Cardiovascular disease is a general term referring to a number of afflictions associated with the heart ("cardio") and blood vessels (vascular). Heart disease and stroke (see below for more information on stroke) directly affect the heart and blood vessels, respectively—and are the first and fifth\(^1\) most common causes of death in the United States—and would subsequently be included as cardiovascular conditions. According to the Centers for Disease Control and Prevention (CDC), approximately one third of the American population live with the effects of heart disease or stroke. The problems of cardiovascular disease are not experienced solely by citizens of the United States. According to the World Health Organization, cardiovascular disease is a significant disease in other countries across the globe, contributing to approximately 31% of all deaths (O).

The below links are optional (O), and will hopefully allow the student to investigate how important cardiovascular disease is in shaping world health:

- The CDC provides heart disease and stroke maps and atlases for the viewer interested in seeing differences of cardiovascular disease incidence within the United States
- The World Heart Federation Global Atlas publication has information on cardiovascular disease across the world
- The World Health Organization Noncommunicable Diseases Country Profiles 2011 includes global information on cardiovascular disease

A message to the HEA150 student: trying to understand the relationship among the below terms, rather than simply memorizing them, may help with learning.

Hypertension

Hypertension is also known as "high blood pressure." Blood pressure is a measure of the force blood exerts against the walls of the arteries or arterioles. Systole (systolic blood pressure) is the pressure exerted against the arteries when the heart contracts, diastole (diastolic blood pressure) is the pressure exerted against the arteries when the heart relaxes. The systolic blood pressure is greater than the diastolic blood pressure, and is represented by the upper number, or first number, in a blood pressure assessment.

The amount of blood the heart ejects per beat is known as the stroke volume. The amount of blood the heart pumps throughout the body in one minute is known as cardiac output. The resistance blood vessels provide against blood flow is known as peripheral resistance.

Blood pressure can increase if:

- the heart expels more blood per beat (increased stroke volume), since there is greater volume moving through a given blood vessel in a specific time period.
- the heart beats faster, since more blood will be moving through a given blood vessel over a specific time period (increased cardiac output).
- the blood vessels contract (constrict), since a smaller vessel needs to accommodate the same amount of blood in a given time period (increased peripheral resistance).

When the arteries or arterioles are exposed to regular bouts of high pressure, the pressure can cause damage to these blood vessels, which, in turn, bleed and clot. The vessel's damaged areas are more likely to accumulate plaque, a substance containing cholesterol, calcium, fibrin and other materials. The plaque accumulation is known as atherosclerosis (read more about atherosclerosis below).

Students often mention cardiovascular terminology to be quite challenging. Below are required and optional resources to help students learn more about blood pressure and hypertension:
Arteriosclerosis
Arteriosclerosis is a general term meaning a hardening or thickening of the body's arteries. This thickening of the arteries may be caused by atherosclerosis (see below), the natural aging process, or other reasons. Some sources use the terms arteriosclerosis and atherosclerosis interchangeably.

Atherosclerosis
Atherosclerosis is a condition resulting from the buildup of plaque--fatty substances, cellular waste, calcium, fibrin and other materials--on arterial walls. The illustration below shows the development of plaque in one of the heart's arteries.

Atherosclerosis is thought to begin when the inner (endothelial) lining of a blood vessel becomes damaged. Damage is caused by smoking, high blood pressure, or other reasons. Once the vessel is damaged, it bleeds and forms a clot. The damaged area accumulates cholesterol, calcium, and fibrin more easily, leading to the plaque buildup. Atherosclerosis can occur in virtually any arterial vessel. When arteries leading to the heart become blocked, blood flow is compromised, which can trigger angina and myocardial infarction ("heart attack"). Atherosclerosis can also prevent optimal blood flow in the periphery of the body, such as the legs, in a condition called peripheral arterial disease.

Students should also view the below images from University of Utah's Pathology Laboratory for Medical Education to see what atherosclerosis does to an artery (R):
- A normal coronary artery
- Atherosclerosis in an artery
- "Fatty streaks" within an aorta, the vessel responsible for pumping oxygenated blood from the heart to the rest of the body

Students should view one or more of the below links for more information about atherosclerosis and peripheral arterial disease:
- How cholesterol clogs your arteries video (AstraZeneca, via YouTube)
- Atherosclerosis video (Nucleus Medical Media, via YouTube)
- Atherosclerosis animation (Penn Medicine, ADAM software)
- What is Peripheral Arterial Disease? (CardioTabs, via YouTube)
- What is Atherosclerosis? (National Heart, Lung, and Blood Institute - no video)
- Arteriosclerosis, Arteriolosclerosis, and Atherosclerosis (Khan Academy video)

Coronary Artery Disease (CAD)
When atherosclerosis occurs in the heart's coronary arteries--those vessels responsible for delivering fresh blood to the heart muscle--the condition is called **coronary artery disease**. The atherosclerotic plaque buildup in the coronary arteries reduces blood flow to the heart muscle, interfering with oxygen demands of the heart.

**Required and optional media:**

- **The Cleveland Clinic** allows you to see where the coronary arteries are located (R)
- **Pathophysiology of Coronary Artery Disease** - a video narrated by Jeffrey Popma, Brigham & Women's Hospital (R)
- The University of Utah's Pathology Laboratory shows images of a **coronary artery with approximately 60% occlusion** (60% blocked), and an artery with even more occlusion (O)
- The Khan Academy explains, "**What is Coronary Artery Disease?**" (O)
- **Coronary artery disease** animation, via Dr. Oz's website (O)

**Ischemia**

When a body tissue does not receive adequate blood flow, that tissue is said to be **ischemic**. Atherosclerosis is one cause of ischemia, because the plaque within a blood vessel may block, or at least interfere with, blood flow to a target tissue. Pain is often associated with ischemia (see angina, below), though sometimes the condition may occur without a person experiencing any discomfort (American Heart Association, O). The Mayo Clinic has more information on **myocardial ischemia** (O).

**Angina**

When there is not enough blood flow (ischemia) to the heart, an individual can experience sensations of pressure or pain in the chest. This pain is referred to as **angina**, or **angina pectoris**. Often, the pressure, pain, or discomfort may radiate into the arms, back, shoulders and neck, which can mislead the sufferer into sensing simple fatigue rather than a more serious medical problem. Angina can be further subdivided into "stable" or "unstable" forms. Stable angina is generally predictable, occurring when a person with heart disease exercises, is under emotional distress, or other experiences another known trigger. Unstable angina occurs unexpectedly, and should be treated as an emergency.

For more information on **stable angina** and **unstable angina**, visit the American Heart Association (O).

**Myocardial Infarction**

Another name for myocardial infarction is "heart attack." Symptoms of a heart attack include pain or tightness in the chest, back, arms, and neck; nausea; an erratic pulse; and perspiration due to a lack of blood flow to the heart. When blood flow within any of the heart's coronary arteries (the vessels delivering fresh blood to the heart) is impeded, part of the tissue starts to die--a myocardial infarction. Blood flow disruption may be due to atherosclerosis present in the coronary arteries. If the atherosclerotic plaque buildup bleeds, the clotting materials (see thrombus below) can also disrupt blood flow. If a coronary artery goes into spasm, blood flow to the heart can be compromised.

To diagnose a heart attack, medical personnel will administer an electrocardiogram test (ECG or EKG), which provides visual information on how well the heart is beating and whether there may be heart attack history or current blood flow problems. Blood tests are also performed to look for specific enzymes and proteins, and an echocardiogram, an imaging test, may also be given to identify the part of the heart affected by the myocardial infarction.

Please view at least one of the following animation and video clips (R):

- View a 3D Medical Animation, "**What is a Heart Attack**," via YouTube
- Heart Attack/Myocardial Infarction, a Nature video via YouTube
- Travel to **emedtv.com**. Once you access this website, stop the current movie clip and instead click on "Understanding Blocked Coronary Arteries" (look toward the bottom of the screen). This clip describes the connection among ischemia, angina, and heart attack.
The below resources are optional (O):

- To view cardiac tissue after a **myocardial infarction**, travel to the University of Utah's Pathology Laboratory for Medical Education (WARNING: SENSITIVE PHOTO, a piece of heart tissue damaged from a heart attack).
- Frederick Memorial Hospital has a photo of heart tissue affected by a **myocardial infarction** (WARNING: SENSITIVE PHOTO; scroll down the page to see image).
- The National Heart, Lung, and Blood Institute: "What Causes a Heart Attack," along with an animation.
- If you have RealPlayer software, you can travel to the National Heart, Lung and Blood Institute to view a video, [Heart Attack Warning Symptoms](#).
- The British Heart Foundation supported the creation of a video clip, [What is a Heart Attack?](#).
- Medmovie.com shows a flash animation showing how atherosclerosis in the coronary arteries of the heart (coronary artery disease) can lead to a myocardial infarction.
- The National Heart, Lung, and Blood Institute has a [Risk Assessment Tool for Estimating Your 10-Year Risk of Having a Heart Attack](#).
- **Acute Myocardial Infarction** (H. Michael Bolooki and Arman Askari, Cleveland Clinic).

Learning these cardiovascular terms and noting how they relate to each other can be challenging. Students are encouraged to view the supporting websites to help with learning.

**Arrhythmia**

An abnormal heart beat is known as arrhythmia. The abnormal beat can be one that is too fast (tachycardia), too slow (bradycardia), or simply irregular, usually due to some underlying disease. Normal heart rhythm is known as "sinus rhythm." A normal heartbeat begins at a specific part of the heart, known as the "SA node." The impulse then travels to the "AV node," and then through the lower parts of the heart to cause the organ to contract. The heart's contraction causes blood to move through the heart. So, an irregular heartbeat can compromise blood flow to the body's organs, including the heart itself.

An arrhythmia can be detected through an ECG test. The [Heart Problems Clinic](#) features examples of what ECG's look like in the case of tachycardia and in a premature beat (O—click on "Arrhythmias" to view ECG patterns). In some patients, pacemakers may be required for specific arrhythmias.

The following online resources are required (R):

- The heart's **electrical system** is described in an audiovisual animation at the National Heart Lung and Blood Institute.
- View various heart rhythms via WebMD animations.
- [Arrhythmias](#), via medmovie.com.

The following online resources are optional (O):

- Practical Clinical Skills has an [EKG (electrocardiogram) Reference Guide](#).
- WebMD: [A Visual Guide to Atrial Fibrillation](#).
- For more information on arrhythmias, refer to the American Heart Association.
- Medtronic posts information about how pacemakers interact with [daily living](#).
- UAB Medicine provides [frequently asked questions](#) about pacemakers.

**Cardiac Arrest**

Cardiac arrest is different from heart attack. Whereas a heart attack is caused by a halting of blood flow to the cardiac muscle, cardiac arrest is an electrical event causing the heart to stop beating. Learn more about the difference between a heart attack and cardiac arrest by viewing a graphic from the American Heart Association, [Cardiac Arrest vs. Heart Attack](#). Ventricular fibrillation, a specific type of arrhythmia, can lead to cardiac arrest. The electrical problems experienced in cardiac arrest are usually the result of some underlying cardiovascular disease. Travel to [Merck.com](#) to read a description of ventricular fibrillation (R). The site also contains images of electrocardiograms: one normal and the other showing ventricular fibrillation. To view an
animation of ventricular fibrillation, travel to the National Heart Lung and Blood Institute's website, then scroll down the webpage to the last animation (O).

Although cardio-pulmonary resuscitation (CPR) is a valuable skill which may help in sustaining life, many organizations recommend automated external defibrillators (AED) be installed in public places in the event of cardiac arrest. Automated external defibrillators (AED's) are portable devices used to defibrillate the heart during cardiac arrest. You can see how an AED operates by watching a Philips Medical Systems HeartStart FRx Demo links to view an AED demonstration, via YouTube. For a cardiac arrest and AED animation, travel to Physio-Control (O).

Thrombus
A thrombus is when a piece of tissue, a blood clot or other foreign body present in a blood vessel prevents adequate blood delivery, which could lead to tissue damage or tissue death. In cardiovascular disease, a thrombus is usually caused by a blood clot existing in a blood vessel. These clots can form whenever the vessel is damaged. The damaged vessel will bleed, and the bleeding will eventually stop through the normal clotting process. The clot can decrease blood flow to tissue, or it can completely impede blood flow. Travel to YouTube to view an about.com animation showing and describing thrombus (R). The Path Guy has an image of a thrombus (O).

Embolus
An embolus is when a piece of tissue, a blood clot or other foreign body circulates in the blood and becomes trapped in a blood vessel too small to let it pass. In cardiovascular disease, an embolus may occur when a thrombus has detached, travels to another blood vessel and slows or stops blood flow at the new site. Travel to Vericoseandmore.com to view an image of an embolus in a blood vessel (R).

Stroke
A stroke occurs when part of the brain dies because it does not receive the blood that it needs. Marked by a sudden weakness, numbness or paralysis in certain parts of the body, sudden speech, sight, walking or thinking changes, a stroke can occur as a result of a blockage (embolus, thrombus), which is the most common reason, or through bleeding (an aneurysm or hemorrhage). To see an animation related to stroke TyneMedia via YouTube (O). To read about symptoms of stroke, visit the Mayo Clinic (O).

The Centers for Disease Control and Prevention feature the Atlas of Stroke Mortality: Racial, Ethnic, and Geographic Disparities in the United States (O)

Congestive Heart Failure
A diseased heart is not able to pump blood effectively. As a result, the blood "backs up" in the veins leading to the heart, which can lead to pulmonary (lung) congestion. Symptoms include swelling in the legs, ankles, and an inability of the kidneys to excrete water and sodium efficiently, making the swelling worse. Congestive heart failure is usually diagnosed through a variety of exams: a blood test, a physical, medical history evaluation, catheterization, ECG, echocardiogram, and chest x-ray are often used.
Optional links (O):
- Merck Manual provides information, including an embedded video, about congestive heart failure
- heartvalvesurgery.com provides an illustration showing the difference between a normal-sized and enlarged heart
- SENSITIVE photo via National Geographic shows a medical worker holding up a normal-sized heart and an enlarged heart