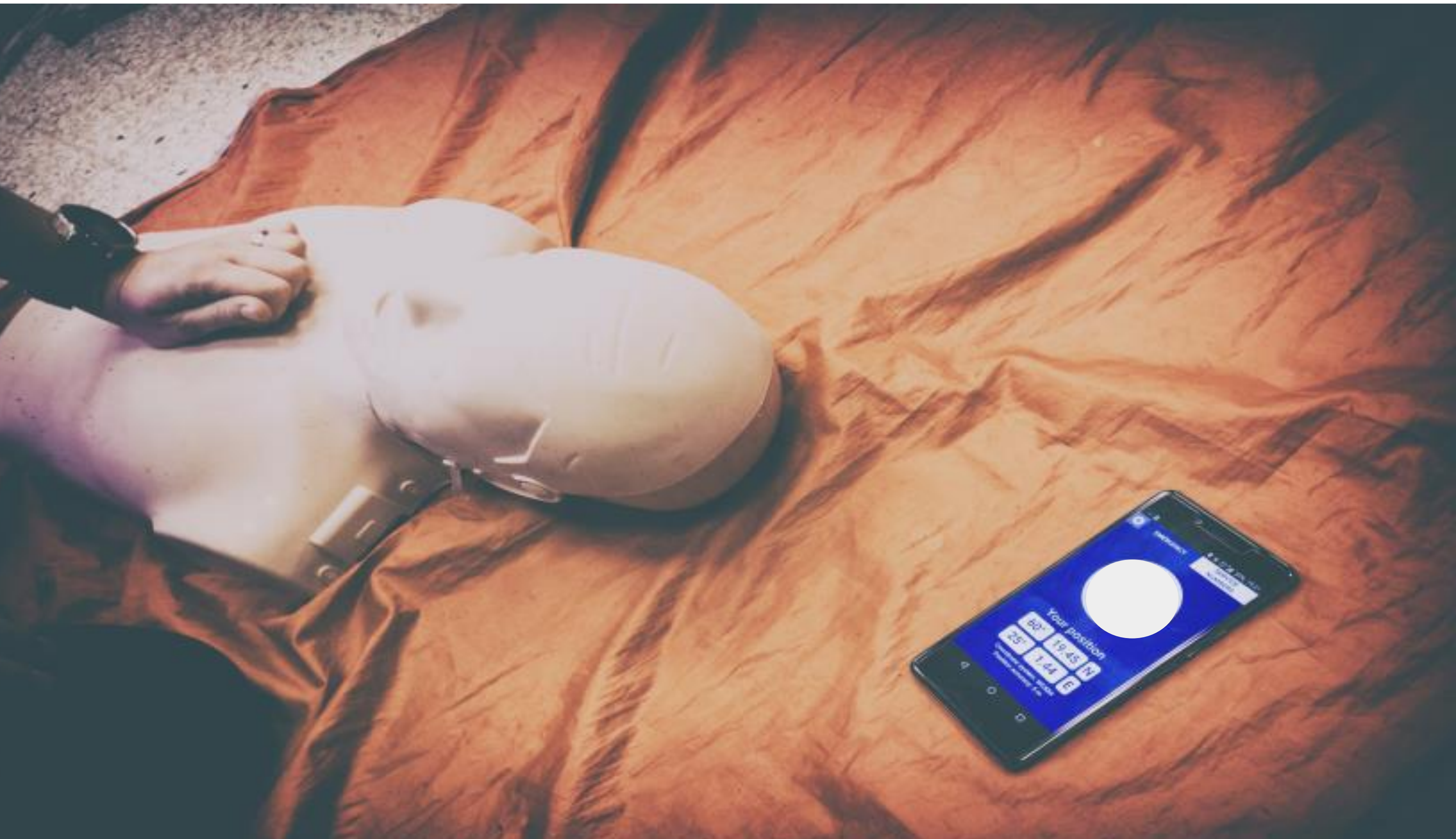
Care CEU's
Continuing Education for Nursing Home Administrators

CPR: A Comprehensive Review



CPR: A Comprehensive Review of the Concepts Behind the Lifesaving Procedure

Introduction

Sudden cardiac arrest accounts for millions of deaths worldwide each year. It can strike without warning and can leave individuals on the brink of death within minutes of onset. Sudden cardiac arrest's lethality is quick and devastating. Fortunately, there is a procedure which possesses the potential to prevent death from sudden cardiac arrest, cardiopulmonary resuscitation (CPR). If performed correctly, efficiently and effectively, CPR possesses the potential to prevent death from sudden cardiac arrest and save lives. However, the lifesaving abilities of CPR rest in the individuals who administer it to those in need. A deep understanding of CPR is required to perform the techniques which make it an invaluable lifesaving procedure. This course will review the most important and universal principles of CPR, while highlighting the essential concepts behind its lifesaving potential.

Section 1: The Anatomy and Physiology of CPR

All living organisms are comprised of cells. Cells are the basic unit of life. In multicellular organisms, like humans, cells are arranged and organized into tissues. Tissues are a large mass of similar cells which work together to carry out a specific function. The human body has many different tissues, which have many different functions. The human body's various tissues make up organs. An organ can refer to the structural units within the human body, which serve a function (1). The human body has many organs such as the heart, liver, kidneys, lungs, stomach and skin. These organs have specific functions and are essential for life. For example, the liver's main function is to filter blood. The kidneys' main function is to extract waste from the blood, while the heart's main function is to pump blood throughout the body (1). The human body's organs do not work independently. In fact, they work together in different systems referred to as organ systems. Organ systems are groups of organs which work together to provide a function for the human body (1). The human body has 11 major organ systems, which include the renal system, reproductive system, digestive system, endocrine system and muscular system. Each organ system depends on each organ within that system to carry out a particular function. For example the digestive system relies on the mouth, esophagus, stomach and intestines to break down food for absorption. Each organ in the digestive system has a specific role and is needed to complement the entirety of the system. If one of the organs within an organ system were to fail or become damaged, the whole system could be compromised. In order for the digestive system to accomplish its function, the mouth has to be operational to allow food to enter the body. The esophagus has to be functional to allow food and liquid to move from the mouth to the stomach. The stomach has to be able to secrete enzymes to break down food and the intestines have to be available to absorb water and move waste. The digestive system is only as strong as its individual components. Each individual organ has to be operational, able and available to complement the rest of the organs in the organ system. If the stomach and/or the intestines were to become damaged enough so they were not able to function properly, the entire digestive system would suffer. In other words, if multiple organs within the digestive system were to become compromised, the entire system could shut down. If the digestive system were to shut down, or if any organ system were to shut down, it could have dire consequences for the human body as a whole. Much like tissues and organs, organ systems do not exist completely independently. Each organ system is made up of different organs and each organ system has a different function; however the organ systems of the human body are all connected and work together to maintain life. If one organ system were to shut down, it could dramatically affect the other organ systems' ability to maintain functionality, which could subsequently affect the human body's ability to maintain life. In order for human life to be sustained, organs and their corresponding organ systems must be fully operational. The collective goal of organs and their corresponding individual organ systems is to maintain life. Without fully functional organs and organ systems, human life would be pushed to the utter brink and ultimately placed in extreme jeopardy. This concept cannot be more evident than with the organ systems which are responsible for maintaining the human body's supply of oxygen. Oxygen is critical to the human body's ability to maintain life. Without oxygen, the human body could not function and life would cease to exist. The organ systems which are responsible for maintaining the human body's supply of oxygen include: the nervous system, the respiratory system and the cardiovascular system.

The Nervous System

The nervous system may not be the first organ system that comes to mind when thinking about organ systems, which are responsible for maintaining the human body's supply of oxygen. However, the nervous system is crucial to the human body and plays a very important role in the body's ability to maintain a sufficient supply of oxygen. The nervous system consists of two parts: the central nervous system and the peripheral nervous system (1). The central nervous system is composed of the brain and the spinal cord. The peripheral nervous system is made up of a multitude of nerve fibers, which extend out from the spinal cord to various muscles and organs. These two systems work together to coordinate the movement of muscles and the functions of organs. In other words, it can be said that the central nervous system controls the human body. It does this by governing a vast network of neurons. Neurons are the basic working units of the nervous system (1). Neurons function to process and transmit information throughout the human body. Neurons receive input, synthesize the information and then transmit messages to the necessary parts of the body required to carry out a particular function. These neuron messages are responsible for the release of neurotransmitters and other electrical signals. The nervous system uses these signals to communicate to organs in order to specify their function. For example, when food enters the body. The nervous system communicates to the stomach and the intestines to begin operating to break down food, absorb nutrients and produce waste. The nervous system communicates to the aforementioned organs in order for them to work together as complete organ system to carry out a specific function- in this example, digestion. This concept of organ communication and organ control highlights the relationship between the nervous system and the body's ability to maintain a sufficient supply of oxygen. The nervous system controls the organs and ultimately the organ systems which directly regulate the body's supply of oxygen. The nervous system communicates to these organ systems to dictate their functionality in order for them to regulate the body's supply of oxygen, which is required to maintain life. Essentially, the nervous system serves as the central communication system for the human body. Its function is to communicate to the organs and organ systems in order for them work properly. The nervous system dictates the function of organs and how organs operate within their respective organ systems. Without the nervous system maintaining communication and control over organ systems, like the ones which directly regulate the human body's supply of oxygen, they would fail. If organ systems fail within the human body, it would no longer be capable of maintaining life. In short, the nervous system controls other organ systems, via internal communication pathways, which regulate the body's supply of oxygen. Therefore, without a fully functioning nervous system, the human body would not be able to maintain a sufficient supply of oxygen or life itself.

The Respiratory System

The respiratory system may be more of what comes to mind when thinking about organ systems, which are responsible for maintaining the human body's supply of oxygen. The respiratory system is comprised of the mouth, nose, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, blood vessels and, of course, the lungs (1). These structures make up the four major parts of the respiratory system, which include: the airways that conduct air between the outside environment and the lungs, the alveoli in the lungs where gas exchange occurs, the nerves which communicate to the muscles when to move and the muscles that let air in and out of the lungs, and finally, the set of blood vessels that move blood to organs and removes waste from the blood (1). The four major parts of the respiratory system work together to carry out the two primary functions of this organ system. The two primary functions of the respiratory system include: bringing oxygen from the outside environment to the alveoli where it can move into the blood and eliminating carbon dioxide that moves from the blood into the alveoli (1). Essentially, the respiratory system is responsible for bringing in oxygen, which the body needs, from outside of the body and expelling carbon dioxide, which the body does not need. To do this, the respiratory system allows oxygen to enter the body via the mouth and nose. Once oxygen enters the body it travels through the pharynx and into the trachea where it is filtered and then brought down into the bronchioles of the lungs. Once oxygen is in the bronchioles of the lungs it is then transferred into the alveoli. The alveoli are tiny air sacs within the lungs that resemble grapes. The alveoli are surrounded by tiny blood vessels referred to as capillaries. Once oxygen enters the alveoli it passes through these air sacs and then through the surrounding capillary walls, into the bloodstream. At the same time, carbon dioxide moves from the bloodstream into the alveoli, where it is then moved out of the lungs and ultimately out of the body. This entire process can be referred to as respiration. Respiration is essential to human life. The respiration process brings in what the body needs and expels what the body does not need. It brings in oxygen and carries out waste in the form of carbon dioxide. The exchange of these two gases provides the body with what it requires to fuel cells, tissues, organs and organ systems, while removing the waste they create. Without respiration and a fully functional respiratory system, the human body would be incapable of maintaining life. If the respiratory system were to become compromised in any major capacity, organs and organ systems would shut down due to a lack of oxygen and carbon dioxide would build up within the body, leading to organ and organ system failure. A delicate balance exists between the body's levels of oxygen and carbon dioxide. The human body, with the respiratory system's help, must maintain this delicate balance in order to maintain life.

The Cardiovascular System

The last of the three main organ systems which are responsible for maintaining the human body's supply of oxygen is the cardiovascular system. The cardiovascular system includes the heart, arteries, capillaries and veins (1). Arguably, the most important part of the cardiovascular system is the heart. The human heart is a muscular organ which is positioned in the middle of the chest behind the breastbone. The human heart consists of four chambers including: the right atrium, the right ventricle, the left atrium and the left ventricle (1). The heart is covered by a sac-like membrane referred to as the pericardium. The function of the heart is to pump oxygen containing blood, more commonly referred to as oxygenated blood, throughout the human body and to its various organs including the lungs and the brain (1). The heart does this by carrying out a well-orchestrated process involving its four chambers. The process begins when blood, from the body, enters the right atrium of the heart. Once blood enters the heart's right atrium, it is then transferred into the right ventricle of the heart (1). After the right ventricle of the heart receives the blood it is then carried over to the capillaries, via the pulmonary arteries, surrounding the alveoli of the lungs (1). As outlined in the previous section, the lungs serve as the human body's location for blood oxygenation. Oxygen enters the human body, via the nose and mouth, where it is then moved down the respiratory system into the alveoli. Once oxygen reaches the alveoli of the lungs, it diffuses through the walls of the alveoli and capillaries into the bloodstream. Once the oxygen enters the bloodstream, the cardiovascular system takes over. The oxygenated blood then moves from the lungs back to the heart, via pulmonary veins, where it is received by the left atrium (1). After being received by the heart through the left atrium, the oxygenated blood is transferred to the left ventricle of the heart (1). Once the left ventricle of the heart receives the oxygenated blood, it is then pumped out of the heart and throughout the body (1). Arteries carry the rich oxygenated blood to the various organs and throughout the body. Once the oxygenated blood delivers the oxygen to the body's organs, it becomes deoxygenated. The deoxygenated blood travels back to the heart, via veins, and the entire cyclical process begins again. The aforementioned cycle allows the cardiovascular system to carry out its two primary functions, which include:

carrying oxygenated blood from the lungs to the cells of the body and carrying blood containing carbon dioxide from the cells of the body to the lungs (1). One way to conceptualize the two primary functions of the cardiovascular system is to imagine the arteries and veins of the cardiovascular system as moving conveyor belts and the heart as the motor, which provides them with the power to stay in continual motion throughout the body. The arteries carry blood containing oxygen to the cells of the various organs, where it is absorbed and exchanged for carbon dioxide. The blood is then transferred to the veins, which carries the blood to the heart and to the lungs where it drops off carbon dioxide to be expelled from the body through the respiratory system and picks up oxygen to bring back to the cells of the organs. This circular cycle of the cardiovascular system continues in perpetual motion to provide the human body with the fuel it needs, in the form of oxygen, to think, move, grow and live, while removing the unnecessary waste it does not need, in the form of carbon dioxide. Much like the nervous system and the respiratory system, a fully functioning cardiovascular system is absolutely necessary for the human body to maintain life.

The Three Organ Systems Responsible for Maintaining the Human Body's Supply of Oxygen	
Organ System	**Function**
Nervous system	• Transmits signals throughout the human body which allows for internal communication between organs and organ systems in order to determine functionality (tells the organs of the body what to do and when to do it) (1)
Respiratory system	• Allows oxygen from the outside environment into the alveoli of the lungs where it can move into the blood (1) • Eliminates carbon dioxide from the body (1)
Cardiovascular system	• Carries oxygenated blood from the lungs to the

	cells of the body (1) • Carries blood containing carbon dioxide from the cells of the body to the lungs (1)

Section 1: Summary

The nervous system, the respiratory system and the cardiovascular system do not work independently to maintain the human body's supply of oxygen. In fact, it is quite the opposite. The aforementioned three systems work interdependently to maintain the human body's supply of oxygen, which means they all depend on each other to maintain a high level of functionality in order to maintain the human body's supply of oxygen (1). One system cannot fully function without the other two organ systems operating. Essentially, for the human body to maintain the necessary supply of oxygen required to maintain life, all three organ systems must be fully operational and working together. If one system were to fail, all three systems would be placed in extreme danger.

As previously highlighted, the nervous system controls the communication between the organs of the body. If the nervous system were to fail, the various organs of the human body would not be able to communicate with each other in order to determine their required function. If the organs of the body were not able to communicate with each other to distinguish their functionality, they would inevitably stop functioning. If the organs of the body stop functioning, the organ systems would fail. In relation to the organ systems which control the body's supply of oxygen, if the nervous system fails the respiratory system and the cardiovascular system would also fail. The respiratory system allows oxygen to enter the body, while also being responsible for expelling carbon dioxide from the body. If the respiratory system were to fail, oxygen would not be able to enter the body and carbon dioxide would build up within the body. Organs cannot function without oxygen. Therefore, if the respiratory system were to fail, the nervous system and cardiovascular system would also eventually fail. The cardiovascular system is responsible for circulating oxygen throughout the body and delivering it to the cells of the various organs. If the cardiovascular system were to fail, the oxygen admitted into the body by the respiratory system would not be able to make it to the cells of the organs of the body. If oxygen cannot be delivered to the organs of the 11 major organ systems of the human body, including the respiratory system and the nervous system, they would begin to fail one by one. Once mass organ system failure occurs within the human body, the body cannot maintain life on its own. The human body requires a sufficient supply of oxygen to function and maintain life. The three organ systems which maintain the body's oxygen supply must all be fully operating and functioning together to meet the demands of the human body in order to sustain life.

Section 1: Key Terms

Organ - refers to the structural units within the human body, which serve a function (1).

Organ system - refers to a group of organs, which work together to provide a function for the human body (1).

Nervous system - refers to the organ system which includes the brain and the spinal cord (1).

Respiratory system - refers to the organ system which includes the mouth, nose, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, blood, vessels and lungs (1).

Cardiovascular system - refers to the organ system which includes the heart, arteries, capillaries and veins (1).

Section 1: Key Concepts

The human body requires a continuous supply of oxygen in order to maintain life.

The nervous system, the respiratory system and the cardiovascular system function interdependently to maintain the human body's supply of oxygen (1).

If the nervous system, respiratory system and/or cardiovascular system were to shut down, the human body would lose its ability to maintain life.

Section 1: Reflection Question

How does the nervous system, respiratory system and the cardiovascular system function interdependently to maintain the human body's supply of oxygen?

Section 2: CPR's Indication and Key Actions

One of the primary indications for CPR is sudden cardiac arrest. Sudden cardiac arrest can refer to the abrupt loss of heart function (1). Cardiac arrest is one of the leading causes of death and is typically caused by coronary heart disease. Sudden cardiac arrest can strike individuals without warning and can leave them unconscious, unable to breath and at the utter brink of survival. Sudden cardiac arrest possesses the potential to be incredibly lethal and can precipitate death within minutes of onset. The lethality of cardiac arrest lies in its devastating effects on the cardiovascular system.

As highlighted in the previous section, the function of the cardiovascular system is to deliver oxygen to the cells of the organs and to carry carbon dioxide from the cells of the organs to the lungs. To accomplish the previous functions the cardiovascular system relies on cyclical process involving the arteries and veins of the body. The arteries deliver oxygenated blood to the cells of the organs and the veins bring blood containing carbon dioxide to the lungs in order for it to be exchanged for incoming oxygen from the respiratory system. The aforementioned process continues in perpetual motion to help the human body maintain a continuous supply of oxygen, and ultimately life. At the center of cardiovascular system and its cyclical process is the heart. The heart is the driving force, which moves oxygenated and deoxygenated blood throughout the body and ultimately allows the cardiovascular system to function. To do this, the heart pumps or beats in a continuous, rhythmic fashion. Each heart beat begins with an electrical impulse. The heart contains its own electrical stimulation center, or natural pacemaker, which can be referred to as the sinus node (1). The sinus node consists of a group of cells located in the wall of the right atrium (1). The sinus node generates an electrical impulse which stimulates the heart to contract and pump blood (1). After each contraction, the heart experiences a period of relaxation. During this period of relaxation, the heart fills with blood until the sinus node generates another electrical impulse, stimulating the heart to contract (1). The heart rhythmically contracts and relaxes to allow for continual blood flow throughout the human body. At rest, the human heart can pump about five quarts of blood per minute (1). During strenuous exertion, such as exercise, the human heart can pump up to approximately 37 quarts of blood per minute (1). Each time the adult heart beats, it pumps about two and a half ounces of blood (1). The more the heart beats, the faster blood is pumped throughout the body and the quicker oxygen is delivered to the cells of the organs, which maintain life. As the oxygen demands of the cells of the various organs increases, so does the demand on the heart. Without the heart's consistent continuous, rhythmic beating, the cardiovascular system would fail. Within that last concept lies the lethality of cardiac arrest. When sudden cardiac arrest strikes, the continuous, rhythmic beating of the heart is interrupted and replaced by an irregular, useless quiver, which can be referred to as ventricular fibrillation (1).

Ventricular fibrillation is considered one of the most dangerous cardiac rhythm disturbances. Once the human heart experiences ventricular fibrillation, it ceases to beat in a continuous, rhythmic, useful manner. Instead it begins to quiver and flutter in an erratic, disjointed, useless manner. The erratic, disjointed quiver of ventricular fibrillation is considered to be useless because once the heart begins to beat in that manner, it can no longer pump blood throughout the human body. Essentially, once the heart experiences ventricular fibrillation, it malfunctions and simply does not work, which has dire consequences for the cardiovascular system and the human body's ability to maintain life.

The heart is the core of the cardiovascular system. It has been said that the cardiovascular system is only as strong as the heart which supports it. If the heart has problems, so will its corresponding cardiovascular system. Beyond that, if the heart malfunctions and stops working, so will the cardiovascular system. When sudden cardiac arrest strikes and ventricular fibrillation sets in, essentially the heart immediately stops working. When the heart stops working, blood cannot be circulated throughout the human body. After all, the heart is, in essence, the motor of the cardiovascular system. It provides the arteries and veins with the necessary power to carry blood throughout the human body. If the heart shuts down, the arteries and veins lose their power supply and, ultimately, their ability to effectively function. With the loss of their function, the arteries can no longer deliver oxygenated blood to the cells of the various organs, and the veins can no longer carry deoxygenated blood to the lungs. Once the flow of oxygenated and deoxygenated blood slows down and eventually stops, the cardiovascular system is effectively rendered inoperative. Once the cardiovascular system shuts down, the lethality of cardiac arrest begins to fully take shape.

As highlighted in the previous section, the cardiovascular system, the respiratory system and the nervous system function interdependently to maintain the human body's supply of oxygen. In order for the human body to maintain a sufficient supply of oxygen to sustain life, all three of the aforementioned organ systems must be operating and working together. If one the previous three organ systems were to fail, they all would subsequently fail and the human body would lose its ability to maintain a sufficient supply of oxygen and life itself. Finally, the true lethality of cardiac arrest is revealed. Simply put, sudden cardiac arrest causes the cardiovascular system to fail. Once the cardiovascular system fails, oxygen can no longer be delivered to the body's organs, including the organs of the respiratory system. This in turn causes the respiratory system to fail. Once the respiratory system fails oxygen can no longer be inhaled into the body and carbon dioxide can no longer be exhaled out of the body. Essential, the human body becomes cut off from its supply of oxygen. Once the human body becomes cut off from its supply of oxygen, it loses its ability to maintain life and the organs of the human body begin to fail within minutes, including the main organ of the nervous system, which is the brain. When cardiac arrest occurs, all of the cells of the human body are affected. However, it can be argued that the brain undergoes the most significant injury (1). Much like the heart, the brain is the center of its organ system, which in this case is the nervous system. As the brain goes so does the nervous system. During cardiac arrest oxygenated blood can no longer reach the brain. As a result the brain begins to lose functionality. As the brain begins to lose its ability to function so does the nervous system and when the nervous system begins to lose its ability to function, the last piece of the puzzle of why cardiac arrest is so lethal, falls into place.

First, cardiac arrest interrupts the normal continuous, rhythmic beat of the heart, which subsequently shuts down the cardiovascular system. Then, due to a lack of oxygen, the organs of the respiratory system begin to fail, effectively disabling it. Finally, the nervous system and, most importantly, the brain begin to shut down. At that point, when all three of the aforementioned organ systems shut down, cardiac arrest becomes the most lethal. Without the cardiovascular system, the respiratory system and the nervous system the human body cannot maintain the necessary supply of oxygen required to maintain life, and without oxygen the body begins to die. However, there is something that can be done to prevent organ failure and death from sudden cardiac arrest: CPR. If CPR is correctly administered within approximately, 2 to 6 minutes after the onset of sudden cardiac arrest, it possesses the potential to prevent organ failure, death and save lives (2). However, the question remains, how?

Rescue Breathing

CPR does possess the potential to prevent death from sudden cardiac arrest. If CPR is administered correctly and within approximately, 2 to 6 minutes after the onset of sudden cardiac arrest, it has been demonstrated that it can save lives (2). The method in which CPR can prevent death from sudden cardiac arrest and, ultimately, save lives can be understood by examining the functions of its two key actions: rescue breathing and chest compressions (1).

Rescue breathing, also known as mouth-to-mouth resuscitation, can refer to the technique of delivering air into an individual's lungs or respiratory system (2). Rescue breathing is typical administered to individuals who have stopped breathing effectively enough to deliver air into the respiratory system. The process of rescue breathing involves exhaling air into another individual's mouth or nose. Air can be directly exhaled into an individual's mouth or nose or it can be delivered via a mask, which can be fitted over the non-breathing individual's mouth. During CPR, effective rescue breaths can be delivered by pinching the non-breathing individual's nose shut and tilting his or her head back (2). Typically, two rescue breaths are administered to the non-breathing individual, with each one lasting for about a second in duration (1). These two, one second long, rescue breaths should provide the non-breathing individual with the much needed oxygen he or she requires. As previously highlighted, during sudden cardiac arrest, the respiratory system shuts down. When the respiratory system shuts down, air carrying oxygen can no longer be inhaled into the body's lungs where it can diffuse into the bloodstream. Without incoming oxygen, the body cannot survive. Thus, it is imperative that oxygen be delivered into the body of those who cannot breath by means of rescue breathing. Rescue breathing is a method to provide those who cannot breathe with the necessary oxygen they need to live. In essence, rescue breathing is a form of artificial ventilation, which stimulates the process of gas exchange within the human body referred to as respiration. The process of gas exchange within the human body is necessary to maintain life. It allows oxygen to enter the body and move into the lungs, where is can diffuse into the bloodstream. It also helps expel carbon dioxide out of the body. This process of gas exchange helps stimulate and maintain the respiratory system, which is rendered inoperative by cardiac arrest. It also helps prevent the other organ systems from shutting down due to a lack of oxygen. However, rescue breathing is only one half of the complete CPR picture. It is imperative that oxygen be delivered into the lungs in order to maintain the necessary ventilation required to allow oxygen to diffuse into the bloodstream. However if there is no way for that oxygen to be delivered to the cells of the organs required to maintain life, it is almost useless. That is where the second key action of CPR becomes relevant.

Chest Compressions

Chest compressions can refer to the act of applying pressure to an individual's chest (2). Typically, chest compressions are administered to an unresponsive individual. Chest compressions should be administered to the center of an individual' chest with the heel of the hand on the individual's sternum, which is the breastbone (2). During CPR, chest compressions are to be delivered to the individual's chest in a rhythmic manner at a rate of 100/minute to 120/minute (2). As previously outlined, when sudden cardiac arrest strikes, it affects the heart. Cardiac arrest interrupts the heart's normal, continuous, rhythmic beat and replaces it with a useless flutter. As a result, the heart can no longer pump blood throughout the body and oxygen can no longer be delivered to the cells of the various organs, effectively shutting down the human body's circulatory system and the cardiovascular system as a whole. If nothing is done within a few minutes after the aforementioned process occurs, the nervous system and the brain will begin to lose functionality and the body will begin to die. In order for the human body to maintain life, there needs to be a continues flow of oxygenated blood circulating throughout the body. However, sudden cardiac arrest robs the body of its ability to naturally fulfill that requirement, which is why chest compressions are included as a key action of CPR and needed during cardiac arrest. External chest compressions delivered onto the chest provide the body with a means for artificial circulation. Rhythmic, external chest compressions administered at a controlled rate of 30 compressions per 2 rescue breaths can be sufficient to kick start the cardiovascular system enough to pump oxygenated blood throughout the body, in order to deliver oxygen to the cells of the various organs (2). It may also be sufficient enough to deliver the required oxygen supply to the brain and nervous system in order to prevent them from shutting down. Essentially, external chest compressions work to artificially circulate oxygenated blood throughout the body in order to stimulate and maintain the cardiovascular system, which is rendered inoperative by cardiac arrest. They also help prevent the other organ systems, most importantly the nervous system, from shutting down due to a lack of oxygen. The human brain can only maintain functionality for a few minutes once its oxygen supply is cut off. After approximately 6 minutes, the brain becomes damaged and begins to die (2). Once the brain dies the nervous system shuts down and the body can no longer maintain life. At that point the human body begins to die. That is, unless CPR is administered. CPR uses its two key actions of rescue breaths and chest compressions to prevent death. If CPR is administered correctly and in a timely manner after the onset of sudden cardiac arrest, it possesses the potential to prevent brain damage and save lives.

The Key Actions of CPR	
Action	**Function**
Rescue breathing	• Provides a means for artificial ventilation, which can stimulate and maintain the functions of the respiratory system
Chest compressions	• Provides a means for artificial circulation, which can stimulate and maintain the functions of the cardiovascular system

Section 2: Summary

Sudden cardiac arrest can shut down the cardiovascular system, the respiratory system and the nervous system. Once the aforementioned organ systems are shut down, the human body can no longer maintain the necessary supply of oxygen required to maintain life, which can lead to death. CPR, if administered correctly and within the first few minutes after the onset of sudden cardiac arrest, possesses the potential to prevent death due its two key actions: rescue breathing and chest compressions (1). Rescue breathing essentially acts as means for artificial ventilation, which can stimulate respiration and maintain the functions of the respiratory system. External chest compressions, when delivered to the center of the chest, can provide stimulus for artificial circulation in order to deliver oxygenated blood to the cells of the body's organs and to maintain the functionality of the cardiovascular system. Maintaining the functions of the cardiovascular system and the respiratory system can prevent the nervous system from shutting down by allowing oxygenated blood to reach the brain. CPR does possess the potential to prevent death from sudden cardiac arrest and can save lives.

Section 2: Key Terms

Sudden cardiac arrest - refers to the abrupt loss of heart function (1).

Ventricular fibrillation - refers to a condition, which can leave the heart beating in an erratic, disjointed, useless manner (1).

Rescue breathing - refers to the technique of delivering air into an individual's lungs or respiratory system (2).

Chest compressions - refers to the act of applying pressure to an individual's chest (2).

Section 2: Key Concepts

The primary indication for CPR is cardiac arrest.

When sudden cardiac arrest strikes the continuous, rhythmic beating of the heart is interrupted and replaced by an irregular, useless quiver, which can be referred to as ventricular fibrillation (1).

Sudden cardiac arrest's lethality lies in its potential to shut down the cardiovascular system, the respiratory system and the nervous system within minutes of onset.

The two key actions of CPR include: rescue breathing and chest compressions (1).

CPR possesses the potential to prevent death due to sudden cardiac arrest.

Section 2: Reflection Question

How can CPR prevent death from sudden cardiac arrest?

Section 3: The History of CPR and Recent CPR Guideline Updates

The history of CPR is extensive. Some medical historians believe a version of CPR has been utilized to prevent death since the beginning of the 17th century. Some believe the history of CPR goes back even further in time. Whatever the case may be, CPR, in one form or another, has been part of emergency health care treatment for centuries. With that said, the history of the modern-day version of CPR begins in the United States of America in the mid 1950's. In 1956, Peter Safar and James Elam developed a modern version of mouth-to-mouth resuscitation (3). The goal of their development was to design a technique which could provide the human body with a means to maintain the functionality of the respiratory system. They understood that once the respiratory system failed, the human body could no longer take in the necessary supply of oxygen required to maintain life. They also understood that after approximately 6 to 10 minutes without oxygen, the human brain begins to experience critical damage and the body begins to die. Peter Safar and James Elam were looking for a way to prevent brain damage and death once an individual lost the ability to breathe on his or her own, and thus a modern-day version of CPR was born. The early form of CPR relied upon mouth-to-mouth resuscitation. The life saving potential of mouth-to-mouth resuscitation was immediately recognized and adopted by the U.S. military in 1957 as a means to revive unresponsive individuals (3). Due to the success of the military's application of mouth-to-mouth resuscitation, it began to be used in the private sector. In the 1960's the American Heart Association (AHA) was formed and mouth-to-mouth resuscitation, along with the utilization of external chest compressions, became known as CPR (3). In 1972 Leonard Cobb held the world's first mass CPR training course, where, for the first time, anyone could learn the lifesaving techniques of CPR. In the years after 1972, due to the success of the first CPR training course, CPR education began to take off in the United States and more and more individuals began to learn how to effectively perform CPR. Today CPR is recognized throughout the world for its lifesaving potential and is a fixture in emergency treatment. CPR has come a long way from its initial inception and has evolved into one of the most effective and widely used lifesaving procedures. Along the way, the AHA has established CPR guidelines to enhance the education process and promote the latest developments designed to increase the effectiveness of CPR. The AHA's guidelines have become a widely accepted mainstay in CPR education, training and administration. The AHA guidelines were last updated in 2015. The remainder of this section will review the most pertinent 2015 updates to the AHA's CPR guidelines and explore their relevance in the current health care climate.

Emphasis on Chest Compressions

The 2015 updates made to the AHA's CPR guidelines placed an emphasis on external chest compressions. External chest compressions are one of the key actions of CPR and are essential to the ability of CPR to prevent death from sudden cardiac arrest. Chest compressions, when performed correctly, provide a means to maintain the functionality of the cardiovascular system. After the onset of sudden cardiac arrest, chest compressions help the heart pump blood throughout the human body in order to deliver oxygen to the cells of the various organs. Without the actions of chest compressions serving as a means to maintain the functionality of the cardiovascular system, after the onset of sudden cardiac arrest, the respiratory system and the nervous system would fail. Once the aforementioned organ systems fail, the human body loses its ability to maintain the necessary oxygen supply required to sustain life and the body begins to die. Chest compressions are essential to prevent death from occurring after the onset of sudden cardiac arrest. Therefore, it is no surprise that the 2015 updates made to the AHA's CPR guidelines focused on the importance of chest compressions.

One of the more significant updates made to the AHA's CPR guidelines in 2015 outlined the relevance of compression-only CPR, also referred to as hands-only

CPR. Compression-only CPR refers to a type of CPR which only involves chest compressions (rescue breathing is not a part of compression-only CPR) (2). The 2015 update specified what untrained individuals should do in the case of sudden cardiac arrest. The update indicated that an individual, untrained in the administration of CPR, should perform compression-only CPR on individuals suffering from cardiac arrest (2). According to the update, the untrained individual should administer compression-only CPR until a CPR trained individual arrives to provide further assistance (2). The reason for the previous update as well as the overall emphasis on chest compressions is due to the research being conducted on CPR and sudden cardiac arrest. Research has indicated that in the minutes leading up to sudden cardiac arrest, and in the few minutes post cardiac arrest, an adult body is capable of taking in enough oxygen to maintain the functionality of the brain (2). In other words, an adult body has enough oxygenated blood remaining in the cardiovascular system, after the onset of sudden cardiac arrest, to delay brain damage and ultimately death. As long as chest compressions are administered to provide a means for circulation, an adult body can maintain its ability to sustain life, with no further increase in the supply of oxygen, for several minutes after the onset of sudden cardiac arrest. Therefore, untrained individuals should focus their attention and effort on compression-only CPR. It does require skill and training to correctly administer rescue breaths to an individual in need of CPR. If rescue breaths are administered incorrectly, they will have little to no positive effect on the outcomes of CPR. To increase the effectiveness of the type of CPR performed by untrained individuals, the update has indicated that untrained individuals should perform compression-only CPR if they are the first responders to sudden cardiac arrest.

C-A-B Sequence

To further emphasize the importance of chest compressions, the 2015 updates made to the AHA's CPR guidelines reinforced the C-A-B sequence of CPR. The C-A-B sequence refers to the recommended sequence of steps, which initiate CPR (2). The

C in the C-A-B sequence stands for compressions (2). The A stands for airway maintenance and the B stands for breaths (rescue breaths) (2). Prior to 2010 the AHA's CPR guidelines recommended to initiate CPR with the A-B-C sequence (the letters of the A-B-C sequence refer to the same actions which correspond with the letters of the C-A-B sequence). In 2010 the AHA's CPR guidelines were altered and the recommended sequence of initiating CPR was changed from the A-B-C sequence to the C-A-B sequence (2). The aforementioned change was a dramatic shift to how CPR was performed. However, the change was made to improve the outcomes of CPR. The 2015 update regarding the C-A-B sequence indicated that it may be reasonable to maintain the C-A-B sequence when initiating CPR (2).

AHA Recommended C-A-B Sequence	
Letter	**Corresponding CPR technique**
C	Chest compressions
B	Airway maintenance
A	Breaths (rescue breaths)

Chest Compression Rate

Another significant chest compression update made to the AHA's CPR guidelines in 2015 focused on the rate of chest compressions. Before 2015, the AHA's CPR guidelines recommended a chest compression rate of 100/minute for adults in need of CPR (2). However, in 2015 the recommended chest compression rate was changed to 100/minute to 120/minute for adults in need of CPR (2). The reason for the recommended increase in the rate of chest compressions was due to the results of clinical studies. The results of the clinical studies showed that higher survival rates were associated with more chest compressions and lower survival rates were associated with fewer chest compressions (2). Therefore, to increase the survival rates of adult individuals in need of CPR, the recommended rate of chest compressions was increased to 100/minute to 120/minute.

Minimize Interruptions in Chest Compressions

In order to ensure that the aforementioned increase in chest compression rate is observed, the 2015 updates to the AHA's CPR guidelines also included an update regarding interruptions in chest compression. The 2015 update recommended that individuals performing CPR should limit interruptions in chest compressions (2). An interruption is considered anything that stops or slows down an individual's ability to perform chest compressions. Individuals performing CPR should focus on maximizing the amount of chest compressions administered per minute. Any interruption to an individual performing CPR could lead to a decrease in the total amount of chest compressions administered per minute, which could have dire effects on the outcomes of CPR. To maximize the outcomes of CPR, the AHA's CPR guidelines recommended to minimize the interruptions in chest compressions.

Chest Compression Depth

The recommended depth of chest compressions was also updated in 2015. Chest compression depth refers to how far the sternum depresses into the chest cavity during the administration of CPR (2). Before 2015, the AHA's CPR guidelines recommended that during the administration of CPR the adult sternum should be depressed at least 2 inches (2). After 2015, the AHA's CPR guidelines recommended that during the administration of manual CPR, individuals should perform chest compressions to a depth of at least 2 inches for an average adult while avoiding excessive chest compressions depths of greater than 2.4 inches (2). The reason for the update in the recommended chest compression depth was simple. Clinical studies showed that a chest compression depth of 2 inches was associated with a greater likelihood of positive CPR outcomes when compared to a shallower chest compression depth (2). Clinical studies also showed that chest compressions exceeding 2.4 inches were associated with potential injuries to the individual in need of CPR (2). Thus, to increase survival rates and to limit injury to those who require CPR, the chest compression depth was updated to a more specific range of 2 to 2.4 inches.

Chest Recoil

Along with the 2015 update in chest compression depth came an update to the recommended chest recoil recommendation. Chest recoil can refer to how far the chest wall rises after a chest compression (2). Full chest recoil occurs when the sternum returns to its natural or neutral position during the decompression phase of CPR (2). Chest recoil is an essential, yet often overlooked, aspect of CPR. Much of the focus of CPR lies in the external chest compression, as it should be; however, chest recoil does warrant its own fair share of attention. The chest compression during CPR forces blood out of the heart and throughout the human body. In order for the chest compression to be effective, there must be a sufficient supply of blood inside of the heart. Proper chest recoil allows the heart to fill with the sufficient supply blood necessary to circulate throughout the human body. If there is an insufficient supply of blood in the heart, the external chest compression won't be as effective and CPR outcomes will be limited. To increase CPR outcomes, the chest of the individual receiving CPR must be allowed to fully recoil in order to enhance the effectiveness of the ever important chest compression. Without effective chest recoil, there can be no truly effective chest compression. Prior to 2015 the AHA's CPR guidelines recommended that individuals performing CPR should allow for complete chest recoil after each compression, to allow the heart to fill completely before the next chest compression (2). The 2015 update to chest recoil advised that individual's performing CPR should avoid leaning on the chest between chest compressions, to allow for full chest recoil in adults suffering from cardiac arrest (2). The reason for the change in the chest recoil recommendation was to specify how individuals could allow for proper chest recoil. Leaning on an individual's chest can greatly hinder chest recoil, which could, subsequently, decrease the heart's ability to fill with blood and ultimately decrease the effectiveness of the external chest compressions and the overall impact of CPR. Therefore, to increase the effectiveness of CPR and to promote positive CPR outcomes, the chest recoil recommendation was altered to allow for additional clarity on proper CPR technique.

Chest Compression Feedback

The 2015 updates also included new recommendations regarding the use of audiovisual feedback devices during the administration of CPR. Audiovisual feedback devices can refer to the technology which allows for real-time monitoring, recording and feedback about CPR quality, including both physiologic patient parameters and individual performance metrics (2). Audiovisual feedback devices can be used to maximize the rate of chest compressions and the impact of rescue breathing during CPR. In 2015, the update made to the AHA's CPR guidelines specified that it may be reasonable to use audiovisual feedback devices during CPR for real-time optimization of CPR performance (2).

Ventilation During CPR With An Advanced Airway

Beyond chest compressions, the 2015 updates included new recommendations regarding ventilation during CPR with an advanced airway. An advanced airway can refer to the use of a endotracheal tube, Combitube or laryngeal mask (2). Before 2015, the AHA's CPR guidelines recommended that when an advanced airway was in place during CPR, 1 breath should be administered every 6 to 8 seconds without attempting to synchronize breaths between compressions (2). In 2015 the previous recommendation was simplified. The new recommendation indicates it may be reasonable for an individual to administer 1 breath every 6 seconds while continuous chest compressions are being performed (2). The reason for the 2015 update was to eliminate the range of time between breaths so the overall process is easier to learn, remember and, untimely, perform (2).

Immediate Recognition and Activation of Emergency Response Systems

The 2015 updates also included new recommendations regarding the initiation of emergency response systems. The 2015 updates indicated that individuals should immediately call for help and/or activate emergency response systems upon discovering an unresponsive individual in need of CRP (2). The new recommendation went on to specify that it may be reasonable for individuals to assess the unresponsive individual's breathing and pulse before fully activating emergency response systems and/or calling for help (2). The intent of the aforementioned recommendation is to encourage individuals to minimize delays and act quickly and efficiently to simultaneously assess and respond (2). Every second counts when administering CPR. A delay in the administration of CPR, even if it is only for a few minutes, can be the difference between life and death. It is important to act calmly, quickly and efficiently when initiating emergency response systems and performing CPR.

Section 3: Case Study, AHA's CPR Guidelines

A nurse is performing manual CPR on a 48 year-old female patient suffering from sudden cardiac arrest. The nurse is administering chest compressions at a rate of 80/minute. The nurse is allowing the chest compressions to be interrupted and the nurse appears to be leaning on the patient's chest between chest compressions. In addition, the depth of the nurse's chest compressions appear to be about 1.5 inches.

Was CPR properly performed the above case study?

When performing CPR, chest compressions should be delivered at a rate of 100/minute to 120/minute with limited interruptions (2). The individual performing CPR should not lean on the chest to allow for sufficient chest recoil (2). The depth of a chest compressions should be at least 2 inches for an average adult (excessive chest compressions depths of greater than 2.4 inches should be avoided) (2). The nurse in the above case study did not follow the previous AHA recommendations.

How could the situation, outlined in the above case study, be handled differently to ensure that CPR is performed in a manner which maximizes CPR outcomes?

The situation in the above case study could be handled in a variety of ways to ensure that CPR is performed in a manner which maximizes CPR outcomes. However, the following key point should be included to optimize CPR efforts: chest compressions should be performed at a rate of 100/minute to 120/minute, with limited interruptions (2). Individuals performing CPR should avoid leaning on the chest between chest compressions, to allow for sufficient chest recoil in adults suffering from cardiac arrest (2). Individuals should administer chest compressions to a depth of at least 2 inches for an average adult, while avoiding excessive chest compressions depths of greater than 2.4 inches (2).

What goals should individuals have when performing CPR?

Individuals may have many goals when administering CPR to those in need, one of which should always be to administer CPR in a manner which possesses the greatest potential to maximize CPR outcomes.

Section 3: Summary

Modern-day CPR was developed in the mid 1950's by Peter Safar and James Elam. After its initial inception, CPR evolved from a United States military application to a global method of preventing death from sudden cardiac arrest. Along the way, the AHA's CPR guidelines became the mainstay in CPR education, training and administration. The AHA's CPR guidelines have been revised and updated throughout the years, most recently in 2015. The 2015 updates made to the AHA's CPR guidelines emphasized the importance of chest compressions. The reason the 2015 updates focused on the importance of chest compressions was due to the clinical research being conducted on CPR and sudden cardiac arrest. Research has indicated that in the minutes leading up to sudden cardiac arrest, and in the few minutes post cardiac arrest, an adult body is capable of taking in enough oxygen to maintain the functionality of the brain and delay death (2). Therefore, it is essential to initiate CPR with chest compression to immediately provide a means for the cardiovascular system to deliver oxygenated blood to the brain in order to prevent irreversible damage and death. It is also essential to maintain the effectiveness of chest compressions throughout the administration of CPR to provide the body with an effective means of delivering oxygenated blood to the cells of the various organs. The 2015 updates were made to the AHA's CPR guidelines to improve the overall efficiency and effectiveness of CPR in order to increase CPR outcomes and to maximize individuals' life saving efforts when administering CPR to those in need.

Section 3: Key Terms

Compression-only CPR - refers to a type of CPR, which only involves chest compressions (rescue breathing is not a part of compression-only CPR) (2).

The C-A-B sequence - refers to the recommended sequence of steps, which initiate CPR (2).

Chest compression depth - refers to how far the sternum depresses into the chest cavity during the administration of CPR (2).

Chest recoil - refers to how far the chest wall rises after a chest compression (2).

Audiovisual feedback devices - refers to the technology which allows for real-time monitoring, recording and feedback about CPR quality, including both physiologic patient parameters and individual performance metrics (2).

An advanced airway - refers to the use of a endotracheal tube, Combitube or laryngeal mask (2).

Section 3: Key Concepts

The AHA's CPR guidelines are one of the primary sources of CPR education, training and administration.

In 2015 the AHA's CPR guidelines were updated to improve the overall outcomes of CPR.

The 2015 updates made to the AHA's CPR guidelines emphasized the importance of chest compressions.

Section 3: Reflection Question

What is the C-A-B sequence and why is it important to the administration of CPR?

Section 4: CPR Administration

CPR possesses the potential to prevent death from sudden cardiac arrest. If performed effectively and efficiently, it can deliver oxygen to the lungs, maintain circulation, prevent brain damage and, ultimately, save an individual's life. The remainder of this course will outline the procedure of CPR, while highlighting the specific techniques which make it an invaluable life support procedure (the information in this section pertains to adult populations).

There are three general symptoms which warrant the immediate administration of CPR. The three symptoms include the following: unconsciousness, inability to breathe and no pulse (2). If an individual exhibits one or more of the previous symptoms, CPR may be warranted.

Individual Assessment

The first major step in the administration of CPR is to assess an individual's responsiveness [For the remainder of the this course, CPR administrator will refer to the individual performing CPR and CPR recipient will refer to the individual in need of CPR] (2). To test a CPR recipient's responsiveness, the CPR administrator should position themselves next to the CPR recipient. The CPR administrator should then speak loudly to the CPR recipient and ask if he or she is okay and/or needs help. In addition, the CPR administrator should attempt to stimulate the CPR recipient. Tapping the CPR recipient on the shoulder may be an effective way to stimulate a response.

The CPR administer may also check the CPR recipient's pulse. However, the CPR administer should take no longer than approximately 10 seconds to do so. To check for a pulse the CPR administer should use his or her first two fingers on his or her dominant hand. The CPR administer should place his or her fingers on one of the CPR recipient's carotid arteries located on either side of the neck. Carotid arteries can refer to the blood vessels, which supply blood to the brain, neck and face (1). The carotid arteries are ideal for checking an individual's pulse.

In addition to testing the CPR recipient's responsiveness and checking for a pulse, the CPR administrator must immediately call for help and/or activate emergency response systems (2). The CPR administrator should also assess the CPR recipient's breathing by observing the CPR recipient's chest. If the CPR recipient's chest appears to be moving in an up-and-down motion, that may be an indication that the individual is breathing. If the CPR recipient's chest does not appear to be moving in an up-and-down motion, that may indicate the individual is not breathing. Furthermore, the CPR administrator should assess his or her environment for danger to assure it is safe to proceed with the administration of CPR. The CPR recipient's assessment must be quick and efficient. Any delay in the administration of CPR could lead to dire outcomes for the CPR recipient. Once the CPR administrator finishes the individual assessment, and it has been concluded that the CPR recipient does indeed require CPR, he or she must quickly proceed to the next step in the CPR process, which is to initiate the C-A-B sequence (2).

Chest Compressions

The next major step in the CPR process is to initiate the C-A-B sequence by performing chest compressions (2). Chest compressions are most effective when they are performed on an individual lying on a flat, hard surface while on his or her back. To perform chest compressions, the CPR administrator should first adjust his or her body so he or she is directly over the CPR recipient's chest. The CPR administrator should be able to lock both elbows over his or her wrists. If both elbows cannot be locked over the writs then the CPR administrator is too low over the CPR recipient and further adjustments need to be made by the CPR administrator. Once the elbows are able to be locked over the wrists, the CPR administrator should place the heel of one hand onto the CPR recipient's sternum. The CPR administer must then place his or her other hand over the hand on the CPR recipient's sternum and interlace his or her fingers (2). The CPR administrator should then lock his or her wrists, elbows and adjust his or her shoulders so they are positioned over the CPR recipient's sternum (2). Then the CPR administrator must move downward onto the CPR recipient's chest (2). The CPR recipient's chest should be depressed at least 2 inches, while avoiding excessive chest compressions depths of greater than 2.4 inches (2). Once the desired chest compression depth is reached, the CPR administrator must then relax the pressure on the CPR recipient's sternum. The CPR administrator should avoid leaning on the CPR recipient's chest between chest compressions to allow for sufficient chest recoil (2). The CPR administrator should not remove his or her hands from the CPR recipient's chest between chest compressions. The CPR administrator should perform 30 chest compressions at a rate of 100 to 120/minute, with limited interruptions in chest compressions (2). Untrained CPR administrators should perform compression-only CPR until a CPR trained individual arrives or until emergency services arrive with an automated external defibrillator (AED) (2). An AED can refer to a portable device, which can deliver an electric shock through the chest to the heart (4).

When sudden cardiac arrest strikes, the heart begins to beat in an erratic, disjointed, useless manner referred to as ventricular fibrillation (1). An AED can be used on individuals suffering from sudden cardiac arrest and ventricular fibrillation, to help the heart return to its normal, rhythmic useful manner of beating (4). An AED has a built-in computer, which can check the heart's rhythm through adhesive electrodes (4). The AED's built-in computer will analyze the heart and determine if defibrillation is required (4). Defibrillation can refer to the administration of an electric shock to the heart in order to restore a normal heartbeat (4). Once the AED determines the heart requires defibrillation, an electronic shock can be delivered to the heart by the AED. The AED's electronic shock possesses the potential to stun the heart and stop all activity, including ventricular fibrillation (4). Once the activity of the heart is stopped, the heart has a chance to reset and return to its normal beating pattern (4). An AED possesses the potential to stop ventricular fibrillation and sudden cardiac arrest before their lethal effects threaten the body's ability to maintain life. In addition, AEDs can be an effective tool to complement CPR's ability to save lives. However, if an AED is unavailable, a CPR trained individual must proceed to the next step in the CPR process and continue to follow the C-A-B sequence.

Airway Maintenance

The next major step in the CPR process is to perform airway maintenance. The A in the C-A-B sequence refers to airway maintenance (2). Airway maintenance has two primary goals. The first goal of airway maintenance is to clear the CPR recipient's airway. An airway can refer to the anatomical route air travels through in order to reach the lungs (1). The second primary goal of airway maintenance is to provide the CPR administrator with an opportunity to determine if the CPR recipient is breathing. The process of determining if the CPR recipient is breathing can be referred to as "checking for signs of life."

To provide airway maintenance, the CPR administrator should place his or her palm onto the CPR recipient's forehead. The CPR administrator must then, gently, tilt the CPR recipient's head back while lifting the CPR recipient's chin forward with the other hand. Once the CPR recipient's head is in the correct position, the CPR administrator should then check for signs of life by placing his or her ear over the CPR recipient's mouth (2). The CPR administrator should also observe the CPR recipient's chest in order to identify if it is moving in a manner which suggests the CPR recipient is breathing. The entire aforementioned process of airway maintenance should be conducted in a quick and efficient manner. If the CPR recipient is not breathing, the CPR administrator should then move onto the final step in the C-A-B sequence.

Rescue Breathing

If there are no signs of life, the CPR administrator may deliver rescue breaths to the CPR recipient (2). To administer rescue breaths, the CPR administer should first pinch the CPR recipient's nose shut by using the fingers on the hand, which already should be resting on the CPR recipient's forehead. Once the CPR recipient's nose is pinched shut, the CPR administrator should tilt the CPR recipient's chin in a manner which opens the mouth. The CPR administrator may then administer rescue breaths to the CPR recipient. Two rescue breaths should be delivered, each one lasting about 1 second in duration (2). While administering rescue breaths, the CPR administrator should observe the CPR recipient's chest to verify it is moving in a up-and-down manner. If the CPR recipient is not breathing after the two rescue breaths are delivered, the CPR administrator should repeat the C-A-B sequence, starting at the beginning (2). The CPR administrator should deliver 30 chest compressions per 2 rescue breaths until the CPR recipient is breathing or until emergency response personnel arrive with an AED (2). Once emergency personnel arrive with an AED, the AED should be utilized, as soon as possible, to deliver an electric shock to the CPR recipient's heart in order to restore a normal heart rhythm (4).

Performing CPR on Children and Infants

The aforementioned CPR information pertains to adult populations; however CPR can be performed on children and infants. The CPR process for children and infants is very similar to the CPR process for adults, although differences do exist. For example, it may be reasonable for the CPR administrator to use one hand when performing chest compressions on small children as opposed to the two-handed technique recommended for adults (2). When performing chest compressions on infants, the CPR administrator should use 2 fingers placed in the center of the infant's chest and the depth of the chest compression should be approximately 1.5 inches (2). The reason for the previous differences are due to the smaller physical dimensions of a child/infant. It may not be practical to administer chest compressions using the two-handed technique recommended for adults.

Another example of a difference in the CPR process among the aforementioned age groups regards the activation of emergency response systems. If a trained CPR administrator is alone, without a mobile device, and discovers an unresponsive adult, he or she should immediately leave the CPR recipient to activate the emergency response systems before initiating CPR (2). If a trained CPR administrator is alone and discovers an unresponsive child or infant, he or she should administer 2 minutes of CPR before activating the emergency response systems (2). This key difference regarding the activation of emergency response systems provides children and infants the extra attention they require to increase CPR outcomes. Furthermore, to maximize CPR outcomes among children and infants, trained CPR administrators should be aware of all of the CPR age-related differences when performing CPR.

Section 4: Case Study, CPR Administration

A nurse discovers an unresponsive adult. The nurse kneels down next to the individual and immediately starts performing CPR. The nurse tilts the individual's head back and delivers 2 rescue breaths. The nurse then performs 30 chest compressions at a chest compression rate of 90/minute. The nurse then checks for signs of life. The CPR recipient displays no signs of life. The nurse gets up, leaves the individual unattended and attempts to get help. The nurse returns to the CPR recipient and reinitiates CPR by delivering 2 rescue breaths.

Was CPR properly performed the above case study?

The nurse in the above case study did not follow the C-A-B sequence. The nurse began administering CPR by delivering 2 rescue breaths to the CPR recipient. When performing CPR, the C-A-B sequence should be followed (2). After the initial CPR assessment, the CPR administrator should perform chest compressions, if deemed necessary. In addition, the CPR administrator should immediately call for help and/or activate emergency response systems (2). Chest compressions should be performed at a rate of 100/minute to 120/minute (2). The nurse in the above case study did not follow the C-A-B sequence, immediately call for help and/or activate emergency response systems, nor did the nurse administer chest compressions at a rate of 100/minute to 120/minute. The aforementioned actions possess the potential to negatively affect CPR outcomes.

How could the situation, outlined in the above case study, be handled differently to ensure that CPR is performed in a manner, which maximizes CPR outcomes?

The situation in the above case study could be handled in a variety of ways to ensure that CPR is performed in a manner, which maximizes CPR outcomes. However, the following key points should be included to optimize CPR efforts. Upon discovering an unresponsive individual, CPR administrators should immediately call for help and/or activate emergency response systems, follow the C-A-B sequence and administer chest compressions at a rate of 100/minute to 120/minute.

What goals should CPR administrators have when performing CPR?

CPR administrators may have many goals when administering CPR to an individual in need, one of which should always be to maximize CPR outcomes.

Section 4: Summary

CPR possesses the potential to prevent death from sudden cardiac arrest. If an individual discovers an adult in need of CPR, he or she must first assess the individual and immediately activate emergency response systems and/or call for help (2). If the CPR administrator determines CPR is required, he or she must follow the C-A-B sequence (2). The C in the C-A-B sequence refers to chest compressions (2). The A in the C-A-B sequence refers to airway maintenance and the B refers to breaths (rescue breaths) (2). If the CPR administer is untrained, he or she should focus on compression-only CPR (2). If the CPR administrator is CPR trained, he or she should follow the C-A-B sequence in its entirety, if deemed necessary (2). The CPR administrator should continue performing CPR, while following the C-A-B sequence, until the CPR recipient is breathing effectively or until emergency personnel arrive with an AED. An AED can be used to deliver an electric shock to the heart in order to reset the heart to its normal beating pattern (4). The CPR process is similar for adults, children and infants. However differences in the CPR process do exist among the aforementioned age groups. Trained CPR administrators should be aware of the CPR age-related differences when performing CPR. Regardless of the CPR recipient's age, CPR must be performed in a quick, calm and efficient manner in order for it to be an effective life saving procedure.

Section 4: Key Terms

Carotid arteries - refers to the blood vessels, which supply blood to the brain, neck and face (1).

Automated external defibrillator (AED) - refers to a portable device, which can deliver an electric shock through the chest to the heart (4).

Defibrillation - refers to the administration of an electronic shock to the heart in order to restore a normal heartbeat (4).

Airway - refers to the anatomical route air travels through in order to reach the lungs (1).

Section 4: Key Concepts

There are three general symptoms which warrant the immediate administration of CPR: unconsciousness, inability to breath and no pulse (2).

To optimize CPR outcomes, the C-A-B sequence should be followed when performing CPR.

An AED can be utilized to deliver an electric shock to the heart in order to restore a normal heart rhythm (4).

The CPR process for children and infants is very similar to the CPR process for adults, although difference do exist.

Trained CPR administrators should be aware of the CPR age-related differences when performing CPR.

CPR should be performed in a quick, calm and efficient manner.

Section 4: Reflection Question

How can a CPR administrator effectively perform CPR?

Conclusion

The human body requires a continuous supply of oxygen in order to maintain life. The nervous system, the respiratory system and the cardiovascular system function interdependently to maintain the body's supply of oxygen. If one, or all, of the aforementioned organ systems were to shut down and stop functioning, the human body would lose its ability to maintain the necessary supply of oxygen required to sustain life.

Sudden cardiac arrest possesses the potential to shut down the nervous system, respiratory system and cardiovascular system, within minutes of onset, subsequently leading to brain damage and death (1). CPR possesses the potential to prevent brain damage and death from sudden cardiac arrest.

The two key actions of CPR include: rescue breathing and chest compressions (1). Rescue breathing provides oxygen for the body, while chest compressions provide a means to circulate oxygenated blood throughout the human body.

In order for CPR to be effective, it must be initiated quickly after the onset of sudden cardiac arrest (2). To maximize CPR outcomes, the C-A-B sequence must be followed (2). Chest compressions should be performed at a rate of 100/minute to 120/minute and 2 rescue breaths should be delivered for every 30 chest compressions (2). Sudden cardiac arrest can be lethal. It can rob an individual of life and lead to death within minutes of onset. However, CPR can save lives. If CPR is administered correctly, efficiently and effectively, it can prevent death from sudden cardiac arrest.

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