infant's head with the hand of the same arm. Allow the infant's legs to straddle your arm, and keep the infant's head lower than their body. Deliver five back blows between the infant's shoulder blades. Immediately turn over the infant by sandwiching them between your forearms, continuing to support the head and keep it low. Deliver five chest compressions using the same two-finger technique as in CPR. Check the infant's mouth for the dislodged object. If it's not visible, turn over the infant, and repeat the back blows and chest thrusts until the object is successfully dislodged.

If the infant becomes unresponsive, initiate CPR, beginning with chest compressions. Look in the mouth for the obstruction before each pair of breaths.

As with all life-threatening emergencies, activate EMS as soon as you recognize a problem. Even if the object is successfully removed without EMS assistance, medical evaluation is recommended.

Victims of Drowning: Aspiration of Water

Aspiration of water can be suspected in cases of drowning. It is usually only a small amount, however, and its removal is not part of first-aid treatment as it is usually a much smaller volume than expected. There is no need to clear the airway of aspirated water before starting CPR.

Regurgitation of stomach contents is common during drowning resuscitation and can make it difficult to maintain a clean and open airway. Using the appropriate force and volume for ventilations will reduce the chance of regurgitation. Therefore, proper ventilation technique can be critical. Whenever regurgitation occurs, turn the person on their side using the recovery-position technique, and wipe or suction vomitus using a finger sweep or suction device.

Suctioning

Suctioning to remove foreign matter can aid in clearing the airway, but it should not interfere with other definitive care. Limit use of a suction device to 15 seconds on an adult, 10 seconds on a child and 5 seconds on an infant to avoid depletion of oxygen supplies in the airway. Prolonged suctioning can result in decreased oxygen, leading to further complications.

Once the airway is clear, return the person to their back, and resume CPR or rescue breathing if indicated.

Review Questions

1. The most common cause of airway obstruction and choking in adults is:
   a. the tongue
   b. food
   c. dentures

2. With infants and children, airway obstruction and choking can also be caused by
   a. food
   b. foreign bodies (toys, coins, nuts)
   c. fingers

3. Grasping the neck is a common sign made by choking victims.
   a. True
   b. False

4. If you suspect that someone is choking,
   a. look in the mouth
   b. check for responsiveness
   c. ask, "Are you choking?"
   d. ask a doctor

5. In which of the following circumstances is permission to assist a choking individual not required?
   a. a responsive choking adult
   b. a choking adult who has become unconscious
   c. a choking child or infant with a parent present

6. With complete airway obstruction, the person will be unable to _____ but might nod their head in response to your question. If the person is unable or has a limited ability to move air, they may soon lose _____.
   a. yell for help, their breath
   b. talk, their breath
   c. breathe/cough/speak, consciousness

7. In the case of a partial airway obstruction, the rescuer should encourage the choking victim to cough but should do nothing else.
   a. True
   b. False

8. If the choking victim becomes unconscious, the rescuer should
   a. drop the person in the hope that the fall will dislodge the foreign body
   b. ease the person to the ground, remove the foreign body if visible, and start CPR
   c. ease the person to the ground, initiate supplemental oxygen therapy

9. An obstructed airway in a responsive infant should be cleared with back blows alternating with chest compressions.
   a. True
   b. False

10. What must you do when a person regurgitates?
    a. Roll the person on their side, and wipe or suction out the mouth.
    b. Blow vomit back into the stomach.
    c. Remove gloves, and wipe away vomit with bare hands.

11. Suctioning for adults, children and infants respectively should be limited to
    a. 15 seconds, 10 seconds, 5 seconds
    b. 2 minutes, 1 minute, 30 seconds
    c. 20 seconds, 10 seconds, 5 seconds
    d. 30 seconds, 15 seconds, 10 seconds

Review answers are on Page 62.

CPR & Related Skills

Chapter 9: Emergency Action Plan

Objectives

1. What elements are included in an emergency action plan?
2. What emergency equipment should be readily available as part of an emergency action plan?

Accidents will happen. As a dive professional or volunteer, you are expected to be prepared and to recognize signs and symptoms of various injuries or illnesses. Once you have completed all sections of this course, you will have the skills required to provide appropriate interventions. Support your skills with proper preparation. This includes emergency action planning, equipment preparation and regular drills with response teams.

Emergency Action Plan

An emergency action plan (EAP) consists of many elements. Thorough planning will reveal specific elements that should be included in your company's EAP. A well-prepared EAP can be a vital resource and save valuable time. In addition, it may also enable others to assist.

In its simplest form, an EAP provides directions for activating emergency medical services (EMS) and facilitating entry into care. In larger organizations, there may be action teams to which specific tasks are assigned to ensure a quick and efficient response to an incident. Meeting or collection points/zones for evacuation of an injured diver and a required chain of notification will also be a part of more involved EAPs.

Regular review of an EAP should be conducted to be sure it is up to date and essential elements have not changed over time.

Basic elements of an EAP include:

- Locations of all emergency kits and supplies
- Communication equipment and how to use it
- Local resources
  - Local EMS contact information
  - Location of the nearest medical facility
  - Transportation options to the nearest medical facility
- Directions for EMS to get to your location if required
- **DAN's Emergency Hotline number is +1 (919) 684-9111** for medical consultation and emergency assistance
- Method for documenting signs and symptoms of injury/illness and aid rendered

You will also need to be able to record information about the injured person. Include the following information:

- Person's name, address and DAN Member number if available
  - Include gender (and age, if available)
- Emergency contact information
- Person's medical history (see S-A-M-P-L-E in Chapter 12)
- Current complaint (signs and symptoms)
- Progression of signs and symptoms
- Assessments conducted and what interventions were rendered
- Dive profile information (if available)
  - How many days of diving
  - Number of dives
  - Maximum depth
  - Surface interval times
  - Gas used for diving (air, nitrox — include percentage, trimix — mix percentages, other)
  - Open circuit or rebreather

You may also want to include steps for providing care. In an emergency it is not uncommon for anxiety to overwhelm thought processes, inhibiting the action of providers. First aid slates and dive accident management slates should be kept with emergency equipment and used in rendering care.

Medical Facility vs. Hyperbaric Chamber

If you must transport an injured diver, go to the nearest appropriate medical facility, not to a hyperbaric chamber. Medical evaluations must be completed before hyperbaric treatment. Not all dive-associated injuries or illnesses require hyperbaric intervention, and not all hyperbaric facilities treat divers.

Other reasons to start with a medical facility include:

- Before accepting the transfer of an injured diver, many chambers require a referral from DAN or a physician.
- Many chambers are not staffed 24/7. Assembling a crew often takes time.
- The chamber may already have a patient under care and therefore may not be available.

By starting with a medical evaluation and contacting DAN Medical Services, unnecessary delays can be avoided. DAN Medical Services can assist a local physician or involve a physician trained in dive medicine in evaluating the individual. If the need for a chamber is identified, DAN can also assist in locating an available chamber. **DAN's Emergency Hotline number is +1 (919) 684-9111**.

Emergency Equipment

First aid kits. Another essential item for dive-accident management is a first aid kit that is appropriate for its intended use and the location of diving activity. Many kits are commercially available, or you can assemble one yourself. In choosing or assembling a first aid kit, consider the types of marine life in the diving environment and any special first aid requirements that may be warranted. Whether commercially or personally assembled you should familiarize yourself with the contents of the first aid kit and other kits or equipment to which you will have access during any dive excursion.

The following items should be included, at a minimum, in a standard first aid kit:

- Protective case (waterproof if used in wet environments)
- Resuscitation barrier device (face shield or mask)
- Nonlatex examination gloves
- Cleansing wipes
- Sterile saline for wound irrigation
- Bandages
- Sterile dressings (various sizes)
- Sterile gauze
- Sterile eye pads
- Adhesive tape
- Scissors (strong enough to cut away clothes)
- Triangular bandage
- Safety pins
- Tweezers
- Adhesive dressings (several sizes)

Optional, but recommended:

- Wound-closure strips (Steri-Strips)
- Isothermal blanket
- Irrigation syringe
- Infectious waste bag
- Penlight
- Splint to immobilize fractures
- Thermometer
- NuMask® or oronasal resuscitation mask
- Disposable razor
- First aid manual
- Cold and hot compresses
- A list with emergency numbers
- Tourniquet or materials to improvise a tourniquet
- Hot and/or cold packs

Medications and ointments may also be helpful but may require input from your doctor to ensure appropriate use. While we have provided suggestions for some common over-the-counter medication, first-aid providers are not legally authorized to dispense medications or share their own prescriptions.

Recommended medications include:

- Antiseptic solution
- Antihistamine tablets
- Eyewash
- Antibiotic ointment
- Hydrocortisone ointment
- Pain reliever

Oxygen units. An appropriate oxygen unit is essential for diveaccident management and should be available at every dive site, whether confined water or open water. Oxygen units are discussed in detail later in this course. Appendix 1 lists several DAN oxygen units that are available.

Remember to check components regularly. Replace any items that have expired or have been used. Check both the first aid kits and oxygen units before each outing, and replenish after every use.

Review Questions

1. Essential equipment to have available at every dive site includes
   a. oxygen unit
   b. first aid kit
   c. emergency action plan
   d. all of the above

2. Emergency action plans should include
   a. local resources and emergency phone numbers
   b. communication equipment
   c. method of documenting information about injured divers and first aid provided
   d. location of the nearest hyperbaric chamber
   e. a, b and c only

Review answers are on Page 64.

Summary

For the average lay-provider, it is likely you will never have to use these skills. However, knowing what to do in an emergency could save someone's life – maybe even that of a loved one or your own.

The material covered in this section addresses life-threatening situations and giave you the academic knowledge in the areas of one- and two-rescuer CPR for adults, children and infants. The use of AED's in these events and three different techniques to address individuals who are choking.

Reading this handbook without instruction and skill practice will not make someone competent to provide CPR or first-aid assistance.

Some skills that are covered in this material may not be allowed or have other restrictions in your region. Your DAN Instructor will advise you of any of these restrictions. You will still be responsible for the academic content on the final exam.

After you have completed the required e-learning and the skills-development portion of the course with your DAN Instructor, your instructor will process your credentials. You can find your credential card(s), in your e-learning profile at dan.diverelearning.com under the "completed" tab, by selecting the course you want. There you will see a grey 'course record' box with information about your course. To the right of that grey box you will see your credential card. You can click on that image and then either print it or save it as an image file. If your course is approved by the United States Coast Guard, there will also be a wall certificate available.

Your credentials are good for two years from the approval date. It is recommended you are retrained prior to your credential expiration to keep your skills proficient.

Thank you for taking this DAN course and your support of DAN – your dive safety organization!

Review Answers (SECTION 1)

Chapter 1 - Page 15

1. C
2. B
3. A
4. A
5. A
6. E
7. A
8. E
9. B
10. D
11. A

Chapter 2 - Page 22

1. C
2. A
3. C

Chapter 3 - Page 28

1. D
2. D
3. A
4. D
5. A

Chapter 4 - Page 33

1. D
2. A
3. B
4. B
5. A
6. A

Chapter 5 - Page 41

1. B
2. B
3. A
4. A
5. A
6. B
7. C
8. A

Chapter 6 - Page 47

1. B
2. A
3. C
4. B
5. A
6. C

Chapter 7 - Page 52

1. B
2. B
3. B
4. B
5. A
6. A
7. B

Chapter 8 - Page 57

1. B
2. B
3. A
4. C
5. B
6. C
7. A
8. B
9. A
10. A
11. A

Chapter 9 - Page 62

1. D
2. E

SECTION 2: First Aid

Introduction

The second section of this handbook covers First Aid and related skills.

It is designed to be used as the second part of the DAN Basic Life Support and First Aid (BLS) course, or as the material for the DAN First Aid course which covers only what is included in this section.

This section covers Scene Safety, Bloodborne Pathogens, Assessments, Positioning for Care, Bleeding Management, Splinting, Injuries that require specific consideration, Burns, Temperature-related injuries, Medical Emergencies and Emergency Action Plans.

Reading this handbook without instruction and skill practice will not make someone competent to provide CPR or first-aid assistance.

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Thank you for taking this DAN course and your support of DAN – your dive safety organization!

Response & Assessment

Chapter 9: Scene Safety

Objectives

1. What is **S-A-F-E**?
2. What are some hazards that need to be assessed before providing first aid?
3. Why is exposure protection critical for rescuers?
4. What are some examples of personal exposure protection equipment?

Rescuer safety comes first! A rescuer's ability to provide first aid is impaired if they are injured when approaching the individual or rendering care. Taking the time to assess the scene and circumstances surrounding the person may prevent compromising the rescuer and causing further injury to the individual. Before providing basic life support (BLS), assess the scene, and take steps to avoid or remove any sources of potential injury.

Look for indications of what may have happened and how your response may need to be adapted to accommodate the circumstance.

Scene Safety Assessment

Before providing aid, take a moment to remember the mnemonic **S-A-F-E**.
S-A-F-E is a reminder to:

- **S**top: Take a moment to think and then act.
- **A**ssess the scene: Before assisting another person, determine if the scene is safe. Dangers may include, but not limited to:
  - Fire
  - Chemicals
  - Electricity or gas
  - Traffic
  - Animals (tentacles from a jellyfish or a pet that feels threatened or is trying to protect their person)
- **F**ind: first aid kit, oxygen unit and automated external defibrillator (AED).
- **E**xposure protection: Avoid contact with blood and other body fluids.
  - Locate and utilize barriers such as gloves, eye shields and resuscitation masks.

S	**Stop**	• Stop • Think • Act
A	**Assess the scene**	• Is the scene safe? • Is it safe to approach the injured diver? • Is the ventilation adequate to use oxygen? • Are any other hazards present?
F	**Find oxygen unit, first aid kit and AED**	• Take them to the injured person • First aid kits contain critical supplies such as barriers
E	**Exposure protection**	• Use barriers such as gloves and mouth-to-mask barrier devices • Don gloves, and inspect them for damage

NOTE:
The acronym **SAFE** has long-standing use by DAN programs. Other acronyms may be appropriate in different regions, but they all accomplish the same intent.

D - check for DANGERS to you, bystanders, and the injured/ill person.
R - is the injured/ill person conscious; do they RESPOND?
S - SEND for Help (Activate EMS and answer questions from the dispatcher)

A - is the AIRWAY open and clear
B - is the injured/ill person BREATHING?
C - begin CPR if the injured person shows no signs of breathing or circulation
D - DEFIBRILLATE with an AED

Note:
This reflects an ABC protocol vs the CAB protocol currently utilized in most parts of the world.

ANZCOR Guidelines utilize DRS ABCD.
D - Check for DANGERS to you, bystanders, and the injured/ill person.
R - Is the injured/ill person conscious?; do they RESPOND?
S - SEND for Help (Activate EMS and answer questions from the dispatcher)

A - Is the AIRWAY open and clear?
B - Is the injured/ill person BREATHING?
C - Begin CPR if the injured person shows no signs of breathing or circulation
D - DEFIBRILLATE with an AED

Note: this reflects an ABC protocol versus the CAB protocol currently used in most of the world

Review Questions

1. Potential hazards that should prompt caution when approaching the scene of an accident include:
   a. fire and animals
   b. expired first-aid certifications
   c. electricity, gas and traffic
   d. a and c

2. The **S-A-F-E** mnemonic helps us remember
   a. to activate EMS
   b. scene safety assessment
   c. to use personal protective equipment
   d. b and c
   e. none of the above

3. Personal protective equipment is a critical part of keeping yourself safe while providing care.
   a. True
   b. False

4. Protective equipment includes:
   a. nonlatex gloves
   b. eye shields
   c. resuscitation masks
   d. all of the above

Review answers are on Page 134.

Response & Assessment

Objectives
1. What is the purpose of the OSHA Bloodborne Pathogens Standard?
2. What four things must be present for disease transmission to occur?
3. How is disease transmission prevented?
4. What action should you take if you think you may have been exposed to a bloodborne pathogen?
5. What is zoonosis?
6. What is required when diving in contaminated water?

Risk of Infection

Anyone in a position to provide first-aid care may come in contact with body fluids or other potentially infectious tissue. Personal protection is a critical aspect of first aid and should be exercised in all situations and for all people — this is the principal of standard precautions.

Standard Precautions

The first-aid provider must be aware of possible disease transmission. Blood, semen and vaginal secretions have the highest risk of transmitting bloodborne pathogens. Saliva, sweat, urine and feces have a lower risk. Casual social contact will not transmit these infections.

When providing care to an injured person, be aware of any active bleeding, and protect yourself from possible exposure. Use appropriate personal protective equipment (PPE), including gloves, face shields, protective eyewear and ventilation masks. In some instances you may consider gowns for added protection. Many employers provide PPE in locations where high-risk exposures are likely.

Additional safety precautions include:
- Avoid contaminated sharp objects such as needles or scalpel blades. Dispose of sharps in an approved container after use.
- Thoroughly wash hands after providing first aid.

Responsibility for the use of standard precautions lies with the rescuer. To minimize your risk, know where first-aid supplies are located in your work environment, and carry protective barrier devices in your own first aid kit. Gloves should be a standard part of an emergency response kit and should be donned before providing care. If they become torn, punctured, contaminated or compromised, replace them.

When removing gloves, avoid contact with the contaminated exterior of the gloves. Gloves should be removed in a manner that keeps the outer surfaces of the gloves from touching your bare skin. Details on how to remove gloves are covered in the skills-development section.

Note:
Gloves protect a rescuer but may be contaminated while providing aid. Be careful to avoid skin contact with bodily fluids when removing gloves.

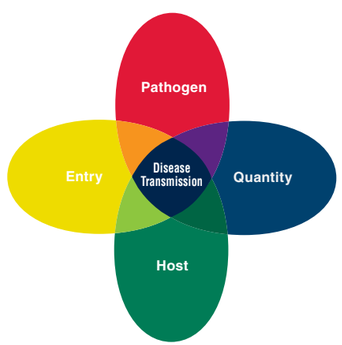
The U.S. Occupational Safety and Health Administration (OSHA) was created in 1970 "to ensure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance."[7] The Bloodborne Pathogens (BBP) Standard in OSHA regulations applies to employees who may come into contact with human blood, bodily fluids, body tissues or organs while carrying out their occupational duties. The primary purpose of the BBP required training is to assist you in understanding the need for protection from bloodborne pathogens, the options to meeting that need, and what to do if an exposure occurs.

Given the wide variety of entities that use the DAN BLS or First Aid course for their training needs, most of the BBP information that follows is very generic. If applicable, facility-specific protocols will be covered by authorized individuals within your company to provide the details needed with your specific operation.

Disease Transmission

For diseases to be transmitted, four things must converge:
- An infectious pathogen
- A sufficient quantity of the pathogen
- Exposure to a susceptible host
- A site of entry/mechanism of transmission

Disease-transmission mechanisms include direct and indirect contact, airborne or vector transmission.



- **Direct** — transfer of a disease agent by person-to-person contact such as touching, biting, kissing, through an open wound and sexual contact

- **Indirect** — transfer of a disease agent through an inanimate object such as clothing, utensils, furniture or doorknobs

- **Airborne** — transfer of a disease agent by droplets containing pathogens subsequently inhaled by another person (Sneezing or coughing by an infected person produces airborne pathogens.)

- **Vector** — transfer of a disease agent via an insect bite (e.g., Lyme disease)

The first three mechanisms of disease transmission are the most common modes of infection in the marine/aquatic environment. Bloodborne pathogens are the specific concern for the first aid provider because blood exposure presents the greatest risk. But the presence of blood is not always as clearly visible as in a cut or wound. It may be present in vomit, urine and feces. Other body fluids can also contain pathogens of concern, although their level of risk is much lower. Simple prevention by avoidance of direct contact is the most effective means of minimizing the risk of infection.

Prevention

Prevention is the best protection. For this reason, first-aid courses focus heavily on use of personal protective equipment (PPE) such as gloves, eye shields, masks and other barrier devices. (PPEs are covered in Chapter 9: Scene Safety Assessment and Standard Precautions.)

Prevention strategies also include thorough washing after any contact with potentially infectious materials and avoiding handling contact lenses, eating or drinking in exposure areas. With the exception of petroleum- or oil-free hand creams, the use of cosmetics should be avoided in these areas.

In some environments you may need protective clothing as barrier devices. If barrier gowns, scrubs or other protective garments are used, the facility will provide them and either dispose of or launder them after use. Such garments should not be worn outside the exposure area. Doing so increases the risk of spreading diseases beyond the controlled exposure areas.

Engineering Controls

Permanent facilities such as aquariums or some commercial diving operations will have stations in designated high-risk areas to facilitate hand washing, eye flushing, and disposal or isolation of contaminated instruments, especially sharps. Field stations or mobile operations will have other options to meet such needs. All options address the requirement to control exposure and minimize the risk of infection.

Three areas should be clearly designated:
- First aid equipment/hand-washing/eye-flush stations
- Hazardous materials disposal (used gauze or bandages, blood-spill kits)
- Areas for eating, drinking, food storage, and cosmetics use

Exposure Control Plan

Each facility that falls under OSHA regulations is required to have an exposure control plan (ECP). This plan is tailored to the specific needs of the individual facility; the designated safety or OSHA Compliance Officer will provide details for your center.

The ECP addresses the use of PPE as well as how contaminated materials are to be handled and properly disposed of. Vaccinations against some BBP, such as Hepatitis B, may be recommended. If so, protocols for receiving vaccinations are covered as part of this plan as this plan, as are the steps the steps to be taken if an exposure occurs, including follow-up procedures.

Documented annual ECP reviews with all personnel are required. The facility is responsible for all record keeping and documentation. You will be advised if your facility is exempt from these protocols.

Epidemiology

There are three specific human bloodborne viral pathogens of which first aid responders should be aware: Hepatitis B, Hepatitis C and human immunodeficiency virus (HIV).

Hepatitis B

Hepatitis B virus (HBV) attacks the liver and may cause both acute and chronic disease. Those infected with the HBV are themselves potentially infectious.[9] Fewer than 5 percent of otherwise healthy people infected with HBV as adults will develop chronic liver disease. The percentage is higher in children infected before age 5. Roughly 20 to 30 percent of adults with chronic infections will develop cirrhosis and/or liver cancer.

- **Transmission**. HBV is transmitted via blood and other bodily tissues including blood transfusions, needle sticks, tattooing and piercing, as well as intravenous drug use and sexual intercourse (vaginal fluids and semen). HBV is very contagious; one in three people exposed to the virus from a puncture wound with a contaminated object will become infected. The virus is also very stable on surfaces outside the body. It can last for up to seven days, making decontamination and clean up very important. There is a vaccine available for HBV that is 98-100% effective and is required of most health care workers.

- **Symptoms**. Most people do not experience symptoms when newly infected. Acute symptoms can last for several weeks. Symptoms may include:
  - Yellowing of the skin and eyes (jaundice)
  - Extreme fatigue
  - Dark urine
  - Nausea and vomiting
  - Abdominal pain

  For some people, symptoms may persist for several months or up to a year.

Hepatitis C

Hepatitis C virus (HCV) is another bloodborne pathogen that can cause severe liver damage. Of those infected with HCV, about 30 percent of infected people spontaneously clear the virus in six months without treatment. Antiviral medications cure more than 95 percent. The remainder have a 15 to 30 percent risk of developing cirrhosis within twenty years.[10]

HCV may cause a relatively mild acute illness or jaundice. Approximately 80 percent of people do not exhibit symptoms, and symptoms may take 2 weeks to 6 months to manifest. Acute symptoms are similar to those of Hepatitis B. Even chronic disease may remain asymptomatic.

- **Transmission**. Routes of transmission/infection are the same as for HBV. The most common source for infection is seen in people who share injection equipment or reuse needles. HCV has also been contracted from blood transfusions (prior to July 1992), needle sticks in health care settings and through sexual intercourse.[10]

- **Symptoms**. People infected with HCV are potentially infectious even if asymptomatic. Symptoms for HCV include:
  - Fever
  - Fatigue
  - Decreased appetite
  - Dausea and vomiting
  - Abdominal pain
  - Dark urine
  - Gray colored feces
  - Joint pain
  - Yellowing of skin and eyes (jaundice)

HIV/AIDS[11]

The human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), attacks the immune system and impairs the body's ability to fight infections.

- **Transmission**. HIV can be transmitted from person to person through contact with infected blood and bodily fluids, including breast milk. HIV cannot be transmitted through casual contact. A puncture-wound exposure from an infected source has an infection risk of 1 in 300. There currently is no immunization or known cure for HIV. However, treatments are available that have been successful in suppressing the virus, reducing its transmission.

- **Symptoms**. People infected with HIV may remain asymptomatic for 2 to 15 years years but can still pass the infection to others. Most infected people develop antibodies within 28 days. Once infection has been confirmed, retesting and treatment options should be pursued.

Some of the potential signs and symptoms of infection include:

The first few weeks after initial infection may be characterized by influenza-like illness including fever, headache, rash or sore throat.

As the infection progresses symptoms may include:
- Swollen lymph nodes
- Weight loss
- Fever
- Diarrhea
- Cough

If You Have Been Exposed

If you believe you have potentially been exposed to a bloodborne pathogen, follow these steps:

- If there is an open wound, do not milk it to make it bleed.
- Wash the wound with soap and water.
- Wash potentially contaminated material off your skin as quickly as possible with soap and water. This is especially important when your skin has cuts, rashes or scrapes.
- For splashes in your face, flush potentially contaminated material from the mucous membranes of your eyes, nose and mouth using large amounts of running water.
- Report the injury per the protocol outlined in your company's emergency action plan.
- Seek medical evaluation and counseling regarding exposure at a local medical facility (emergency department).

Zoonosis

In the marine environment there is also concern about transmission of diseases or infections from marine life to humans. Zoonosis is a general term describing diseases carried by vertebrate animals and contractible by humans. This disease group is not technically part of bloodborne pathogens; however, many of the same diseasetransmission concerns and prevention measures apply. Therefore, it is practical to address them here.

- **Transmission**. These diseases can be transmitted via direct contact, handling of contaminated inanimate objects or aerosols. Zoonotic diseases result from infection by bacteria, fungi or protozoa. Human infection typically occurs through penetrating wounds but can occur through existing open wounds, ingestion, inhalation or contact with mucous membranes. The possibility that any animal or habitat may be carrying a zoonotic disease should be considered when planning diving activities.

- **Symptoms**. Symptoms will vary with the specific disease but may include itching, rashes, nodules, inflamed lymph nodes, nausea, diarrhea and fever. Any symptoms should be evaluated by a health care provider.

- **Prevention**. Use of protective clothing is recommended when around animal areas. Cuts, abrasions and other open wounds should remain covered when the possibility of contact may occur. Injuries incurred should be thoroughly cleaned and monitored for symptoms. Diving activity is discouraged until adequate healing has occurred.

Thoroughly wash all areas in direct contact with animals or their habitat following exposure. Full showers as soon as possible after any diving activity are recommended. To reduce the risk of inadvertent ingestion of infectious matter, avoid eating or drinking in areas where animals are or have been present.

Contaminated Water and Chemicals

Exposure to contaminated water and chemicals is a common risk faced by some professional divers, including commercial and public safety divers; this requires specialized training that is beyond the scope of this course.

Hazardous-material and contaminated-water training is available through emergency and disaster training agencies. A number of resources are provided in the back of this book for those interested or in need of this kind of training.

Whatever care you provide, particularly as it relates to emergency and disaster response, act within the scope of your training and preparation and with the appropriate equipment.[6] Do not put yourself in danger.

Review Questions

1. When removing gloves after providing first aid, it is important to keep the outer surface of the glove from touching your skin.
   a. True
   b. False

2. The OSHA Bloodborne Pathogens Standard exists to
   a. ensure safe and healthful conditions for working men and women
   b. set and enforce standards
   c. provide training, outreach, education and assistance guidelines
   d. all of the above

3. Disease transmission occurs when which of the following is present?
   a. an infectious pathogen
   b. sufficient quantity of the pathogen
   c. exposure to a susceptible host
   d. site of entry/mechanism of transmission
   e. all of the above

4. Disease transmission can be prevented by
   a. personal protective equipment
   b. thorough hand washing
   c. engineering controls
   d. all of the above

5. If you think you may have been exposed to a bloodborne pathogen, you should
   a. cover it tightly to protect it
   b. milk it to make it bleed
   c. report it according to your organization's emergency action plan
   d. both b and c
   e. all of the above

6. Zoonosis is a generic term describing dis eases transmitted from vertebrate animals to humans.
   a. True
   b. False

7. Specialized training is required when diving in contaminated water.
   a. True
   b. False

Review answers are on Page 134.

Response & Assessment

Chapter 12: Assessments

Objectives
1. What are the two general types of assessments?
2. What are the three steps to the Initial Assessment Sequence?
3. What is agonal breathing?
4. What is a secondary assessment?
5. What general guidelines should be used when conducting a secondary assessment?

There are two types of assessments: Primary or Initial, and Secondary. The objective of each type of assessment is to determine what issues the injured or ill person has, and for the responder to develop a course of action.

In the Primary or Initial Survey, the objective is to quickly identify immediate life-threatening issues. The Secondary Assessment is to help determine any other issues, be they minor or major.

Primary Assessment

The assessment sequence consists of these primary steps:
- Rapid assessment of normal breathing and the presence of a pulse, and assess for level of consciousness.
- Activate EMS.
- Adjust the individual's position for ongoing care as appropriate. (This will be discussed later in this course.)

Assessing Responsiveness and Checking for Signs of Life

In the first part of the Initial Assessment the responder is looking for the ABC's – Airway, Breathing, and Circulation, then the person's level of consciousness and their chief complaint.

Once a rescuer ensures the scene is safe, assess the individual's level of responsiveness. Tap the person's collarbone and shout, "Are you OK?" Remember to introduce yourself, state you are

trained in first aid and express your desire to help. If they are responsive, you know they have an Airway, are breathing, and circulation is present.

If the person can answer, leave them in the position in which they were found. Call EMS, and then, if there is no evidence of injury, place the individual in the recovery position or a position of comfort. The rescuer should reassure the injured or ill person and try to find out what happened, asking what their chief complaint is specifically.

Then the responder can then assess the individual's level of consciousness. The level of consciousness can be evaluated using the A-V-P-U acronym. This assessment can and should be used continuously during care while awaiting EMS. It will identify changes in responsiveness, alerting you to changes in the injured person's condition.

A	**Person is alert**
V	**Not alert but responds to verbal stimuli**
P	**Not alert but responds to painful stimuli**
U	**Unresponsive to all stimuli**

If the individual does not respond, quickly check for normal breathing. To check for a pulse, use the first two fingers of either hand to press gently on the appropriate artery. For adults and children, check for the presence of a pulse at the carotid artery in the neck. Locate the carotid artery by placing your first two fingers on the "Adam's apple" of the person's throat, and slide your fingers toward you and slightly upward into the groove on the side of the neck. Allow at least five seconds but no more than 10 seconds to determine if a pulse is present. Some pulses may be difficult to identify if thick tissue is present in the neck. Adjust the pressure of your fingers as necessary, but avoid excessive pressure because blood vessels can be collapsed, obscuring a pulse. If no pulse is present or you are unsure, activate EMS immediately or send a bystander to call for help then begin CPR. If you are not trained in CPR, get with your DAN Instructor to become CPR trained.

Note:
Abnormal respirations are commonly associated with cardiac arrest. Breathing efforts may be infrequent, irregular, diminished or characterized as noisy gasps known as agonal breathing. This type of breathing is quite different from that seen in a normal resting or sleeping person and is not adequate to support life. Abnormal respirations may be present in both responsive and unresponsive injured/ill people.

Note:
For individuals with a definite pulse or showing signs of life (movement) but not breathing normally, chest compressions are not required. Provide rescue breaths to supplement abnormal or absent breathing. This skill is addressed later in this course.

The rescuer should also try to keep bystanders at a distance to avoid added stress. Enlist the assistance of others, if necessary. To establish responsiveness with infants, rub or tap the soles of their feet, or tap their shoulder or chest. Do not shake an infant. Check for a pulse in infants at the brachial artery in the upper arm. Locate the brachial pulse by placing your fingers on the inner arm just under the armpit and in the groove formed by the muscles of the arm. Use gentle pressure here as well, adjusting as required to find a pulse, if present. Allow at least five seconds but no more than 10 seconds to determine if a pulse is present. If no pulse is present and you are alone, begin CPR (CPR for infants is described later in this course). Conduct CPR for two minutes, then activate EMS if not already done.

Secondary Assessment

A Secondary Assessment can be used to determine if a person has other injuries or to help determine which injury to address first. Performing a secondary survey may reveal a more serious injury than the person's chief complaint. Sometimes the chief complaint is the one that is causing the most pain or discomfort, but it may not necessarily be life-threatening. The secondary survey can help the responder identify more serious injuries that may not present themselves with as much pain as other, less-serious, injuries.

To conduct a secondary assessment, leave the injured person in the position they were found and conduct the assessment. You will use your eyes and hands to identify any abnormalities or problems. You are looking for anything that doesn't seem right, specifically looking for:

- Deformities (Fractures are often associated with falls and can cause considerable pain and limb deformity.)
- Contusions (Bruises, especially bruising in the abdomen and these are often very tender)
- Abrasions
- Punctures/Penetration injuries
- Bleeding
- Tenderness
- Lacerations
- Swelling

General Guidelines

Before you begin a secondary assessment, remember to be S-A-F-E and protect yourself from bodily fluids with personal protective equipment. Ask for permission before initiating your assessment, and advise the individual that the exam requires limited touching. Pay close attention to his response to your examination, and note any areas where pain or discomfort occurs. Signs of serious injury should prompt EMS activation. If a life-threatening injury is noted,

stop the assessment and deal with the injury and activate EMS if not already accomplished.

As you conduct the secondary survey, talk with the injured person to determine if they have any pain or particular discomfort. This is also a good opportunity to conduct a **S-A-M-P-L-E** survey. (see Additional Material box)

S	Signs / Symptoms
A	Allergies
M	Medications
P	Pertinent medical history
L	Last oral intake
E	Events leading to the current situation

Signs/Symptoms: Signs are what the responder can observe about the injured or ill person such as the color of their nail beds or their breathing (rate and depth), responsiveness, or visible bleeding. A symptom is what the injured or ill person tells you they are experiencing. Examples of symptoms include dizziness, nauseous, hot or cold, and blurry vision. Has the injured or ill person ever experienced these signs/symptoms before? Record any signs or symptoms that you notice or are reported. When possible, record direct quotes by the injured or ill person as they describe their symptoms.

Allergies: This includes medications, food, animals, and environmental exposures. While an allergy may seem benign at first, that allergy may give you, and EMS, other information that could be critical. Common allergies are to bee stings, certain foods such as peanuts or strawberries and certain medications like penicillin (PCN).

Medications: Ask the person if they are taking any medications, including any over-the-counter medications, such as pain relievers, cold remedies, multivitamins or herbal supplements. Consider asking if they have been using recreational drugs if the circumstance warrants.

Pertinent Medical History: Pertinent is a key term here. Major medical issues are the concern. For example, we do not need to know about childhood illnesses with no after effects, but we do need to know if they had a cardiac event last few years.

Last Oral Intake: Ask what and when the person has had to eat or drink most recently. Even if the injury appears minor, ask.

Events Leading to the Current Situation: Have the injured or ill person describe in as much detail as they can, the events leading up to the incident. When recording their statements, use as many direct quotes as possible.

If the person is unresponsive, and their spouse, parent/guardian, significant other or friend is present, you should ask them for as much of this information as possible. Asking them will help you in your assessment, and the information gathered will be helpful to EMS when they arrive.

Part of the initial history includes recording pulse and respiration rates (vital signs). Vital signs, which help provide a baseline of the individual's condition, should be monitored because they may indicate a change in the individual's condition. Each measurement is recorded in a per-minute format. To quicken the process, count each for 30 seconds and multiply by two.

Conducting the Assessment

Use your eyes and hands to find any abnormalities or possible problems.

Start at the head, looking for signs of injury, blood or body fluids and note any areas that stimulate a painful response.

Inspect the person's nose and ears for blood or fluid.

Palpate the person's neck. The mechanism of injury will give you a good idea about whether a head or neck injury is likely.

Move in front of the individual, and shade their eyes from the sun or lights. Do this one eye at a time to see if the eyes dilate in response to the shade.

Next, palpate the person's collarbone to check for deformities or discoloration. Press your fingers along each collarbone individually to assess movement or reaction to your examination.

Examine the chest by placing both hands on either side of the rib cage, and ask the individual to take a deep breath. Note any open wounds. If you see bubbling, apply direct pressure to the wound to stop air from moving in and out.

Note:
If the injury is related to scuba diving, feel the front of the neck for air bubbles and a crackling sound coming from underneath the skin. This sign indicates subcutaneous emphysema, which is caused by air bubbles escaping from the lungs and chest cavity, or it can indicate a lung overexpansion injury. If this sign is present, call EMS if you have not already done so.

Divide the abdomen into four quadrants with the navel as the center point. Gently press on each quadrant in turn to check for any areas that are sensitive, stiffened, hard or painful. If the individual complains of pain in any particular area, press on that area last.

If the lower back can be easily reached without moving the injured person, palpate the areas of the back that can be assessed.

Next, place a hand on either side of the person's pelvis, and gently push straight down and then in from both sides. Note any instability or painful responses.

Finally, palpate down the legs and arms by gently squeezing to feel if bones beneath the skin and muscle are displaced. Areas of obvious deformity do not require palpation as pain and further injury is possible. Attempt to stabilize the injured limb to limit movement and pain if EMS will be delayed (more than 10 minutes).

Test for retained nerve and motor control by asking the person to wiggle his fingers and toes.

Note any findings and pass onto EMS personnel.

Review Questions

1. The two types of assessments are
   a. There is only one assessment
   b. Initial and complete
   c. Primary and secondary
   d. Partial and complete

2. The purpose of a secondary assessment is to identify injuries that may not be readily apparent.
   a. True
   b. False

3. What are the three steps to the Initial Assessment sequence?
   a. Rapid assessment of breathing and pulse; level of consciousness; activate EMS
   b. Check for Pulse and begin CPR
   c. Stop; Assess the scene: Find the first aid kit.
   d. Secure the scene; Activate EMS and wait

4. Any breathing sounds at all are considered normal?
   a. True
   b. False

5. What are some of the general guidelines when conducting a secondary assessment?
   a. Remember SAFE; work from the feet to the head
   b. Ask permission; use a gentle, but firm, touch
   c. Look for deformities, contusions, bleeding, tenderness and swelling
   d. Remember SAFE; ask permission; activate EMS if needed
   e. b and c

Review answers are on Page 134.

Response & Assessment

Chapter 13: Positioning for Care

Objectives

1. When should the recovery position be used?
2. When should the recovery position not be used?
3. What technique can be used to move a person from laying on their front to laying on their back?

Positioning an Injured or Ill Person for Care

If the person is responsive, and able to move — After assessing for injuries, place an them in a position of comfort: seated, supine (lying flat on the back) or in the recovery position. Depending on the injury, some positions may be more comfortable than others. For instance, someone experiencing a cardiac or respiratory event may feel better sitting up and slightly reclined. While those with other injuries may feel better laying down.

If the person is unresponsive, -- if they are still breathing and have a pulse, place them in the recovery position. This minimizes the risk of airway obstruction by the tongue or body fluids for individuals with a reduced level of consciousness.

Recovery Position

If normal breathing is present or resumes, place the unresponsive, injured person in the recovery position to ensure an open airway. This helps to prevent blood and vomit from obstructing the airway or flowing into the lungs. Should vomiting occur or if blood or other fluids are present in the mouth, gravity will aid in their removal and minimize the chance of aspiration. It does not matter which side in the absence of other influencing factors - injury, trauma, accessible space.

Remember to call local EMS. Until help arrives, continually check that the individual is still breathing. If EMS is delayed, rotate person to other side every 30 minutes if there are not any contraindications – injury, trauma, accessible space.

The recovery position is accomplished from a supine (on their back) position.

- Kneel beside the individual, and make sure that both of their legs are straight.
- Place the individual's arm nearest to you at a right angle to their body, with elbow bent and palm facing upward.
- Bring the far arm across the individual's chest, and hold their hand against the cheek nearest to you.
- Place your other hand under the leg farthest from you just above the knee, or grab the pant leg of their clothing, and pull the knee up, keeping the foot on the ground.
- Holding the individual's hand against their cheek, pull the far leg to roll them toward you and onto their side.
- Adjust the top leg to form 90-degree angles at both the hip and knee.
- Tilt the head to ensure the airway remains open.
- Adjust their hand under their cheek, if necessary, to keep the head tilted.
- Assess breathing and circulation regularly.

Note:

Do not place people with suspected spinal injury in the recovery position because it places them at increased risk of further injury.

If you use the recovery position, monitor the peripheral circulation of the person's lower arm, and ensure that the duration of pressure on this arm is kept to a minimum.

Log Roll

If the person is not on their back, you need to roll him into that position. To minimize the risk of neck and back injury or in the case of suspected spinal trauma, use the log-roll technique.

- Kneel at the unresponsive person's side.
- Carefully straighten their arms and legs; place the arm closest to you above their head; place their other arm against their torso.
- Support the head and neck with one hand.
- Place your other hand on the opposite arm, and pull it gently into their side.
- Roll the individual toward you, while avoiding twisting their head, neck and back.
- Use a smooth, continuous movement to roll the person to their side and then onto their back.
- Keep twisting movements to a minimum throughout the entire roll.

Note:
When two rescuers are present, one should immobilize the individual's head while the second person rolls them onto their back. The rescuer at the head controls the action by directing when to roll the person.

Review Questions

1) Placing an unconscious, breathing person in the recovery position is important to maintain an open airway and to minimize the potential of blood and vomit to cause obstruction.
   a. True
   b. False

2) Persons with neck, spine or pelvic injuries should not be placed in the recovery position.
   a. True
   b. False

3) A breathing, responsive injured diver should be placed in a position of comfort or the recovery position.
   a. True
   b. False

4). If a person is on their stomach (prone), one technique to use to move them to a supine position is the _____
   a. Pia roll
   b. Back roll
   c. Jelly roll
   d. Log roll

Review answers are on Page 134.

Response & Assessment

Chapter 14: Lifting & Moving

Objectives
1. What are the general considerations for a rescuer when attempting to move an ill or inured person?
2. When should an ill or injured person be moved?

It is extremely rare that a rescuer would be called upon to move an injured person. In fact, moving a person is strongly discouraged due to the additional injury that is often caused to the individual in the attempt. You should leave the person in the position found. Avoid moving anyone with suspected neck, spinal or pelvic injury.

There are two exceptions:
- The person needs to be moved onto their back for CPR.
- The person is in imminent danger (e.g., due to fire, explosives or uncontrolled traffic).

Use discretion when moving an injured or ill person, and avoid it if at all possible. If a situation presents in which a move is absolutely necessary, however, there are several ways to move someone.

Move the person in an orderly, planned and unhurried fashion to protect both the firstaid provider and the person being moved. Plan ahead, and select the safest and easiest method(s) that involves the least chance of rescuer injury. Remember that rescuer safety comes first. Putting yourself in danger is generally not recommended.

When lifting, protect yourself, and remember important principles of body mechanics, including maintaining a straight, rigid back and bending at the hips, not at the waist. Keep your head in a neutral position, not flexed forward or extended backward. Use your legs, not your back, to lift. Body alignment is also critical for the injured person. Keep the spine aligned, and move the person along the long axis of their body.

Armpit-Forearm Drag (Rautek Technique)

To perform the armpit-forearm drag (also known as the Rautek move), reach under the individual's armpits from behind, and grab their left forearm with your right hand and their right forearm with your left hand. Pull the person in the direction of the long axis of the body.

Shirt Drag

If the individual is wearing a collared shirt, you can use it to support their head and pull by grabbing the shoulders and collar of the shirt. Support the their head at the base of their skull with your fists, and pull along the long axis of the body. Be careful not to compromise the person's airway.

Coat or Blanket Drag

Another effective technique is to use a coat or a blanket to drag a person to safety. To get the individual onto the blanket, you will need to roll them onto their side and then tuck the blanket underneath them. Lay the person back down, and pull the other edge of the blanket out from beneath them. Gather the blanket into place under the person's head in a similar manner to the shirt drag, and pull.

Lifts

To lift a person off the ground, use a direct ground or an extremity lift. Use these techniques only when there is immediate danger to the injured or ill person; none of these techniques allows you to adequately protect the individual's spine in case of an injury to the head, neck or spine. With heavier individuals, a long backboard is more effective and minimizes potential injury to the individual and rescuer.

A direct ground lift requires two or more rescuers. They should be on the same side of the person. One rescuer supports the person's head, neck and lower back. The other rescuer supports the hips and legs.

The extremity lift also requires two rescuers: one to lift from behind the person, reaching under the arms and grasping the person's opposite wrists, and the other to lift at the person's knees by wrapping their arms around the individual's legs.

Review Questions

1. Movement of an injured person should be limited to times of emergency or when the current location places the individual at risk of further injury.
   a. True
   b. False

2. The rescuer should consider which of the following body mechanics when lifting?
   a. keep back straight
   b. bend only from hips
   c. keep head neutral
   d. lift with legs
   e. all of the above

Review answers are on Page 134.

First Aid Skills

Chapter 15: Bleeding Management

Objectives

1. What is the primary function of blood?
2. What is the body's response to bleeding?
3. How can the rescuer help control bleeding?
4. When and how should a tourniquet be placed?

The primary function of the blood is to supply nutrients and oxygen to body tissues and to remove waste products such as carbon dioxide. Blood consists of approximately 55 percent plasma (liquid) and 45 percent cells or solid particles (44 percent red blood cells and 1 percent white blood cells and platelets).

The circulating blood volume in an adult is approximately 5 quarts/liters. Actual blood volumes will vary depending on body size. Acute blood loss may result in hypovolemic shock, a condition in which decreased blood volume causes inadequate tissue oxygen supply. Severe bleeding (hemorrhaging) must be stopped to avoid hypovolemia, which is especially important in children because they have less circulating blood volume than most grown adults.

The body has two mechanisms for limiting blood loss. The first is vasoconstriction (narrowing of blood vessels), which occurs in response to injury and helps reduce blood loss. Second, platelet activation initiates blood clotting. For minor bleeding, this process works extremely well and with little support will stop blood loss. When bleeding is more severe, additional intervention may be needed.

First responders can aid the clotting process by applying direct pressure on the wound, using an absorbent bandage.

When approaching an injured person perform the following steps:

- Assess the scene and ensure that the person is breathing
- If the injury requires medical attention, activate EMS
- Ask permission to provide first aid
- Don gloves/personal protective equipment

Direct Pressure

- Direct pressure over a bleeding site is usually sufficient to control most bleeding. This is accomplished by using gloved hands, absorbent pad or dressing. If the bleeding continues and seeps through the pad, add additional absorbent material on top of the original pad. Do not remove the original pad. Dressing removal may remove clotting blood and disrupt the clotting process. Continue to hold direct pressure until the bleeding stops.
- Secure the pad with a clean or sterile bandage. The bandage should be big enough to cover the pad, extending past the edge (1-2 inches if possible). Wrap the bandage from the distal side (farthest from the heart) of the wound site toward the heart.

Note:
Direction of the bandage wrap is not critical to managing the injury. Wrapping the bandage from distal to proximal however does provide for a more secure bandage.

- The bandage should help maintain direct pressure but not prevent circulation. You can check circulation by squeezing the nail beds and looking for the pink color under the nails to return quickly after pressure is released. It should return to its normal pink color in 2-3 seconds. In cold conditions, color refill may take slightly longer. If color does not return in a timely manner, loosen the bandage and rewrap.

Hemostatic Dressings

Another option for controlling bleeding that is not responding to direct pressure or is located in an area where a tourniquet cannot be used is a dressing impregnated with hemostatic agents. Impregnated dressings may have a colored line (typically blue) through the length of the gauze for easy identification.

Remove any other dressing materials so the agents can have direct contact with the bleeding site. Cover the entire bleeding surface with the hemostatic dressing, and continue to apply direct pressure. Apply additional layers of hemostatic dressings if necessary. Hold dressings in place with a pressure bandage.

Advise medical personnel that a hemostatic agent was used to assist with control of bleeding. Retention of the dressing's packaging material may be helpful to emergency personnel. Hemostatic dressings should not be left in place more than 24 hours.

Wound Packing

In the case of penetrating wounds such as propeller injuries or knife wounds, bleeding is occurring inside the wound. Direct pressure on the external surface of the wound will not provide pressure at the source of the bleeding. For these wounds, dressing material should be packed into the wound and lateral pressure applied and maintained during the wound packing process.

Hemostatic impregnated gauze, if available, is a good choice for this type of wound. If it is used, advise EMS personnel. It will require some modification in their care.

Tourniquets

If direct pressure fails to control massive bleeding, the next step may be to utilize a tourniquet if the injury is on an extremity. Tourniquets are a primary intervention when the bleeding is a massive arterial (spurting) bleed and is life-threatening.

A tourniquet is a wide band, at least 5cm (2 inches), placed tightly enough around an arm or leg to stop blood flow. It must be applied with sufficient force to stop arterial bleeding, not just venous bleeding. Arteries are deeper in the body and therefore require forceful pressure to stop arterial flow. This is accomplished with the use of a windlass device (part of a commercial tourniquet or makeshift in an improvised tourniquet). Double check the effectiveness of a tourniquet by assessing distal pulses, which should not be present if the tourniquet is applied tightly enough.

Newer tourniquets have appeared in the market that do not use a windlass to tighten the tourniquet. These tourniquets utilize a ratchet mechanism that quickly applies pressure and is self-securing.

A tourniquet should be:

- Utilized only when direct pressure is not effective
- Placed 1-2 inches proximal to the wound or high on the limb when source of bleeding cannot be readily identified.

Note:
Tourniquet placement may be determined by local regulations or protocols. Check with your DAN Instructor for the protocols in your area.

A tourniquet should NOT be:

- Placed directly over knees, elbows or other joints. If there isn't room to place a tourniquet between a wound and a joint, place the tourniquet 1-2 inches proximal to the joint.
- Made of wire or rope. A narrow, excessively tight or insufficiently padded band may cause local damage to tissues in minutes.
- Utilized with injuries caused by venomous animals.

Applying a Tourniquet

Before applying a tourniquet, inspect the wound to ensure direct pressure was being applied directly to the site of the bleeding. If not, attempt direct pressure once more. Place a commercial tourniquet as noted above and secure it in place. Twist the windlass until bleeding stops and secure it with the mechanism on the tourniquet.

Wrap an improvised tourniquet proximal to the wound, as noted above, several times, and secure it in place with an overhand knot. Place a stick or similar object on top of the knot, and tie a second overhand knot over it. Twist this "handle" just until the bleeding stops. Secure the handle in place by wrapping it with a second bandage.

Use a marker to write on the injured person's forehead "T" or "TK" (for "tourniquet") and the time the tourniquet was placed. This ensures subsequent caregivers are aware the tourniquet is there and how long it has been on. The tourniquet should not be removed until the injured person is under advanced medical care.

Tourniquets may cause pain in the extremity. Advise the injured person of this when applying the tourniquet.

Death of tissue below the tourniquet is possible after two or more hours. However, documentation exits of limb survival for extended periods of time after placement of a tourniquet.

Review Questions

1. The primary function of the blood is to supply nutrients and oxygen to the body tissues and to remove carbon dioxide.
   a. True
   b. False

2. Should the first dressing become soaked, you should, _____
   a. Remove the dressing and replace it with a fresh dressing
   b. Place additional dressings on top of the existing dressing as needed
   c. Remove the dressing and irrigate the wound
   d. Leave it as is

3. Which of the following is the first line of action to control external bleeding?
   a. direct pressure
   b. tourniquets
   c. hemostatic dressings

4. A tourniquet should be placed _____
   a. if the wound exhibits massive arterial bleeding
   b. if bleeding is not stopped by direct pressure over the wound
   c. 2.5-5cm (1-2 inches), or high and tight
   d. all of the above

5. A tourniquet should be removed after two hours regardless of continued bleeding.
   a. True
   b. False

Review answers are on Page 134.

Objectives
1. What are the two general categories of fractures?
2. What is the difference between a Strain and a Sprain?
3. What is a dislocation?
4. What is the proper splinting technique?

Fractures

There are two general categories of fractures open and closed. A closed fracture means the bone does not puncture the skin. A deformity may or may not be visible. Open fractures occur when the broken bone punctures the skin. The bone may be observed or may have retreated back under the skin, but the open wound is still present. Open fractures are at high risk for bone and tissue infections. They should be covered with sterile dressings as soon as possible and the limb immobilized. Although such wounds will bleed, avoid excessive pressure.

Check pulses, capillary refill and sensation in any injured limb. Be sure movement of the fingers and toes is possible and the individual has normal sensation distal to the injury. Repeat these checks every 15 minutes after you apply a bandage to ensure that circulation hasn't been impaired.

Apply a splint any time you think one might be helpful, but do not attempt to push or realign bones back into place. Pad the injured area to provide both security and comfort, and prepare to evacuate the injured person to the nearest appropriate medical facility.

Strains and Sprains

Bones are connected to other bones by ligaments. Bones are connected to muscle by tendons. Ligaments, tendons and muscles work together to move the bones and joints. Sometimes injuries happen to these soft tissues as well. The usual mechanism is either trauma or stretching or tearing of the ligament or tendon. This typically occurs when a joint is displaced beyond its normal range of motion.

These types of injuries can be very mild – requiring only a few days to heal. Other times these injuries may require surgery.

To treat an injured person with a strain or sprain, apply a splint as you would with a suspected fracture.

Dislocations

Dislocations are when the normal position and function of a joint becomes disturbed. Forceful trauma often causes these types of injuries. Once a joint is dislocated, even after relocation by medical personnel, it usually takes less force to dislocate the same joint again. It is common for ligament injuries to accompany dislocations. Sometimes other soft tissues, like muscles, blood vessels and nerves, are also adversely affected. A joint can become partially or fully dislocated and then return to its normal function and position spontaneously, known as subluxation. Other times, the joint can remain entirely out.

As you assess the affected joint and the anatomy distal to the injury, advise EMS immediately if you note diminished circulation or sensation.

Treatment of dislocation is like that of a strain, sprain or break. Do not attempt to realign or relocate the dislocated joint. Instead, splint the dislocation in place as you would a broken bone.

Splinting

Splints reduce movement and physical stress to injured limbs. If EMS is readily available, protect and stabilize the injured limb and wait for help. In a remote location or if emergency services are delayed, splints can both ease pain and protect the limb from further injury. Properly applied splints or casts will not only secure the injured area but will also immobilize the joints above and below the injury. For example, if splinting a forearm immobilize both the wrist and elbow.

You can use just about anything to immobilize an injured limb. Commercial splints may be made for a specific purpose, but splint materials can be improvised. Prior to splint application, remove all jewelry, and ensure adequate visualization of the injured area. This may involve cutting away clothing. Keep the injured area in the same position. Do not attempt to realign the bones (reduce) or straighten the limb. Immobilize joints on either side of the fracture to prevent further injury. Once the splint is in place, check the fingers or toes for circulation, movement and sensation (CMS). Continue to monitor circulation, movement and sensation.

Review Questions

1. What are the two general categories of fractures?
   a. open and closed
   b. simple and compound
   c. complete and incomplete
   d. painful and not painful

2. A sprain is the overstretching of a ligament.
   a. True
   b. False

3. A dislocation only affects the joint.
   a. True
   b. False

4. The proper technique for splinting is:
   a. splint only the affected area and check for CMS
   b. immobilize the joint above and below the injury and check for CMS
   c. only splint a suspected fracture and check for CMS
   d. only use commercially available splints and check for CMS

Review answers are on Page 134.

First Aid Skills

Chapter 17: Special Considerations

Objectives

1. When should an impaled object be removed?
2. How do you treat an amputation?
3. What is the method to treat an eye injury?
4. How do you bandage a joint?
5. How do you address an open chest wound?
6. What should you do with an abdominal wound?
7. How does a first aid provider deal with internal bleeding?
8. How do you manage a suspected spinal injury?
9. What do you do with an avulsed tooth?
10. What are the signs of an infected wound?

There are some injuries that require specific interventions to help obtain a favorable outcome. Each of these will be discussed individually.

Impaled Objects

If the injury includes an impaled object, leave the item in place. Secure it with dressings and bandages, and transport the injured person to advanced medical care. Object removal is generally not advised because it may cause additional injury. An exception to this protocol is when the object penetrates the cheek and into the mouth. In this case removal is advised if it won't result in further harm. Objects that have penetrated into the mouth may cause airway obstruction or impede airway management, therefore it is best to remove them. Once the object is removed, apply absorbent material (gauze) to both sides of the wound.

Amputation

Sometimes a trauma involves the removal of a part of the body. Amputation injuries could range from a finger getting pinched in the hinge of a dive boat ladder to the severing of an entire limb. With an amputation, control bleeding as necessary using the techniques previously covered, including utilizing a tourniquet. Be ready to treat for shock or provide CPR if necessary.

If the amputation is incomplete and the skin, muscle or tendons are still attaching the body part, immobilize it using a splint and bulky gauze. Never detach an incomplete amputation.

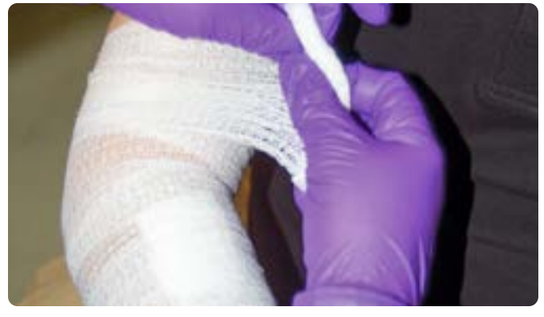
If the amputation is complete, attempt to preserve the parts, no matter how damaged they appear to be. Wrap them in saline-moistened gauze, seal them in a plastic bag and place it in a container with ice. Do not place the amputated part directly on or in the ice. Ensure the amputated part is transported with the injured person.

Eye Injuries

With eye injuries, it may be necessary to cover the injured eye to minimize pain and to provide comfort. To patch an eye, fold clean gauze over the closed eyelids, then place tape over the eyes with anchors at the forehead and cheek. Bandage both eyes in a manner that eliminates gaps at the edges of the bandage to prevent the injured eye from moving with the uninjured eye.

Bandaging Joints

When applying bandages across joints, maintain the area in a comfortable position, and try to keep the joint immobilized to minimize further discomfort or bandage displacement.



Open Chest Wound

Sometimes the injured person has a severe injury to their chest. Trauma to the chest can lead to a condition called pneumothorax, in which a leak in the lung causes air to collect. In diving this can be caused by rapid ascent or breath-holding during ascent. Another common cause of a pneumothorax is a blunt or penetrating wound to the chest; for example, slipping on the wet boat deck and hitting your ribs on the gunwale of the boat or accidental discharge of a spear gun. Sometimes this trauma generates a hole in the chest wall that allows air exchange between the chest cavity and the outside air. This kind of injury is called an open or a sucking chest wound.

If you have an open chest wound, tape an occlusive dressing around the injury by covering the hole with clear plastic (like a piece of clear plastic wrap or a sandwich bag) and taping the plastic on three sides. The incomplete seal allows exhaled air to escape, but the flap from the open fourth side will close to prevent external air from getting into the chest cavity. A transparent material is ideal so EMS can better see what is going on, but aluminum foil or a piece of a garbage bag will work if nothing else is available.

Similarly, an open neck wound can lead to the risk of a gas embolism in the brain. An occlusive dressing is appropriate in these conditions as well. A commercially-available product like HyFin® Vent Chest seals can work well in these circumstances.

Abdominal Wounds

Abdominal injuries that result in exposure of internal organs are medical emergencies and should prompt immediate activation of EMS. If faced with an abdominal injury in which internal organs are exposed or protruding, don't touch the organ or push it back into the abdominal cavity. Simply cover it with a dressing moistened with sterile or clean drinking water, and protect the injured person from further harm. Provided the injured person hasn't suffered a spinal injury, you may also flex the injured person's knees and hips to relax the abdominal muscles.

Internal Bleeding

Internal bleeding can be a life-threatening condition. It requires immediate medical attention from EMS or hospital personnel. It often results from blunt trauma, sudden deceleration injuries (such as a car collision), or certain bone fractures (e.g., femur or pelvis).

The following may indicate internal bleeding:

- Rigid or swollen abdomen
- Vomiting or coughing blood
- Blood in urine
- Bloody or tarry stool

- Intense muscle pain
- Difficulty moving the related joints
- Fainting or dizziness
- Low blood pressure
- Signs of shock

To treat the injured person for internal bleeding:

1) Open the airway if needed.
2) Activate EMS (if not already activated).
3) Minimize movement of the injured person.
4) Apply ice to the affected area (unless the internal bleeding is in the skull).
5) Evacuate to EMS as soon as possible.

Spinal Injury Management

If the injury mechanism is such that you suspect a spinal injury, your primary duty to the injured person is to deal with any immediate threats to their life. Perform CPR if necessary. If CPR is not necessary, your role is to keep the injured person calm and still. Activate EMS if you have not done so. If possible, kneel at the person's head and find a comfortable position to stay in for potentially a long time. Place your hands on both sides of the person's head to keep them immobile. Do not attempt to straighten or realign the head unless the airway is compromised. Be sure to talk to and reassure the person as you wait for EMS to arrive.

Tooth Loss

Traumatic loss of a tooth can damage both the tooth and the supporting structures in the mouth. The greatest chance for survival of the tooth is reimplantation within an hour. If the first aid provider can re-implant the tooth without undue pain to the person, it should be done. Otherwise, store the tooth in one of the following solutions and seek immediate dental care.

- Egg white
- Whole milk
- Coconut water
- Injured person's saliva (but not in the person's mouth)

If available, the following solutions may be used:

- Hank's Balanced Salt Solution
- Ricetral
- Propolis

Wound Infections

The skin is our primary and most effective defense against infection. When this protective layer is breached, the introduction of bacteria, fungi, viruses and other organisms into tissue layers beneath the skin is enabled. The source of injury is important because organic material comes with higher risks of wound infections and delayed healing.

Thoroughly cleaning wounds with soap and fresh water soon after injury is a simple yet effective way to minimize infection risk. Delayed cleaning may enable microorganisms to replicate beneath the skin, resulting in infection. The presence of bacteria within a wound does not necessarily constitute infection; instead, this is often referred to as "contamination."

When bacterial populations thrive and become large enough, interrupt healing or cause further tissue damage, then an infection has occurred.

Signs of infection appear within hours, days or even several weeks following injury. Inflammation is one of the cardinal signs of any infection, and the components typically present with an infection can be easily recalled using the acronym P-R-I-S-H.

- Pain
- Redness
- Immobilization (loss of function)
- Swelling
- Heat (elevated warmth of the infected area)

Other signs of infection include the following:

- Pus and yellowish discharge
- Foul smell
- Swollen lymph nodes
- Fever
- Chills
- Nonhealing wounds

Marine-acquired wounds, particularly in people with compromised immune systems (e.g., diabetes, cancer, AIDS), may require more aggressive treatment. If a marine acquired wound is beyond your skills to manage or shows any signs of worsening, seek immediate medical attention.

Review Questions

1. When should impaled objects be removed?
   a. If the object obstructs the airway
   b. The object should never be removed
   c. The object should always be removed
   d. Only if the impaled object is smooth

2. What are the two types of amputations?
   a. Painful and not painful
   b. Minor and major
   c. Complete and incomplete
   d. There is only one type of amputation

3. What is the method for bandaging an injured eye?
   a. Don't bandage the eye at all
   b. Bandage both eyes
   c. Bandage only the injured eye
   d. Just have the injured person keep their eyes closed

4. You should never put a bandage on a joint.
   a. True
   b. False

5. When bandaging an open chest wound you should _____
   a. Only use the wound-packing technique
   b. Use an occlusive dressing secured on 3 sides
   c. Use an occlusive dressing secured on 4 sides
   d. Leave it open

6. If an injured person has intestines exposed you should put them back in.
   a. True
   b. False

7. If the injured person shows signs of internal bleeding you should apply ice, unless it's a head injury.
   a. True
   b. False

8. When dealing with a suspected spinal injury you should _____
   a. Do nothing, just activate EMS and monitor them.
   b. Stabilize the head
   c. Realign the head
   d. Only realign the head if the airway is compromised
   e. b and d
   f. all of the above

9. If a tooth comes out, and it can't be re-implanted on the spot, there is nothing you can do.
   a. True
   b. False

10. Signs of an infected wound include:
    a. Redness
    b. Swelling
    c. Pus
    d. Fever
    e. All of the above

Review answers are on Page 134.

First Aid Skills

Chapter 18: Burns

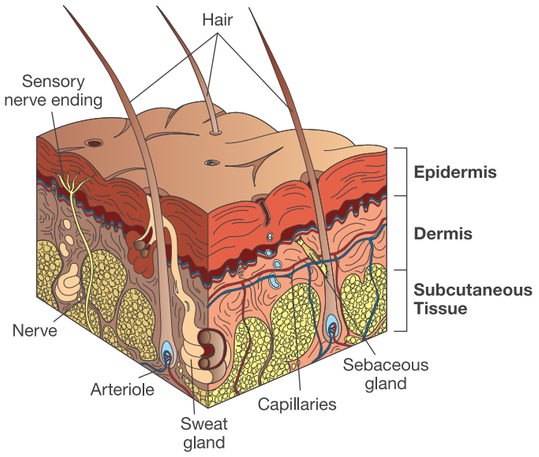
Objectives

1. How are burns categorized?
2. What is a superficial burn?
3. What is a second-degree burn?
4. What is a third-degree burn?
5. What is a fourth-degree burn?
6. What is the general first-aid treatment for burns?
7. How should chemical burns be treated?

Burns refer to tissue damage caused by heat, chemicals, electricity, sunlight or radiation.

Thermal injury from hot liquids, steam, building fires, flammable liquids and chemicals are the most common causes. As with all cases of severe injury, continuously monitor the individual, and treat for shock if any signs of that condition become apparent.

Burns can disrupt the protective function of skin and result in fluid loss and increased risk of infection. They can cause swelling, blistering, scarring, shock and even death. Burns are named or categorized based on the depth of tissue involvement.



Burn Categories

Superficial Burn (first degree burns)

- Tissue injury is limited to the epidermis (outermost layer of the skin)
- Characterized by redness (erythema) and minimal swelling such as in a sunburn
- Mild discomfort
- Commonly treated on an outpatient basis

Partial-Thickness Burn (second degree burns)

- Involves the epidermis and variable depths of the dermis (skin layer below the epidermis)
- Often occurs with scalding injuries and severe sunburns
- May present as blisters and blanching skin to white, glistening/wet appearing base
- Most painful of all burns
- Requires medical evaluation and ongoing care especially if hands, feet, face, genitals or buttocks are affected
- Deeper burns may take three to four weeks to heal
- Deeper burns may require excision/debridement (removal of dead tissue)

Full-Thickness Burn (third degree burns)

- Involves epidermis, all layers of dermis and extends down to subcutaneous tissue
- Appears dry, leathery and insensate (with out sensation in the area most affected), often without blisters
- May appear waxy or charred
- Presents with variable degrees of pain
- Can be difficult to differentiate from deep partial-thickness burns
- Commonly occurs when clothes catch on fire
- Always requires emergency medical care

and prompt attention by a burn surgeon and will need skin grafting to heal

Fourth-Degree Burn

- Full-thickness burn extending to muscle or bone
- Commonly the result of high-voltage electric injury or severe thermal burn
- Exit wounds may be present as a secondary injury.
- Requires hospital admission

Dry chemical burns

- Occur on contact
- Skin may appear irritated and red
- Signs may not be immediately evident or noticeable
- May cause numbness or extreme pain
- Can diffuse into deeper tissues

First-Aid Provider Response to Burns

Determination of burn depth is not a primary concern of a first-aid provider. Of immediate importance is removing the individual from the source and stopping further injury. To stop further burning, use cool or very cold but not freezing running water or saline for at least 10 minutes but refrain from prolonged immersion. It may take more time and water than anticipated to halt burn progression. Cooling measures applied too aggressively or for too long can cause more tissue damage and may lead to hypothermia.[11]

Refrain from applying ointments, lotions or antiseptics. Topical antibiotic ointments or creams should be used only under the direction of a physician.

Avoid the use of ice or butter on burn wounds because these measures will not help and may cause more tissue damage. In addition, medical staff will want to inspect the wounded area and will have to remove any applied product.

If there are blisters, keep them intact, and refrain from releasing blister fluid. Removal of blistered skin increases the risk of infection (as the primary skin barrier is removed) and will also expose tender tissue, resulting in additional pain. Blisters that have broken should be left in place and protected with an appropriate dressing and bandage.

If the burn was caused by a semisolid or liquid such as tar, grease or oil, flush the area with water to cool the tar or anything that has burned to the skin (such as clothing) or grease and stop the burning process. Refrain from attempts to remove substances such as tar because you may cause additional tissue damage. These burns can be severe, so seek medical attention or call EMS.

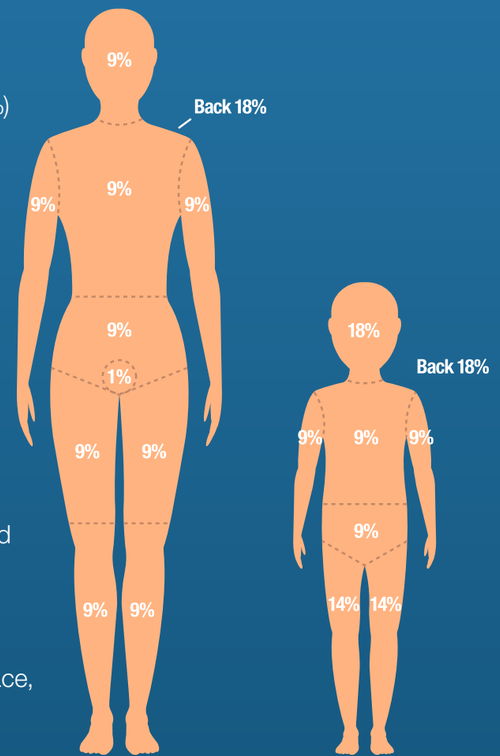
Dry chemicals such as lye, pool chemicals such as solid chlorine granules or tablets, and certain detergents require additional diligence. These chemicals will react with the water causing further burns or potentially deeper burns. Therefore, the FIRST step in treating dry chemical burns is to brush off the dry chemical and carefully remove any jewelry and clothing that may have become contaminated taking care to not spread the chemical onto yourself or anyone else. After the dry chemical has been brushed off, flush with copious amounts of water. Be aware that any residual dry chemical that was not brushed off will begin to react, will most likely be painful and potentially causing further burning. Flush with copious amounts of clean water for at least 15 to 20 minutes. Seek medical evaluation as soon as possible.

Advanced Concepts

The Rule of Nines is a method health care providers use to help determine how much of a person is burned and to help in treatment.

For an adult:
Head and neck 9%
Anterior trunk (front of body) 18%
Posterior trunk (back of body) 18%
Each Arm (including the hand) 9% (total of 18%)
Each leg (including the feet) 18% (total of 36%)
Genitalia 1%

For a child:
head and neck 18%
anterior trunk 18%
posterior trunk 18%
arms (including hands) 9% each
legs (including feet) 14% each



If a person has more than 9% of their body burned, they should be referred to a specialized burn center. Other reasons to refer to a burn center are:

- The person is a child
- Burned areas are in key areas such as the face, hands, feet , genitals or major joints
- Chemical burns
- Electrical burns
- Third- or fourth-degree burns

Depending on the circumstances and extent of injury, always remain ready to provide airway support and BLS. Burns to the face are associated with smoke inhalation and may cause upper-airway damage that compromises airway patency. Any signs of breathing difficulty should prompt activation of EMS if they have not already been notified. Individuals with extensive burns or difficulty breathing should be placed in a semi-reclining position and continuously monitored.

After you have ensured that the individual is stable, breathing easily, removed from the source and the burning process has been stopped or slowed, cover the injured area with a dry sterile dressing. If available, use burn-specific dressings, such as: adaptic or iodoform gauze (petroleum impregnated — non-adhering) over the injured area as a primary dressing, followed by dry gauze. This will enhance the person's comfort and make dressing changes more comfortable. If burns involve vital areas such as the face, hands, joints or genitals, seek immediate medical attention.

Burns of the Fingers and Toes

If the burn involves the hand, foot, fingers or toes, remove all jewelry on the affected extremity. When dressing burned fingers or toes, ensure digit separation with the use of gauze padding if the digits can be easily separated. Seek medical evaluation of these burns.

Facial Burns

Burns to the face may affect vital structures such as the eyes, ears or airway. Medical professionals should assess injuries to these areas. If the eyelids are burned, refrain from opening, and seek immediate medical attention.

Chemical burns to the face and eyes require immediate action. Call EMS and continuously flush affected area with cold water for about 20 minutes.

Review Questions

1. Superficial burns are severe and involve all skin layers.
   a. True
   b. False

2. Immediate first aid for burns includes removal from the source and the application of cool water to stop the burning process.
   a. True
   b. False

3. In the event of chemical burns to the face or eyes, continuously flush the area with cool water for approximately 20 minutes, and call EMS.
   a. True
   b. False

Review answers are on Page 134.

Objectives

1. What is hypothermia?
2. What is the first aid response to hypothermia?
3. What special consideration must be taken into account for hypothermia?
4. What is hyperthermia?
5. What are four methods of heat transfer, and how can they benefit the hyperthermic individual?
6. What are the signs and symptoms of heat exhaustion and heat stroke?
7. What is the first aid response to hyperthermia?

The human body has a limited tolerance for temperature extremes. Prolonged unprotected exposure may raise or lower core body temperatures and cause health concerns that require prompt attention. The body maintains a relatively stable core temperature, which represents a balance between heat production and heat loss. The normal core body temperature is 36 to 37°C (97 to 99°F).

Hypothermia[17]

When external temperatures are too low or the body's heat production is inadequate relative to the external demands, core temperatures can drop. Hypothermia (hypo = less than normal + thermia = generation of heat) is defined as core temperatures below 35°C (95°F).

MILD hypothermia is classified as a body core temperature of 32-35°C (90-95°F). Expected symptoms include shivering, lethargy and apathy. Motor skills may also be compromised.

MODERATE hypothermia occurs with body core temperatures of 28-31°C (83-89°F). At this point the shivering stops, cognitive function is markedly reduced (stupor), and heart and respiratory rates tend to slow.

SEVERE hypothermia occurs when body core temperatures go below 28°C (82°F). At this point, coma and unconsciousness are likely, and people may appear dead.

Cold-Water Immersion

Water has the ability to conduct heat away from the body 20-27 times faster than air. As such, cold-water immersion should raise the suspicion of potential hypothermia and prompt rewarming efforts.

Localized injuries such as frostnip and frostbite are possible in cold water diving. These injuries are the result of vasoconstriction due to cold exposure. Common areas of injury are fingers, toes, nose and ears. Skin in the affected areas may be discolored, and pain or tingling may be present.

Frostnip

Frostnip is treated by getting the affected person out of the cold, removing wet clothing and applying heat. Even a warm hand over the affected area will help rewarm the area. Do not rub tissues showing signs of frost nip.

Frostbite

Frostbite is a much more serious condition in which tissues actually freeze. Length of exposure to the cold is a factor in frostbite. Remove clothing, and immerse affected areas in a warm water bath; do not rub tissues. Once rewarmed and dry, place dry dressings between exposed digits and seek medical evaluation.

Do not attempt to rewarm tissues affected by frostnip or frostbite when there is an imminent risk of refreezing.

Rewarming Strategies

When hypothermia is suspected, prevent further heat loss, and initiate rewarming strategies.

Remove the person from the cold, and place them in a dry, warm environment away from wind. Remove wet clothing, and replace with dry, warm coverings to include the head, and activate EMS. Monitor breathing and heart rate, and be prepared to perform CPR if either becomes dangerously slow or stops and the person becomes unconscious.

In addition to the steps described above, rewarming can also include the use of warm water bottles or heating pads applied to the chest, neck and groin to optimize core warming.

Symptom severity and the person's mental status will largely determine the course of further treatment. Anyone presenting with a history of confusion, lethargy, unconsciousness or stupor

Handle hypothermic people gently and carefully, as rough handling may cause cardiac arrhythmias such as ventricular fibrillation.

should receive prompt medical attention. Calling EMS may enable faster recovery (with more aggressive rewarming techniques) and appropriate monitoring.

Hypothermia can cause cardiac arrhythmias and subsequent unconsciousness, a condition that may stabilize with rewarming. This condition has led to an axiom within emergency medical circles that "patients aren't dead until they're warm and dead." Therefore, resuscitation efforts are often performed for prolonged periods with hypothermic people and especially so with children who have been saved after prolonged cold-water immersions.

Special Consideration: Core Temperature After-Drop

The term "core temperature after-drop" refers to a reduction in core temperature subsequent to rewarming and is characterized by clinical deterioration.[17] Current theory for this phenomenon reasons that as peripheral tissues warm, vasodilation allows cooler blood from the extremities to circulate back into the body core. This may result in additional core cooling and cardiac arrhythmias. Rewarming efforts aimed at core temperature elevation minimize the chances of the after-drop phenomenon.

When treating moderate to severe hypothermia, focus on rewarming strategies, activate EMS, and be prepared to initiate CPR. Minimize or, better yet, eliminate any exertion by the individual during or after care until evaluated by medical personnel.

Hyperthermia

Hyperthermia occurs when the body is overheated and the normal cooling mechanisms are overwhelmed (hyper = above normal + thermia = generation of heat).

The body's natural cooling mechanisms include sweating and peripheral vasodilation. Sweating enables evaporative heat loss, and peripheral vasodilation (seen as flushing) brings blood to the body's surface, which enables cooling through evaporative heat loss and other cooling mechanisms described below. Personal factors or individuals at elevated risk of hyperthermia include the following:

- Infants and children
- Obesity
- People over 65 years of age
- Exertion/exercise
- Dehydration
- Health issues such as diarrhea that predispose to dehydration
- Divers wearing drysuits or heavy wetsuits for cold-water diving during hot weather
- Divers wearing drysuits for contaminated-water activities during hot weather

The severity of hyperthermia can range from mild to life-threatening. Signs, symptoms and appropriate first aid will vary depending on the degree of overheating and the individual's condition.

The next sections describe the progression of hyperthermia severity and the appropriate care for each level.

Heat Rash

Heat rash — commonly seen around the neck, groin, elbow creases and beneath breasts — looks like small pimples and is caused by excessive sweating. While seen in all ages, it is most common in young children. Treatment is simple and involves cooling and keeping areas dry. This rarely requires medical attention and usually resolves on its own.

Heat Cramps

Heat cramps are muscle spasms resulting from excessive fluid and electrolyte loss. They are often associated with strenuous activity and may be a sign of heat exhaustion. Immediate first aid measures include the following:

- Stop all activity, and rest in a cool place.
- Drink clear liquids, preferably with electrolytes (sports drinks).
- Do not return to strenuous activity for several hours.
- If symptoms do not resolve within about an hour, seek medical attention.

Heat Exhaustion

Heat exhaustion occurs as a result of excessive fluid and electrolyte loss. Those most prone to heat exhaustion include the elderly, people taking diuretics (medications that cause fluid and electrolyte loss) and people working or exercising in hot environments where fluid and electrolyte loss are most likely to exceed the rate of replacement.

Warning signs of heat exhaustion include the following:[23]

- Heavy sweating
- Nausea/vomiting
- Headache
- Muscle cramps
- Fatigue
- Weakness
- Fainting

Untreated, heat exhaustion can progress to heat stroke and should receive prompt attention. If symptoms are severe, call EMS immediately, and perform cooling measures until they arrive.

Immediate first aid measures include the following:

- Remove the person from the heat source.
- Keep them at rest.
- Place the person in a cool environment.
- Remove unnecessary clothing.
- Replace fluids and electrolytes — oral intake is usually safe
- Cooling methods: evaporation, conduction, convection and radiation
  - — Sponge the head, neck and torso.
  - — Place the person near an air-conditioning vent or fan.

Heat Stroke

Heat stroke is a life-threatening condition in which the body's temperature exceeds its ability to effectively regulate cooling. Core temperatures may exceed 41°C (106°F).

Signs and symptoms of heat stroke may include the following:

- Rapid pulse
- Red, hot and usually dry skin
- Strange behavior
- Hallucinations
- Confusion
- Seizures
- Coma and death

Immediate first aid measures include the following:

- Remove the person from the heat source
- Activate EMS
- Keep the person at rest
- Place the person in a cool environment and on a cool surface
- Remove unnecessary clothing
- Cooling methods: evaporation, conduction, convection and radiation
  - — Apply cold packs to the head, neck, armpits and groin
  - — Cover the person with water-soaked towels or blankets (keep coverings wet with additional cool water)
  - — Place the individual near an air-conditioning vent or fan
- Replace fluids and electrolytes (intravenous fluids are usually advised because airway management may be compromised)

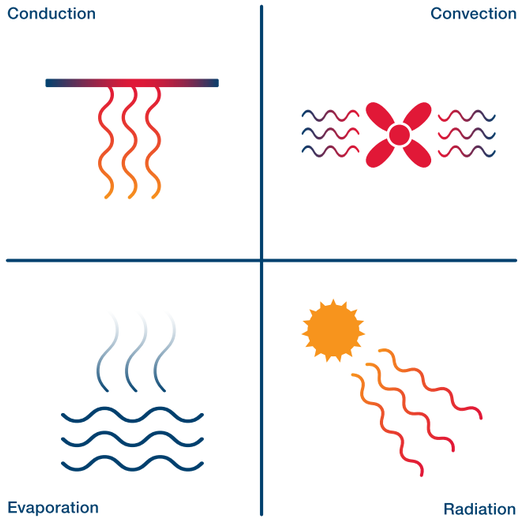
Continually monitor the person for airway compromise, seizure, unconsciousness or cardiac arrest.

Note:
Symptom onset may be rapid and requires aggressive cooling and immediate activation of EMS.

Cooling Measures

There are four primary mechanisms for heat loss: conduction, convection, evaporation and radiation. The process of breathing can also result in heat loss, but this process is passive and doesn't affect the first responder. When trying to cool someone with hyperthermia, the use of multiple methods simultaneously will have the greatest effect.

Conduction is the transfer of heat from a warmer object to a cooler object when the two objects are in direct contact. An example of conductive heat loss occurs when backpackers sleep on cold ground.



- Cooling methods: Sponge around the head and neck, or immerse in a tepid (lukewarm) bath or shower. Refrain from ice-water immersion because this causes peripheral vasoconstriction and may be counterproductive.

Convection is heat loss that occurs in response to the movement of fluid or gas. This method of cooling is experienced by wind chill or an indoor fan.

- Cooling methods: Use a fan, air conditioning vent or exposure to wind. It works best if combined with a cool mist spray to utilize evaporative heat loss.

Evaporation is heat absorbed by sweat that is then released or removed from the body when liquid phase-changes to gas as part of evaporation.

- Cooling methods: Sponge with cool water, or use mist to maintain skin moisture. Key areas are the head, neck and torso.

Radiation is the transfer of electromagnetic energy (primarily in the infrared spectrum) between two objects of different temperatures. The temperature difference between objects will determine the direction of heat transfer. For example, fire radiates heat and will warm a cooler room. When body temperature is higher than the surroundings, our heat will generate ambient warmth.

- Cooling methods: Remove from direct sunlight, place in the shade or a cool room, and remove heavy or unnecessary clothing.

Seek immediate medical attention in the following situations:

- Symptoms are severe
- A history of heart problems or high blood pressure exists
- Symptoms worsen or last longer than one hour

Continually monitor the person for airway compromise, seizure, unconsciousness or cardiac arrest.

Review Questions

1. The first step in rewarming is to prevent further heat loss.
   a. True
   b. False

2. Management of hypothermia may include
   a. removal from the cold
   b. removal of wet clothing
   c. use of blankets and heat packs
   d. calling EMS
   e. all of the above

3. Heat stroke is a medical emergency that requires aggressive cooling and activation of EMS.
   a. True
   b. False

Review answers are on Page 134.

First Aid Skills

Chapter 20: Medical Emergencies

Objectives

1. What is asthma?
2. What are the signs and symptoms of heart attack?
3. What is hypoglycemia versus hyperglycemia?
4. What is the primary first aid for seizures?
5. What is the primary first aid action for poisoning?
6. What is the preferred first aid for exertional dehydration?
7. What restrictions should be observed by someone who may have suffered a concussion?
8. What are the signs and symptoms of an allergic reaction?
9. What steps should be taken if an allergic reaction occurs?
10. What are the signs and symptoms of cardiogenic shock?
11. What steps should be taken if cardiogenic shock occurs?
12. What are the signs and symptoms of hypovolemic shock?

First aid is medical care for injuries or illnesses that are not immediately life-threatening. Because this action occurs after an initial assessment for urgent needs, it is referred to collectively as secondary care. Before initiating care, perform a general assessment.

- State of health: Obtain a general impression of the individual's health and well-being. Are they in physical distress or pain?
- Observe respiratory effort, chest expansion, respiratory rate and use of accessory muscles.
- Notice if the skin is pale or red and flushed.

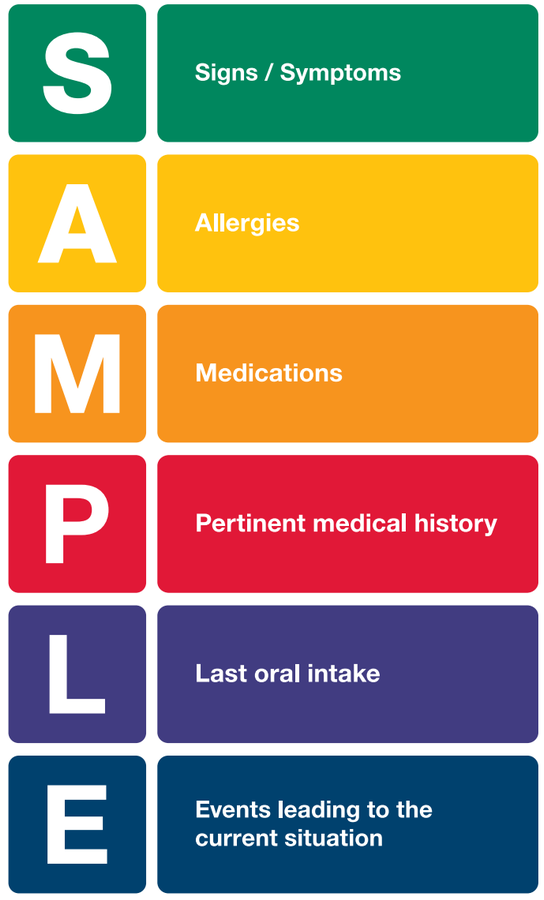
History

When talking to an injured or ill person, gather and record a history of the event(s) that led to the injury. If it was a traumatic event, determine the mechanism of injury, if possible. This information helps determine the potential severity of the injury. It may also reveal other injuries that are not immediately detectable. Also ask about previous injuries to the same area that may confuse your findings.

The mnemonic **S-A-M-P-L-E**, which was introduced earlier in this course, is repeated here for emphasis in its role in secondary assessment. It is used to help you remember what information to gather when taking a history.

S-A-M-P-L-E stands for:

- **S**igns/**S**ymptoms
- **A**llergies
- **M**edications
- **P**ertinent medical history
- **L**ast oral intake
- **E**vents leading to the current situation



While conducting the history interview, observe how the individual appears overall. For example, note if their breathing is difficult or if they are having trouble speaking. Do they appear flushed or sweating more than you would expect?

Illness Assessment

Not all concerns facing a dive professional will be the result of a dive injury or a trauma. Emergencies may result from unexpected trauma or underlying disease. In a medical emergency, determine the individual's complaints and when symptoms began. Examples of common concerns include the following:

- Breathing difficulties
- Chest pain
- Abdominal pain
- Altered level of consciousness

The conditions described below represent a short list of common emergencies that first aid providers may encounter. A brief description of interventions is included.

Asthma

Asthma is a noncontagious respiratory illness characterized by airway narrowing and enhanced bronchial thickening. People with asthma are more prone to abrupt airway narrowing if exposed to particular triggers. For example: dust/pollen, pet dander, exercise, cold. Most asthmatics are

aware of their condition and have medications that can help reverse symptoms of chest tightness or shortness of breath. Asthma medications are commonly administered with a metered-dose inhaler, and symptom relief can be rapid.

When someone with asthma has a prolonged attack with severe symptoms, such as labored breathing, wheezing, bluish skin tones, or tripod positioning' Tripoding is when the individual leans forward from with a standing or sitting position supporting their upper body with their hands on their knees or another surface. This position can be specifically indicative of respiratory distress.

Asthma can be a life-threatening situation and requires prompt medical attention. When this happens, activate EMS immediately. Try to calm the person to reduce their breathing workload and anxiety. Assist the individual with their prescribed inhaler if necessary. (An inhaler should not be given to someone for whom it is not prescribed.)

Heart Attack

A heart attack — acute myocardial infarction (AMI) or acute coronary syndrome (ACS) — is the term used to describe the symptoms associated with blockage of the arteries that supply the heart. If the heart attack is severe enough to cause the heart to stop functioning or stimulate a life-threatening arrhythmia, first responders may need to initiate CPR and use an AED. When the person is suffering from a heart attack but is still conscious and breathing, your role is more supportive.

In this situation, keep the person in a position of comfort, and activate EMS and monitor their heart rate and respirations. Do not do anything else until EMS has been activated unless you need to begin CPR. EMS may direct you to give one adult (325mg) aspirin. Crush it or have the ill person chew it for 30 seconds before swallowing for faster absorption. Note that use of an enteric-coated aspirin will delay absorption.[19]

Some people with a history of heart problems carry nitroglycerine, which is available as either pills or a sublingual (under the tongue) spray. You may need to assist the individual with taking his own prescription, but do not attempt to give nitroglycerine to a individual who doesn't have a prescription. When assisting someone with nitroglycerine, do not handle the pills with bare hands because the medication can be absorbed through the skin. Nitroglycerine is administered under the tongue to be absorbed and not swallowed. It is administered every five minutes for a total of three doses. Do not administer more than three doses, regardless of the person's condition.

Not all heart attacks are painful, and there are many different variables to look for when it comes to heart conditions. Symptoms vary between men and women as well as among individuals with preexisting medical conditions. Common signs and symptoms were described in Chapter 5, Cardiopulmonary Resuscitation.

Note:
The term "massive heart attack" is often used to describe a sudden cardiac arrest. The term "heart attack" refers to pain secondary to a blocked artery that feeds the heart. As a result of blood-flow restriction, an area of the heart muscle may die, but this does not necessarily result in death of the individual.

Diabetic Emergency

Diabetes is a disease that affects normal blood-sugar control. When blood-sugar (bloodglucose) levels are markedly elevated (hyperglycemia) or low (hypoglycemia), people can become symptomatic.

Blood glucose comes from the breakdown of dietary carbohydrates found in foods such as rice, cereals, grain, potatoes, fruits and sweets. Insulin, a hormone made in the pancreas, facilitates cellular uptake of blood glucose. When insulin is either made in insufficient quantities or is ineffective (in the case of insulin resistance), blood-sugar levels will rise and may result in hyperglycemia.

Hyperglycemia may require medical intervention but rarely requires emergency treatment from the first-aid provider. The diabetic experiencing hyperglycemia will usually be capable of checking their own blood sugar and administering their own insulin if needed. A first aid provider should not administer insulin as this can easily make the condition worse.

For diabetics who require insulin injections, use of insulin without adequate dietary intake will cause a drop in blood-glucose levels and may cause hypoglycemia.

If someone with diabetes suddenly feels unwell or starts behaving uncharacteristically, consider having them check their blood-glucose level with a glucometer (blood-glucose measuring device — standard equipment for all diabetics). Most diabetics will recognize their symptoms, but if they are unable to think clearly, they may need your help. Confusion, altered behavior, excessive sweating or tremors in someone with a history of diabetes can quickly lead to a serious medical emergency that requires advanced medical care as quickly as possible. Some people will wear medical-alert tags to inform rescuers that they have diabetes.

Hypoglycemia is an acute condition requiring rapid intervention. Interventions by a first-aid provider should be limited to assisting with ingestion of foods with high sugar concentrations such as glucose tablets or 20 g of carbohydrates such as candy (quantity varies), jelly beans (15-20), fruit leathers (two strips) or orange juice (200 mL; 3/4 cup). If the diabetic is responsive enough to swallow, 15 ml (1 tablespoon) of honey or corn syrup or 200 ml (3/4 cup) of orange juice may be given.[20]

It may take 10-15 minutes for the hypoglycemic symptoms to resolve, so waiting to activate EMS is suggested. If symptoms do not resolve in that time frame, administer additional high sugar

concentrations as noted previously and call EMS.

If you are in doubt about a diabetic's condition, give sugar. However, never administer insulin without a medical directive. (Usually this would be done by EMS if required.)

Once a diabetic who is experiencing hypoglycemia has had something to eat or drink, stay with him to ensure that their condition and mental status improve. If their mental status deteriorates, it may become necessary to call EMS and continue to support until help arrives.

Stroke

Stroke is the leading cause of long-term disability and the third leading cause of death in the U.S. Strokes are a medical emergency that can result in permanent neurological injury, disability and death. They result from either blood-vessel blockage (usually from a blood clot or thrombus) or from blood-vessel rupture that causes bleeding (hemorrhage).

Strokes can manifest with sudden loss of motor function (ability to move one half of the body), inability to understand or formulate words, or loss of a visual field. Many strokes are not associated with headache. Most strokes come on suddenly and are painless — the person suffering from one may be unaware of its occurrence.

In the absence of head trauma, stroke should be suspected when neurological symptoms (those affecting the nervous system) suddenly appear. The faster acute injury is detected and EMS alerted, the greater the chances that medical treatment will reduce injury and disability.

Signs of stroke include the following:

- Facial droop
- Inability to raise or move an arm
- Slurred, garbled or nonsensical speech

If any of these signs are present, call EMS immediately.

The **F-A-S-T** mnemonic may help you quickly identify a possible stroke and reinforces the need for immediate activation of EMS.

Remember: **F-A-S-T** first, then call EMS.

- Facial droop. Facial droop occurs on one side of the face and in stroke may involve either the left or right side.
- Arm weakness. Assess arm weakness by asking the injured person to raise both Arms straight out in front of them. Ask the person to hold that position for about 10 seconds. Watch for lowering of an arm.
- Speech. Stroke is frequently associated with speech difficulty or reduced vocal clarity.
- Time. Rapid recognition and activation of EMS is critical as timely intervention can dramatically influence outcome and recovery time.

Activate EMS at the first sign of stroke. Depending on the individual's condition, BLS may benecessary as airway management can become compromised.

F	**Facial droop**
A	**Arm weakness**
S	**Speech difficulty, sudden severe headache**
T	**Time (note the time, and call EMS immediately)**

Seizures

Seizures (also known as fits and convulsions) result from a sudden massive electrical discharge within the brain. Seizures may present as brief trancelike (petit mal) states or full body convulsions (grand mal). Epilepsy is a disorder that results from surges in electrical signals inside the brain, causing recurrent seizures. Generalized seizures affect both cerebral hemispheres (both sides of the brain). They cause loss of consciousness for either brief periods or for several minutes. A common type of generalized seizure is the tonic-clonic or grand-malseizure. Seizures may also be focal and involve only one limb.

Generalized seizures often start with a brief cry followed by a fall to the ground. Alternating stiffening (tonic phase) and jerking (clonic phase) movements of the arms, legs and face characterize a seizure. The period following a generalized seizure is known as the postictal phase. During this period people may be unresponsive, in a deep sleep, weak, disoriented or combative. This phase usually resolves within 30 minutes.

As a first-aid provider, there isn't much you can do for a seizing person, nor is there much you need to do. During a seizure your first priority should be to move objects away from the seizing person that may be struck or cause injury. Protect, but do not attempt to restrain an individual during a seizure, and avoid placing anything in the person's mouth.

Once the person has stopped actively convulsing, conduct your initial assessment, and ensure an open airway. Continue to monitor the individual for changes. Next, take a history, and establish whether the person has a seizure disorder. If not, attempt to determine any other conditions that may have caused the seizure. This information will be useful for EMS.

Conditions associated with seizure predisposition include the following:

- High fevers (primarily in young children experiencing spiking fevers)
- Infections, including meningitis or encephalitis
- Poisoning, including drugs or heavy metals
- Hypoglycemia
- Head trauma
- Shock
- Hypoxia/hyperoxia
- Drug or alcohol overdose or withdrawal
- Intracerebral bleeding (i.e., stroke)
- Certain complications of pregnancy

Poisoning

A poison is any substance that is harmful to your body if too much is eaten, inhaled, injected or absorbed (through the skin). Any substance, including medications, can be poisonous if too much is taken.

Common signs of poisoning include the following:

- Nausea/vomiting
- Abnormal blood pressure
- Headache
- Seizures
- Abdominal pain
- Injury to skin
- Dilation or constriction of pupils
- Irregular heart rate
- Altered mental status
- Diarrhea
- Shortness of breath

Any time you suspect poisoning, call 911, other local emergency number or a poison control center. (The number for the U.S. Poison Control Center is 1-800-222-1222.) International Poison Control Centers can be found at http://apps.who.int/poisoncentres/ (Feb 2019)

Stating the poison type (type of medication, drug, etc.), approximately how much was used and current symptoms will help guide management. An individual's medical status can worsen rapidly, so all suspected poisonings should be evaluated in a hospital.

Once EMS has been activated, your primary role is to monitor breathing and be prepared to perform BLS in the event the person's airway become compromised, loses consciousness, stops breathing or evidence of circulation disappears.

Provide EMS or the treating medical facility with the substance to ensure appropriate treatment. If the substance is not available, attempt to find out the name, chemical composition or list of ingredients and bring that to the hospital.

If the poison is a liquid that was absorbed through the skin or came into contact with broken skin, irrigate all affected parts of the body with water for 20 minutes or until EMS arrives. If the poison is a powder, brush off any residual powder (use exposure protection) before irrigating the exposed area. Immediately treat an eye injury due to any chemical exposure (liquid or powder) by flushing the eye with tap water for 15 minutesor until EMS arrives. All poisoned individuals need to see a physician, even if it appears that all signs of a problem have been controlled and the emergency is over.

Exertional Dehydration

Vigorous exercise with profuse sweating, especially in hot, humid environments, can lead to dehydration and loss of electrolytes. As long as the individual can swallow, oral rehydration in the absence of shock or confusion is a reasonable first-aid approach.

Attempt rehydration with 5-8 percent carbohydrate-electrolyte solutions (commercially available sports drinks). Plain water is an alternative but is not as effective. If the individual has heat-related symptoms, refer to Chapter 19, Temperature-Related Injuries.

Concussion

Concussion is a mild traumatic brain injury that results in symptoms such as feeling stunned or dazed, dizzy or unsteady. Headache, visual disturbances, confusion or memory loss are also symptoms of concern following a head injury. The range of symptoms can make recognition of concussion difficult. The potential for long-term consequences makes any decision about response critical. Anyone who experiences any of these symptoms after a blow to the head should not be allowed to sleep until they have been be evaluated by a health-care professional. Defer use of mechanical machinery, driving, cycling, participation in sport activities or use of any electronic equipment (including computers, cell phones, and tablets) until after evaluation and clearance by a health-care provider. The most critical post-concussion time frame is 3-5 days. This period can make the difference between a 30-day recovery vs a year or more.

Shock

Shock is a life-threatening condition. Frequently this is due to lack of blood perfusion to the tissues. There are many types of shock some of which are described below. There are many different triggers for shock including allergies, cardiac conditions, and profuse bleeding. Regardless of trigger, treatment is straight forward - management of the trigger event and monitoring the thermal state of the individual and their food/liquid intake.

ANAPHYLACTIC SHOCK

Anaphylactic shock is a severe allergic reaction that may occur subsequent to envenomations. Life-threatening manifestations involve airway narrowing, which requires rapid activation of emergency medical services. As a first responder, you can help by supporting an open airway and by assisting the individual with administration of allergy medications.

Most allergic reactions are fortunately less severe and are characterized by local skin reactions. Once you've ensured the individual is breathing normally, thoroughly clean and rinse the affected area. In some cases allergy medications may be useful, but this requires familiarization or medical guidance.

Signs and symptoms (mild/moderate)
- Generalized itching (pruritis)
- Localized redness, swelling, raised rash that may change with time (urticaria/hives)
- Bloodshot, puffy eyes
- Facial swelling (eyes, lips)
- Localized or diffuse swelling (edema)

Signs and symptoms (severe)
- Airway narrowing
- Respiratory distress
- Cardiac arrest

First aid
- Anaphylactic shock is a medical emergency. Call 911 or your local emergency medical services number immediately. Do not call DAN first.
- Assist the injured person with administration of allergy medications if prescribed for them personally. First-line medications include antihistamines. If airway narrowing or difficulty breathing is present, consider use of an epinephrine auto-injector if one is prescribed for the injured person.
- Monitor airway and breathing
- Avoid giving the person anything by mouth

CARDIOGENIC SHOCK

Cardiogenic shock refers to a reduction in the heart's ability to circulate blood to the brain and vital organs. Causes include heart attack (myocardial infarction), unstable arrhythmias and envenomations, especially from box jellyfish. (Note: Stonefish venom may also have vasoactive effects that cause hypotension and may result in decreased blood flow to the brain and other vital organs.)

Signs and symptoms
- Hypotension (low blood pressure)
- Altered mental status
- Pale, cool, clammy skin
- Reduced urinary output
- Cold hands and feet
- Nausea and vomiting
- Severe shortness of breath
- Unconsciousness
- Weak pulse
- Cardiac arrest
- Chest pain (can radiate to the arms,shoulder, neck or back)

First aid
- Cardiogenic shock is a medical emergency. Call 911 or your local emergency medical services number immediately. Do not call DAN first.
- Have the person lie down on their back or in a position of comfort. Take necessary steps to maintain a normal body temperature.
- Check for signs of circulation; if absent, begin CPR
- Keep the person warm and comfortable
- Avoid giving the person anything by mouth

HYPOVOLEMIC SHOCK

Hypovolemic shock results from a sudden decrease in circulating blood volume that results in a deficiency of blood supply to vital organs. Blood loss is secondary to internal or external bleeding. In the marine environment, the most likely cause is large animal bites (sharks, seals, eels), but acute blood loss can also occur due to nontraumatic events such as intestinal disease.

To control external bleeding, use universal precautions, and apply direct pressure. Universal precautions include barrier devices such as nonlatex medical gloves plus protective eyewear or a surgical-style mask if blood is being spattered.

Signs and symptoms
- Anxiety or agitation
- Pale, cool, clammy skin
- Confusion
- Generalized weakness
- Rapid breathing
- Decreased urine output
- Unconsciousness

First aid
- Hypovolemic shock is a medical emergency. Call 911 or your local emergency medical services number immediately. Do not call DAN first.
- Attempt to stop all external bleeding by applying direct pressure
- Have the person lie down on their back or in a position of comfort. Take necessary steps to maintain a normal body temperature.
- Check for signs of circulation; if absent, begin CPR
- Keep the person warm and comfortable
- Avoid giving the person anything by mouth

Review Questions

1. A general first-aid assessment includes assessing
   a. overall impression of the individual's health and well-being
   b. respiratory effort
   c. presentation of skin color
   d. all of the above

2. Asthma
   a. is a noncontagious respiratory illness
   b. is airway narrowing that makes breathing difficult
   c. can be treated by metered dose inhalers
   d. can be life-threatening if severe and prolonged
   e. all of the above

3. All heart attacks are painful.
   a. True
   b. False

4. Hypoglycemia is a condition
   a. in which blood sugars are low
   b. that should be treated with additional insulin
   c. that can be reversed by eating and/or drinking foods with high sugar content
   d. both a and c

5. F-A-S-T stands for Face, Arms, Smile, Time.
   a. True
   b. False

6. During a seizure, the rescuer's primary concern is to move objects that may cause injury if the person should hit them.
   a. True
   b. False

7. In the event of suspected poisoning,
   a. determine what was ingested
   b. determine how much was taken
   c. note current symptoms
   d. call the local poison control center or EMS
   e. all of the above

8. Plain water is the preferred first-aid measure for exertional dehydration.
   a. True
   b. False

9. Someone who appears to have suffered a concussion can resume his regular activities regardless of how he may feel.
   a. True
   b. False

10. The signs and symptoms of allergic reaction include
    a. itching
    b. localized redness with swelling (hives)
    c. swelling that affects the eyes, lips and possibly the airway
    d. all of the above

11. In the event of an allergic reaction, the rescuer should
    a. assist the injured person with any medications prescribed for them
    b. monitor airway and breathing
    c. immediately begin CPR
    d. a and b only

Review Questions

12. Cardiogenic shock refers to
    a. a decrease in blood volume
    b. the heart's inability to circulate blood
    c. an allergic reaction
    d. all of the above
    e. none of the above

13. The primary course of action for cardiogenic shock is to immediately call EMS and
    a. be prepared to begin CPR
    b. provide fluids to restore blood volume
    c. both a and b
    d. neither a nor b

14. Hypovolemic shock results in
    a. cool, clammy skin
    b. confusion
    c. weakness
    d. all of the above

15. Respond to hypovolemic shock by
    a. contacting EMS
    b. controlling any external bleeding
    c. providing fluids to replenish blood volume
    d. all of the above
    e. a and b only

Review answers are on Page 134.

Preparedness

Chapter 21: Emergency Action Plan

Objectives

1. What elements are included in an emergency action plan?
2. What emergency equipment should be readily available as part of an emergency action plan?

Accidents will happen. As a dive professional or volunteer, you are expected to be prepared and to recognize signs and symptoms of various injuries or illnesses. Once you have completed all sections of this course, you will have the skills required to provide appropriate interventions. Support your skills with proper preparation. This includes emergency action planning, equipment preparation and regular drills with response teams.

Emergency Action Plan

An emergency action plan (EAP) consists of many elements. Thorough planning will reveal specific elements that should be included in your company's EAP. A well-prepared EAP can be a vital resource and save valuable time. In addition, it may also enable others to assist.

In its simplest form, an EAP provides directions for activating emergency medical services (EMS) and facilitating entry into care. In larger organizations, there may be action teams to which specific tasks are assigned to ensure a quick and efficient response to an incident. Meeting or collection points/zones for evacuation of an injured diver and a required chain of notification will also be a part of more involved EAPs.

Regular review of an EAP should be conducted to be sure it is up to date and essential elements have not changed over time.

Basic elements of an EAP include:

- Locations of all emergency kits and supplies
- Communication equipment and how to use it
- Local resources
  - Local EMS contact information
  - Location of the nearest medical facility
  - Transportation options to the nearest medical facility
- Directions for EMS to get to your location if required
- **DAN's Emergency Hotline number is +1 (919) 684-9111** for emrgency medical consultation
- Method for documenting signs and symptoms of injury/illness and aid rendered

You will also need to be able to record information about the injured diver. Include the following information:

- Diver's name, address and DAN Member number if available
  - Include gender (and age, if available)
- Emergency contact information
- Diver's medical history (see **S-A-M-P-L-E** in Chapter 12)
- Current complaint (signs and symptoms)
  - Progression of signs and symptoms
- Assessments conducted and what interventions were rendered
- Dive profile information
  - How many days of diving
  - Number of dives
  - Maximum depth
  - Surface interval times
  - Gas used for diving (air, nitrox — include percentage, trimix — mix percentages, other)
  - Open circuit or rebreather

You may also want to include steps for providing care. In an emergency it is not uncommon for anxiety to overwhelm thought processes, inhibiting the action of providers. First aid slates and dive accident management slates should be kept with emergency equipment and used in rendering care.

Medical Facility vs. Hyperbaric Chamber

If you must transport an injured diver, go to the nearest appropriate medical facility, not to a hyperbaric chamber. Medical evaluations must be completed before hyperbaric treatment. Not all dive-associated injuries or illnesses require hyperbaric intervention, and not all hyperbaric facilities treat divers.

Other reasons to start with a medical facility include:

- Before accepting the transfer of an injured diver, many chambers require a referral from DAN or a physician.
- Many chambers are not staffed 24/7. Assembling a crew often takes time.
- The chamber may already have a patient under care and therefore may not be available.

By starting with a medical evaluation and contacting DAN Medical Services, unnecessary delays can be avoided. DAN Medical Services can assist a local physician or involve a physician trained in dive medicine in evaluating the individual. If the need for a chamber is identified, DAN can also assist in locating an available chamber. **DAN's Emergency Hotline number is +1 (919) 684-9111**.

Emergency Equipment

First aid kits. Another essential item for dive-accident management is a first aid kit that is appropriate for its intended use and the location of diving activity. Many kits are commercially available, or you can assemble one yourself. In choosing or assembling a first aid kit, consider the types of marine life in the diving environment and any special first aid requirements that may be warranted. Whether commercially or personally assembled you should familiarize yourself with the contents of the first aid kit and other kits or equipment to which you will have access during any dive excursion.

The following items should be included, at a minimum, in a standard first aid kit:

- Protective case (waterproof if used in wet environments)
- Resuscitation barrier device (face shield or mask)
- Nonlatex examination gloves
- Cleansing wipes
- Sterile saline for wound irrigation
- Bandages
- Sterile dressings (various sizes)
- Sterile gauze
- Sterile eye pads
- Adhesive tape
- Scissors (strong enough to cut away clothes)
- Triangular bandage
- Safety pins

- Tweezers
- Adhesive dressings (several sizes)

Optional, but recommended:

- Wound-closure strips (Steri-Strips)
- Isothermal blanket
- Irrigation syringe
- Infectious waste bag
- Penlight
- Splint to immobilize fractures
- Thermometer
- NuMask® or oronasal resuscitation mask
- Disposable razor
- First aid manual
- Cold and hot compresses
- A list with emergency numbers
- Tourniquet or materials to improvise a tourniquet
- Hot and/or cold packs

Medications and ointments may also be helpful but may require input from your doctor to ensure appropriate use. While we have provided suggestions for some common over-the-counter medication, first-aid providers are not legally authorized to dispense medications or share their own prescriptions.

Recommended medications include:

- Antiseptic solution
- Antihistamine tablets
- Eyewash
- Antibiotic ointment
- Hydrocortisone ointment
- Pain reliever

Oxygen units. An appropriate oxygen unit is essential for diveaccident management and should be available at every dive site, whether confined water or open water. Oxygen units are discussed in detail later in this course. Appendix 1 lists several DAN oxygen units that are available.

Remember to check components regularly. Replace any items that have expired or have been used. Check both the first aid kits and oxygen units before each outing, and replenish after every use.

Review Questions

1. Emergency action plans should include
   a. local resources and emergency phone numbers
   b. communication equipment
   c. method of documenting information about injured person(s) and first aid provided
   d. location of the nearest hyperbaric chamber
   e. a, b and c only

2. First aid kits should be checked and assessed for appropriate supplies
   a. on a monthly basis
   b. on a weekly basis
   c. as needed

3. Hyperbaric chambers will always be available to treat injured divers.
   a. True
   b. False

Review answers are on Page 134.

Summary

For the average lay-provider, it is likely you will only use a few of these skills. However, knowing what to do in an emergency could save someone's life – maybe even that of a loved one or your own.

The material covered in this section addresses various life-threatening and other serious situations and gives you the academic knowledge in the areas of Scene Safety, Assessments, How to move injured and ill persons, bleeding management, splinting, specialized injuries, burns, temperature related issues and medical emergencies.

Reading this handbook without instruction and skill practice will not make someone competent to provide CPR or first-aid assistance.

Some skills that are covered in this material may not be allowed or have other restrictions in your region. Your DAN Instructor will advise you of any of these restrictions. You will still be responsible for the academic content on the final exam.

After you have completed the required e-learning and the skills-development portion of the course with your DAN Instructor, your instructor will process your credentials. You can find your credential card(s), in your e-learning profile at dan.diverelearning.com under the "completed" tab, by selecting the course you want. There you will see a grey 'course record' box with information about your course. To the right of that grey box you will see your credential card. You can click on that image and then either print it or save it as an image file. If your course is approved by the United States Coast Guard, there will also be a wall certificate available.

Your credentials are good for two years from the approval date. It is recommended you are retrained prior to your credential expiration to keep your skills proficient.

Thank you for taking this DAN course and your support of DAN – your dive safety organization!

Review Answers (SECTION 2)

Chapter 10 - Page 68
1. D
2. D
3. A
4. D

Chapter 11 - Page 76
1. A
2. D
3. E
4. D
5. C
6. A
7. A

Chapter 12 - Page 83
1. C
2. A
3. A
4. B
5. E

Chapter 13 - Page 86
1. A
2. A
3. A
4. D

Chapter 14 - Page 89
1. A
2. E

Chapter 15 - Page 94
1. A
2. B
3. A
4. D
5. B

Chapter 16 - Page 97
1. A
2. A
3. B
4. B

Chapter 17 - Page 103
1. A
2. C
3. B
4. B
5. B
6. B
7. A
8. E
9. B
10. E

Chapter 18 - Page 108
1. B
2. A
3. A

Chapter 19 - Page 115
1. A
2. E
3. A

Chapter 20 - Page 126
1. D
2. E
3. B
4. D
5. B
6. A
7. E
8. B
9. B
10. D
11. D
12. B
13. A
14. D
15. E

Chapter 21 - Page 132
1. E
2. C
3. B

Glossary

acute — rapid onset or short-term duration

adaptic gauze — nonadhering dressing

agonal breathing — an abnormal pattern of breathing characterized by gasping, labored breathing, accompanied by strange vocalizations and involuntary muscle twitching

ambient — surrounding on all sides

arrhythmia — a problem with the rate or rhythm of the heartbeat

aspiration — inhaling fluid or a foreign body into the bronchi and lungs, often after vomiting

asymptomatic — without symptoms

bloodborne pathogens — infectious microorganisms in human blood that can cause disease

cardiopulmonary resuscitation (CPR) — an emergency procedure that is performed in an effort to manually preserve intact brain function until further measures are taken to restore spontaneous blood circulation and breathing in a person in cardiac arrest

chronic — persistent or long lasting

cirrhosis — a consequence of chronic liver disease characterized by replacement of liver tissue by fibrosis, scar tissue and nodules, leading to loss of liver function

debridement — removal of dead, damaged or infected tissue to improve the healing potential of remaining healthy tissue

defibrillation — a therapeutic dose of electrical energy to the affected heart with a device called a defibrillator, which depolarizes a critical mass of the heart muscle, terminates the arrhythmia and allows normal sinus rhythm to be reestablished by the body's natural pacemaker

distal — away from the center of the body

dysrthymia — irregular or abnormal heart rate

electrolyte — minerals in your blood and other body fluids that carry an electric charge that affect the amount of water in your body, the acidity of your blood (pH), your muscle function and other important processes EMS arrives or the individual is transported to advanced medical care

first responder — as used in the context of this course is an individual who arrives first on the scene and has first-aid training that addresses the immediate need for care until EMS arrives

Glossary Continued

hyperoxia — excess oxygen or higher than normal partial pressure of oxygen

hypovolemic — a state of decreased blood volume

hypoxia — inadequate oxygen content

intracerebral — occurring or situated within the brain

iodoform gauze — sterile gauze treated with an antiseptic

isothermal — of, relating to or indicating equal or constant temperatures

jaundice — a yellow color of the skin, mucus membranes or eyes

lethargy — the quality or state of being lazy, sluggish or indifferent

oronasal — pertaining to the mouth and nose

peripheral — related to or located in the outer boundary of the body

postictal — pertaining to the period following a seizure or convulsion

proximal — nearer to the center of the body

regurgitation — expulsion of material from the mouth, pharynx or esophagus, usually characterized by the presence of undigested food or blood; vomiting

resuscitation — to revive from apparent death or from unconsciousness

sepsis — a severe infection that affects the entire body

sublingual — under the tongue

subcutaneous emphysema — gas bubbles under the skin that can be felt with the fingers

symptomatic — showing symptoms

thrombus — blood clot

venomous — secreting or transmitting venom (toxin)

ventricular fibrillation (VF) — a condition in which there is uncoordinated contraction of the cardiac muscle of the ventricles in the heart, making them quiver rather than contract properly

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Divers Alert Network® (DAN) is an international nonprofit organization dedicated to improving dive safety through research, education, medical information, evacuation support, products and services.

Among the services DAN provides to the diving public is the DAN Emergency Hotline (+1 (919) 684-9111). This hotline is available 24 hours a day, seven days a week for anyone who suspects a diving injury, requires assistance or needs to activate ***DAN TravelAssist***® (an exclusive benefit of DAN membership). Callers are connected directly with a member of DAN's Medical Services department, who can facilitate medical consultation with dive medicine specialists and coordinate evacuation to ensure appropriate care.

DAN's non-emergency safety resources include the DAN Medical Information Line (+1 (919) 684-2948), the online Health & Diving libary (DAN.org/Health-Medicine) and Alert Diver magazine, as well as Smart Guides, safety quizzes, and more.

Membership dues and insurance purchases support DAN's nonprofit efforts. DAN members enjoy benefits such as access to the DAN Dive Accident Insurance program, medical evacuation support, print copies of ***Alert Diver*** magazine, free online seminars and more.

Your participation in this DAN training course demonstrates your commitment to dive safety. Continue your education and your commitment by supporting **the industry's only organization dedicated solely to improving dive safety**. Join DAN today.

To learn more about DAN and the multitude of resources it provides, or to become a member, please visit **DAN.org**.

DAN First Aid Programs

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- **Emergency Oxygen** for **Scuba Diving Injuries** (EO2)
- **Basic Life Support:** **CPR** and **First Aid** (BLS)
- **Neurological Assessment** (NEURO)
- **First Aid** for **Hazardous Marine Life Injuries** (HMLI)

Professional Training Course

- **Diving First Aid** for **Professional Divers** (DFA PRO)

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